Guinness Sustainable Energy

Investment Commentary – May 2025

RISK

This is a marketing communication. Please refer to the prospectus, supplement and KID/KIID for the Funds (available on our website), which contain full information on the risks, 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. The Funds invest at least 80% in companies in the sustainable energy sector and can be volatile.

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 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.

CONTENTS

April in review	2
Managers' comments	3
Performance	6
Portfolio	8
Outlook	12
Important information	25

PRI Principles for Responsible Investment

COMMENTARY

IBERIAN BLACKOUT

Grid security and resilience have come into sharp focus following the landmark power blackout in Spain and Portugal at the end of April. This month we examine the case for grid infrastructure investment and re-appraise the role of renewables in a stable and balanced grid.

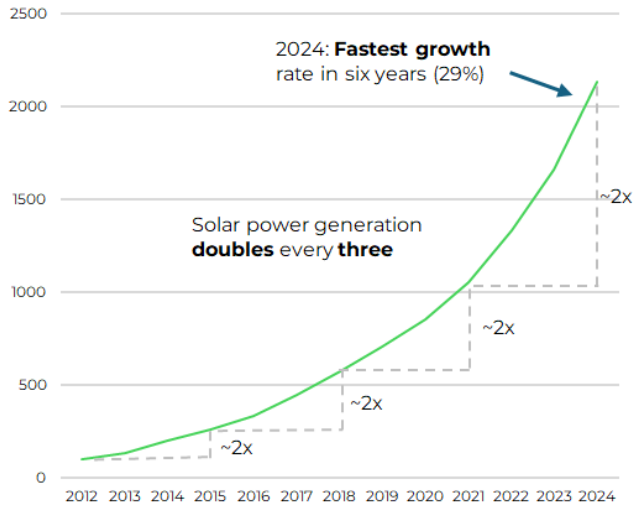
EQUITIES

The Guinness Sustainable Energy Fund (Class Y) delivered a return of 1.9% (in USD) in April, outperforming the MSCI World Index which returned 0.9%. With companies beginning to report first quarter earnings, the impacts of ongoing geopolitical and economic uncertainty are starting to filter through. Among the Fund's top performers were companies that displayed resilient earnings and were able to offer robust guidance, while underperformers tended to have greater exposure to ongoing tariff developments. In particular, a few of our holdings in the renewable energy sector, such as Enphase and Xinyi Solar, showed weak performance in April.

CHART OF THE MONTH: GROWTH OF GLOBAL SOLAR

Solar was the largest source of new electricity generation globally for the third year in a row in 2024 and has doubled in the last three years. Global solar power capacity growth has inflected in recent years. Having taken decades to reach 1 TW in 2022, it took only two years to reach 2 TW in 2024. Growth in China has been particularly rapid, and the country was able to meet 81% of its incremental power demand last year with solar additions, according to Ember.

Electricity generation from solar power (TWh)



Source: Ember Global Electricity Review 2025

APRIL 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
Global electric vehicle (EV) sales rose 29% year-on-year (YoY) in Q1 2025 to 4.1 million units, according to research house Rho Motion. China led both in volume (2.4 million units) and growth (+36% YoY), with sales almost entirely shielded from the ongoing tariff dispute due to limited imports. Europe saw strong gains in key markets, with battery electric vehicles sales up 37% in Germany, 64% in Italy, and 42% in the UK, though sales in France declined due to recent policy changes impacting incentives. North American sales grew 16% YoY despite political and economic uncertainty, with future growth likely to be impacted by uncertainty around US tariffs.	Electric Vehicle Sales	
The outlook for the offshore wind sector in the US deteriorated in April as Norwegian energy company Equinor was forced to halt construction of its Empire Wind 1 project following a stop-work order from the Trump administration. This is an unwelcome development for the sector, as it had been hoped that active projects would be shielded from political forces. In the same month, RWE suspended its US offshore wind activities citing regulatory uncertainty, and the consultant Wood Mackenzie downgraded its 5-year US outlook due to policy instability and project delays.	US Offshore Wind	
Developments in battery charging technologies are helping to overcome concerns about EV driving range, a key barrier to adoption. In April, Chinese battery manufacturer CATL unveiled its newly upgraded battery cells that it claims can offer 520km range on a 5-minute charge. The announcement followed that of its rival BYD, which set a new industry standard earlier in the year when it unveiled its upgraded charging system that enabled 470km range on a 5-minute charge. According to Bernstein analysts, charging speeds have doubled over the past year and increased tenfold over the past 3-4 years as intense competition has driven further innovation in the space.	Battery Technology	
A Reuters survey conducted in April found that nearly half of the 13 major electric utility companies surveyed had received inquiries from data centre companies for volumes and power that would exceed their peak demand or existing generation capacity. The survey results point to the sheer scale of incremental demand facing the US and raises questions about where incremental supply will come from and how quickly it can be deployed. One of President Trump's key challenges will be overseeing sweeping grid and energy investments to overcome capacity constraints so that he can achieve his goal of "energy domination" whilst enabling the US to win the AI race.	US power demand	
China's energy transition continues to gain momentum, with wind and solar generation capacity surpassing fossil-fuel based thermal power for the first time. The country reached its 2030 wind and solar installation target in 2024, six years ahead of schedule, and has increased its capacity to 1,482 GW. At the same time, China continues to invest in other low-carbon technologies and infrastructure, recently approving the construction of 10 new nuclear power units, adding to the 10 units that have already been approved since 2022. Under current construction forecasts, China is likely to become the global leader in installed nuclear capacity by 2030.	China's energy transition	

MANAGERS' COMMENTS

The landmark power blackout which occurred in Spain & Portugal at the end of April has prompted debate and enquiry as to the suitability and resilience of the grid and the role of renewables in power generation. In this note we summarise the incident, and outline our thoughts around the implications, including the case for grid resilience, and the sensible scaling of renewables in the mix.

Europe's largest power outage, with causes still unclear

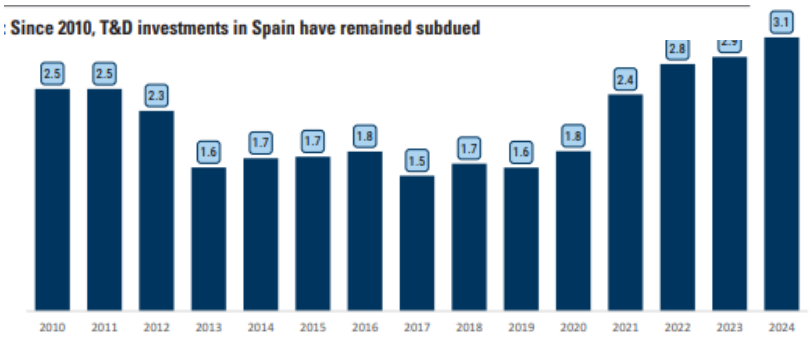
At around midday on April 28th, Spain experienced a blackout which saw nationwide power supply falling by around 60% to 10GW taking around 18hrs to fully remedy. The resolution required a material draw from power interconnectors that connect the Iberian Peninsula to France and Morocco. Red Eléctrica, Spain's grid operator, stated that two "loss of generation" events occurred within seconds of one another, taking 10GW of solar and 3GW of nuclear capacity offline. This caused material changes to the frequency of transmission onto the grid, causing system-wide failure. Whilst the specific cause of the upstream outage remains under investigation, we see three clear implications.

Remaking the case for grid transmission and distribution spending

First, the case for grid resilience has been reaffirmed by this incident. Around 33% of the European grid is aged 40 years or older, well beyond its envisaged working life. There has been chronic underinvestment in the European grid; Spain in particular has seen essentially flat transmission and distribution (T&D) capex from 2010-21 at around €2bn per annum (pa), in spite of a significant modernisation in the generation fleet. This change in generation towards renewables introduces significant load variation and frequency adjustments to the grid, which in turn requires more modern grid infrastructure to transform, manage and distribute. Investment has begun to increase in the last 2-3 years but is still little higher than 2010-11.

We note that the two previous major European blackouts - Spain in 2001 and Italy in 2003 - unlocked a supportive regulatory cycle for T&D investment. We therefore see this outage as a significant opportunity within the **grid equipment** (e.g. portfolio companies: Schneider, Itron, Eaton, Hubbell), **cable providers** (Prysmian) and **grid contractors** (SPIE), sectors which are exposed to T&D grid capex. The focus of this incident is of course Europe, but we have written for some time about the equivalent need for investment in the similarly aged North American grid, where we see substantial opportunity for the same group of investee companies to provide solutions.

Transmission & Distribution investment in Spain, 2010-24 ($bn)



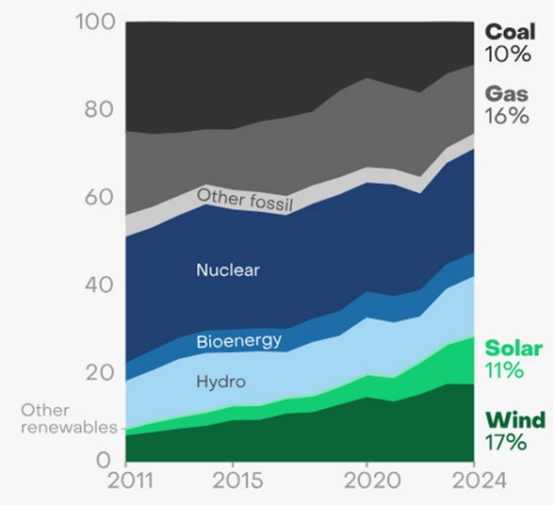
Source: Goldman Sachs, April 2025

The role of renewables queried, but the case remains robust

Secondly, this blackout raises the question of the reliability of renewables within the grid. Spain, at the time of the outage relied upon c.80% renewable energy, principally solar. Intermittency, the variation in output from renewable energy, has introduced grid instability challenges. These can ordinarily be dealt with through the load management of conventional power plants (nuclear, hydro, gas, coal) which can moderate production to prevent the grid from being overloaded in the case of a surge or fill in with back-up power in the case of an outage. The speculated unavailability of such conventional power capacity in this incident might well explain the scale and length of the blackout. It may also prompt policymakers to question whether the grid can operate, in its current form, with such high levels of renewables penetration. Whilst we see this as an unwelcome headwind for the deployment of solar and wind in Spain, we caution that renewables constitute a

significantly smaller share of electricity generation in the EU as a whole (17% wind and 11% Solar in 2024), and the US (10% wind and 4% solar in 2023), making the backdrop to the Spanish outage somewhat unique.

EU power generation by source, 2011-2024

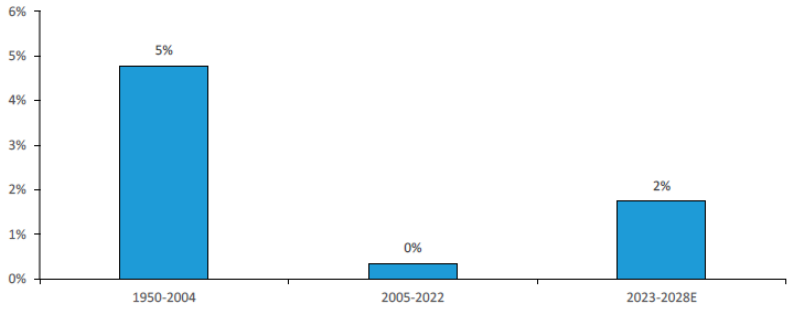


Source: Ember, April 2025

The recent issues experienced in Spain and Portugal raise questions about power supply and the challenge of producing a flexible and functional grid. But they also highlight a demand issue: the step change in power consumption that is occurring in many parts of the world, including Europe. Spain, for example, has seen 4% growth in power demand so far this year. Supporting this has been growing electrification, and demand from data centres, where the pipeline of interconnection requests now equals an incremental 19GW of demand, equivalent to c.60% of Spain's current power consumption.

We expect global electrification and data centre demand growth to lift total load growth from the 0-0.5% of the past decade to 1.5-2.0% for the next 5-10 years. The data presented below demonstrates this inflection for US power demand. We see renewables as the clear solution to this incremental demand, supplying power at the lowest marginal cost and being deployed with the shortest build times. Consequently, we see a case for renewable **OEMs** (Vestas, First Solar), and **Power Utilities/IPPs** (Iberdrola, Next Era) who deploy renewables as potential beneficiaries.

Global electricity demand growth (1950-2028E)



Source: Bernstein

Regulated battery storage: a potential beneficiary

Finally, battery storage could be a beneficiary of the blackout. Regulated battery storage allows grid operators to manage load effectively and reduce the impact of intermittency that renewables introduce to the grid. Investments into regulated energy storage in Europe have been limited, with Spain currently having deployed c.100MW of capacity against a planned 12.5GW by 2030. This could conceivably be upsized and accelerated following the blackout and would likely be funded as part of a greater investment in the grid. We see opportunities here for the aforementioned **grid contractors** as well as **battery OEMs** (LG Chem).

Conclusion

We see the Iberian blackouts as a clear wake-up call that grids across the developed world require modernization and digitalization, after decades of underinvestment. We consequently see incremental growth potential for our investment opportunity set, with its exposure to grid spending. However, we recognize that this is far more than just a question of grid infrastructure. Rather, the blackouts will put further pressure on policy makers to reconcile the sharp inflection in global power demand growth, examined in our March 2025 monthly commentary, with supply. We see renewables as a key part of the supply solution, representing the cheapest and fastest route to new power, with events in Iberia remaking the case that they must be deployed in tandem with storage and grid modernization.

PERFORMANCE

Past performance does not predict future returns.

The **Guinness Sustainable Energy Fund** (Class Y, 0.68% OCF) delivered a return of 1.9% in the month, while the MSCI World Index (net return) delivered 0.9% (all in USD terms).

Guinness Sustainable Energy Fund	Ytd	1 Yr	3 Yrs	5 Yrs	10 Yrs*
Fund (Class Y)	-3.5%	-11.5%	-10.2%	71.4%	35.7%
MSCI World NR Index	-0.9%	12.2%	37.0%	92.1%	144.2%
Out/Underperformance	*-2.6%*	*-23.7%*	*-47.2%*	*-20.7%*	*-108.5%*

	2024	2023	2022	2021	2020
Fund (Class Y)	-11.8%	-0.4%	-12.5%	10.4%	84.1%
MSCI World NR Index	18.7%	23.8%	-18.1%	21.8%	15.9%
Out/Underperformance	*-30.4%*	*-24.2%*	*5.6%*	*-11.4%*	*68.2%*

	2019	2018*	2017*	2016*	2015*
Fund (Class Y)	31.4%	-15.2%	20.2%	-15.4%	-12.0%
MSCI World NR Index	27.7%	-8.7%	22.4%	7.5%	-0.9%
Out/Underperformance	*3.7%*	*-6.5%*	*-2.2%*	*-23.0%*	*-11.2%*

*Data as of 30.04.2025. 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 -0.9% in the month of April in GBP, while the MSCI World Index (net return) delivered -2.5%.

WS Guinness Sustainable Energy Fund	Ytd	1 Yr
Fund (Class Y, 0.67% OCF)	-9.2%	-16.7%
MSCI World NR Index	-7.1%	5.1%
Out/Underperformance	*-2.1%*	*-21.8%*

	2024	2023
Fund (Class Y, 0.67% OCF)	-10.4%	-5.8%
MSCI World NR Index	20.8%	16.8%
Out/Underperformance	*-31.2%*	*-22.6%*

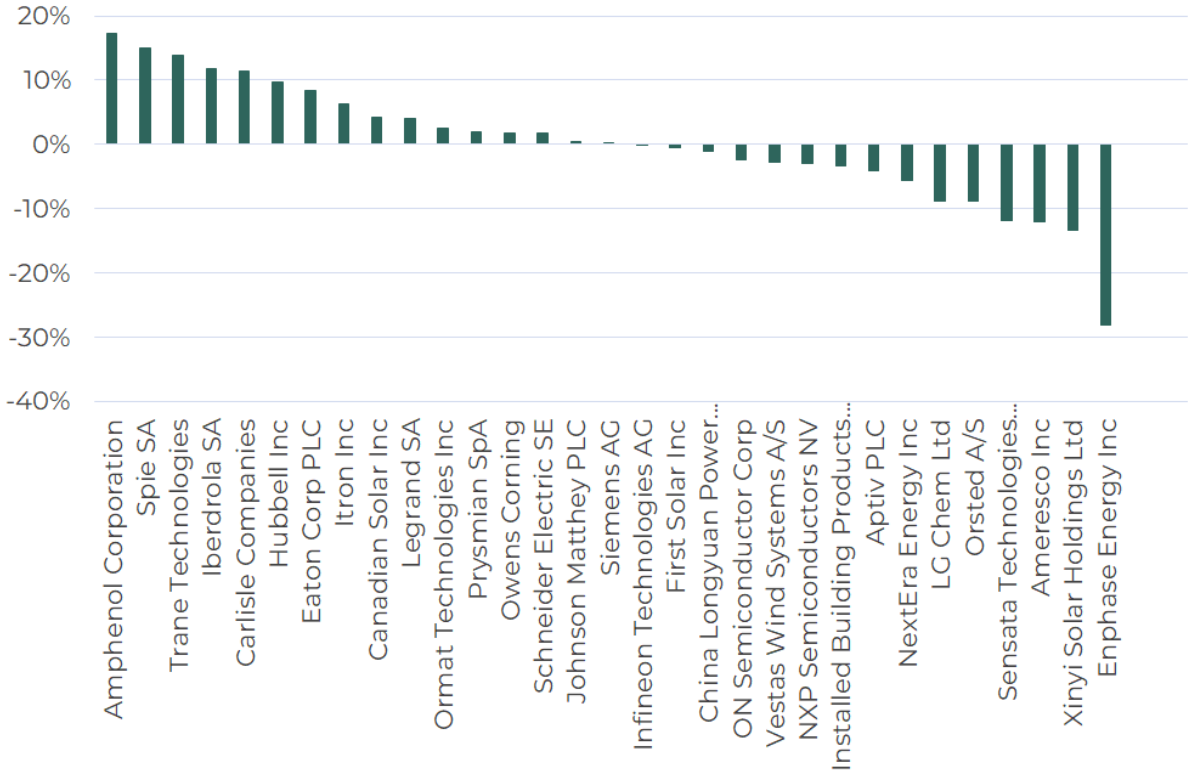
Data as of 30.04.2025. The Fund was launched on 30.12.2022.

Source: FE fundinfo, bid to bid, total return net of fees. 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.

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 Amphenol Corporation, Spie SA, Trane Technologies, Iberdrola SA and Carlisle Companies while the weakest performers were Enphase Energy Inc, Xinyi Solar Holdings Ltd, Ameresco Inc, Sensata Technologies Holding PLC and Orsted A/S.

Stock by Stock performance over the month, in USD

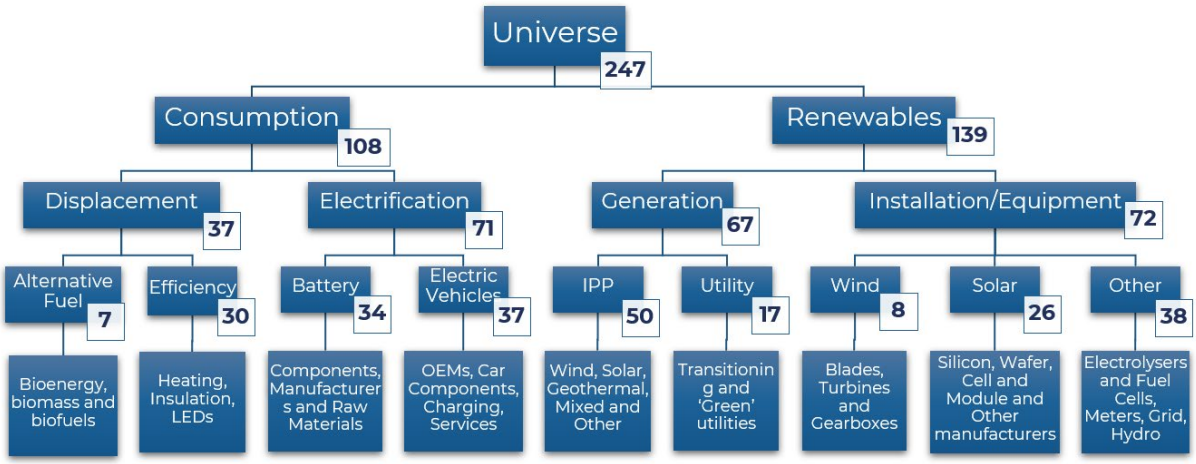


Source: Bloomberg. As of 30th April 2025

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:

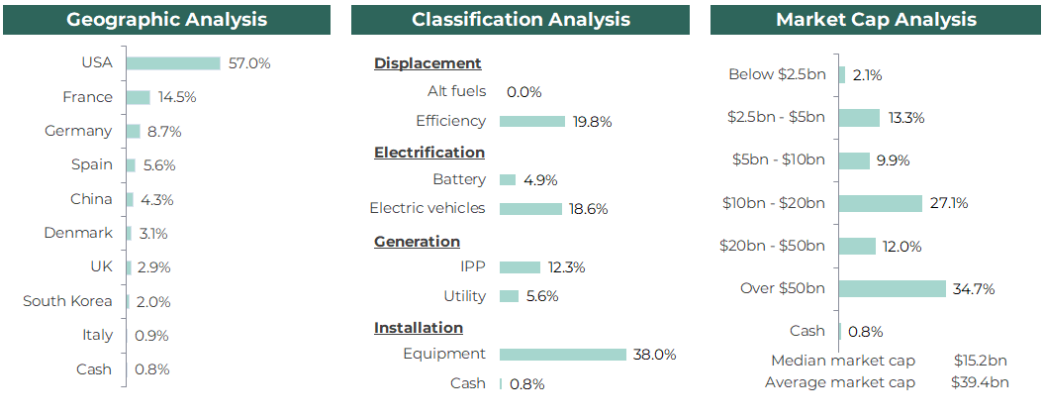
PRI Principles for Responsible Investment

Buys/Sells

Sells

- In April, we sold two of our positions in **China Suntien** and **Gentherm** and recycled the capital into building a full position in **Amphenol**.

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					
	Apr-25		*Dec-24*	Dec-23	Dec-22	Dec-21	Dec-20	Dec-19	Dec-18
Consumption	**43.3%**	***1.7%***	***41.6%***	**43.9%**	**44.9%**	**43.4%**	**36.7%**	**41.7%**	**26.5%**
Displacement	19.8%	*1.8%*	*17.9%*	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%*	*0.0%*	*3.9%*
Efficiency	*19.8%*	*1.8%*	*17.9%*	*15.3%*	*15.0%*	*11.8%*	*9.9%*	*13.4%*	*12.5%*
Electrification	23.5%	*-0.1%*	*23.6%*	28.5%	29.9%	31.6%	26.8%	28.2%	10.1%
Batteries	*4.9%*	*-1.7%*	*6.6%*	*10.2%*	*11.6%*	*8.9%*	*10.8%*	*12.6%*	*3.9%*
Electric vehicles	*18.6%*	*1.6%*	*17.0%*	*18.4%*	*18.2%*	*22.8%*	*16.0%*	*15.7%*	*6.2%*
Renewables	**55.9%**	***-1.9%***	***57.7%***	**51.9%**	**49.3%**	**51.3%**	**60.4%**	**54.1%**	**69.7%**
Generation	17.9%	*-2.6%*	*20.5%*	19.5%	17.7%	23.1%	24.6%	22.2%	27.3%
IPP	*12.3%*	*-3.1%*	*15.4%*	*10.9%*	*8.7%*	*14.5%*	*17.0%*	*18.9%*	*26.7%*
Utility	*5.6%*	*0.5%*	*5.2%*	*8.6%*	*9.0%*	*8.6%*	*7.6%*	*3.2%*	*0.6%*
Installation	38.0%	*0.8%*	*37.2%*	32.4%	31.6%	28.2%	35.8%	32.0%	42.5%
Equipment	*38.0%*	*0.8%*	*37.2%*	*32.4%*	*31.6%*	*28.2%*	*35.8%*	*32.0%*	*42.5%*
Cash	0.8%	*0.1%*	*0.7%*	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 April 2025	PE			EV/EBITDA			Dividend Yield		EPS Growth (%pa)		CFROI	
	2024	2025E	2026E	2024	2025E	2026E	2025E	2026E	2019-24	2024-27	2025E	2026E
Guinness Sustainable Energy Fund	18.3x	16.1x	13.5x	10.8x	9.9x	8.4x	1.8%	2.1%	5.9%	15.5%	10.1%	10.8%
MSCI World Index	20.4x	19.0x	17.1x	13.8x	12.8x	11.7x	2.0%	2.1%	6.7%	9.9%	9.6%	10.1%
Fund Premium/(Discount)	*-11%*	*-15%*	*-21%*	*-22%*	*-22%*	*-28%*						

*2024 P/E = Latest month-end price / 2024 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 April 2025

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

We hold a c.43% 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.5%) or the electrification of transportation (c.19% weight), while we have c.20% weight to those companies involved in either displacing existing energy sources or improving overall energy efficiency.

We hold one lithium-ion battery manufacturer, LG Chem, which is a Korean chemicals company and the largest lithium-ion battery manufacturer 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 Aptiv and Sensata are component manufacturers and service providers that should benefit from the ever-increasing amount of electronics present in electric vehicles. Amphenol supplies connectors, sensors and high voltage interconnect solutions that are vital for EVs and EV charging infrastructure.

Our displacement holdings provide pure-play quality exposure to heating industries (Trane Technologies), insulation (Installed Building Products, Owens Corning, Carlisle Companies), 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.18% weight to companies involved in the generation of sustainable energy and 38% weight to those exposed to the installation of or equipment used in the process of sustainable energy generation.

China Longyuan is a pure-play Chinese wind power producer and represents one of our six 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 Enphase manufactures 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

Our remaining exposure to installation (Itron, Eaton, Legrand, Siemens, Spie, 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 April 2025

	Theme	Example holdings	Weighting (%)
1	Electrification of the energy mix	Iberdrola, legrand	38.7%
2	Rise of the electric vehicle and auto efficiency	Sensata Technologies, APTIV	8.1%
3	Power semiconductors	NXP, Infineon	9.2%
4	Battery manufacturing	LG Chem	2.0%
5	Expansion of the wind industry	Vestas	6.6%
6	Expansion of the solar industry	First Solar	6.6%
7	Heating, lighting and power efficiency	TRANE TECHNOLOGIES, CARLISLE	24.1%
8	Geothermal	ORMAT	3.9%
9	Other (inc cash)		0.8%

Portfolio at end March 2025 (one month in arrears for compliance reasons)

Guinness Sustainable Energy Fund (31 March 2025)			P/E			EV/EBITDA			Price/Book		
Stock	**ISIN**	**% of NAV**	**2024**	**2025E**	**2026E**	**2024**	**2025E**	**2026E**	**2024**	**2025E**	**2026E**
Displacement/Efficiency											
Hubbell Inc	US4435106079	4.1%	22.1x	18.7x	17.6x	13.9x	13.6x	12.8x	5.4x	4.8x	4.2x
Trane Technologies	IE00BK9ZQ967	4.6%	29.7x	26.3x	23.5x	19.4x	18.6x	17.1x	10.1x	9.1x	7.9x
Installed Building Products Inc	US45780R1014	2.7%	18.6x	16.2x	14.7x	10.1x	10.9x	10.0x	6.7x	5.3x	0.8x
Carlisle Companies	US1423391002	2.7%	18.6x	15.3x	13.6x	12.0x	11.5x	10.7x	6.1x	5.8x	4.8x
Owens Corning	US6907421019	2.6%	8.2x	9.7x	8.9x	6.4x	6.8x	6.5x	2.4x	2.1x	1.9x
Ameresco Inc	US02361E1082	1.0%	17.0x	16.0x	9.7x	12.2x	9.9x	8.3x	0.6x	0.6x	0.6x
		17.7%									
Electrification/Battery											
LG Chem Ltd	KR7051910008	2.1%	n.m.	24.6x	9.2x	8.4x	6.6x	4.8x	0.5x	0.6x	0.5x
Johnson Matthey PLC	GB00BZ4BQC70	2.8%	83.0x	9.1x	7.7x	9.3x	5.2x	4.8x	1.0x	1.0x	1.0x
		4.9%									
Electrification/Electric Vehicles											
Aptiv PLC	JE00BTDN8H13	3.0%	7.1x	8.2x	7.1x	6.9x	6.7x	6.3x	1.6x	1.4x	1.2x
Amphenol Corporation	US0320951017	3.5%	33.0x	28.3x	25.2x	19.4x	17.5x	15.8x	8.1x	7.0x	5.8x
ON Semiconductor Corp	US6821891057	2.2%	10.3x	16.2x	11.0x	6.7x	9.6x	7.8x	2.0x	1.8x	1.6x
Infineon Technologies AG	DE0006231004	3.6%	17.2x	19.4x	13.8x	9.2x	9.9x	7.8x	2.4x	2.1x	1.9x
NXP Semiconductors NV	NL0009538784	3.1%	16.6x	16.2x	13.5x	11.6x	11.7x	10.2x	5.3x	4.5x	4.2x
Sensata Technologies Holding PLC	GB00BFMBMT84	2.4%	6.1x	7.6x	6.9x	5.2x	7.5x	7.1x	1.3x	1.2x	1.1x
Gentherm Inc	US37253A1034	0.9%	10.7x	10.6x	8.8x	5.1x	5.2x	4.6x	1.3x	n.m.	n.m.
		18.7%									
Generation/IPP											
China Longyuan Power Group Corp Ltd	CNE100000HD4	2.6%	8.3x	6.7x	6.1x	10.3x	9.9x	9.0x	0.7x	0.6x	0.6x
Ormat Technologies Inc	US6866881021	3.7%	32.2x	35.3x	30.2x	15.0x	11.8x	10.5x	1.8x	1.6x	1.6x
NextEra Energy Inc	US65339F1012	5.0%	22.0x	19.3x	18.0x	18.4x	14.1x	12.6x	2.9x	2.6x	2.4x
Orsted A/S	DK0060094928	2.7%	27.3x	12.3x	10.6x	7.5x	7.3x	6.6x	2.1x	1.5x	1.3x
China Suntien Green Energy Corp Ltd	CNE100000TW9	0.8%	7.8x	5.6x	5.0x	10.6x	8.9x	8.0x	0.7x	0.6x	0.6x
		14.8%									
Generation/Utility											
Iberdrola SA	ES0144580Y14	5.5%	16.9x	16.3x	15.4x	10.5x	10.5x	9.9x	2.0x	1.8x	1.7x
		5.5%									
Installation/Equipment											
Schneider Electric SE	FR0000121972	4.6%	26.8x	21.9x	19.4x	15.9x	14.4x	13.0x	4.2x	3.6x	3.2x
Legrand SA	FR0010307819	4.8%	20.9x	19.0x	17.5x	13.6x	13.0x	12.0x	3.5x	3.1x	2.9x
Eaton Corp PLC	IE00B8KQN827	4.2%	27.3x	22.6x	20.2x	19.0x	17.8x	16.2x	5.8x	5.4x	5.0x
Siemens AG	DE0007236101	4.7%	21.3x	17.7x	17.8x	14.0x	12.8x	11.3x	3.1x	2.9x	2.7x
Itron Inc	US4657411066	3.8%	20.0x	19.5x	17.3x	15.3x	15.7x	13.8x	3.4x	2.9x	2.6x
Spie SA	FR0012757854	3.8%	16.9x	14.0x	12.7x	8.4x	8.4x	7.8x	3.3x	2.8x	2.5x
Xinyi Solar Holdings Ltd	KYG9829N1025	1.8%	18.9x	13.3x	9.6x	8.5x	8.4x	6.8x	0.9x	0.9x	0.8x
Enphase Energy Inc	US29355A1079	1.6%	62.4x	18.9x	15.2x	39.5x	15.4x	12.4x	9.9x	7.8x	5.5x
First Solar Inc	US3364331070	2.4%	10.0x	6.9x	4.8x	6.5x	4.8x	3.4x	1.7x	1.4x	1.1x
Canadian Solar Inc	CA1366351098	1.3%	n.m.	n.m.	4.1x	9.3x	7.6x	4.4x	0.2x	0.2x	0.2x
Vestas Wind Systems A/S	DK0061539921	2.3%	28.3x	16.0x	11.6x	7.6x	5.6x	4.6x	3.8x	3.1x	2.6x
		35.3%									
Cash	Cash	**3.1%**									

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

Sustainable energy policy in the **United States** has been dominated by the re-election of Donald Trump. His term will be a backward step for the energy transition and will bring a shift in US energy policy as he targets reduced energy costs, "energy dominance", and improved competitiveness for US industry via the removal of environmental regulations. The Inflation Reduction Act (IRA) – the key Democrat-led legislation providing $369bn of tax credits for clean energy investment – is a target for the President to help raise funds to support tax cuts elsewhere.

With respect to the Inflation Reduction Act, we think that President Trump will struggle to make substantial reforms and that he will have more success using his executive powers to promote fossil fuels instead. We expect him to put greater domestic content requirements on the various IRA tax credits, to broaden the reach of Foreign Entity of Concern (FEOC) designation beyond the electric vehicle industry and to slow down the awards of new offshore wind permits (since there is federal involvement in offshore wind). In addition, he will likely leave the Paris Agreement, lift the liquefied natural gas (LNG) export pause, roll back environmental restrictions and impose new tariffs (in excess of those placed by Biden in mid-2024) on imports related to renewable energy, particularly from China.

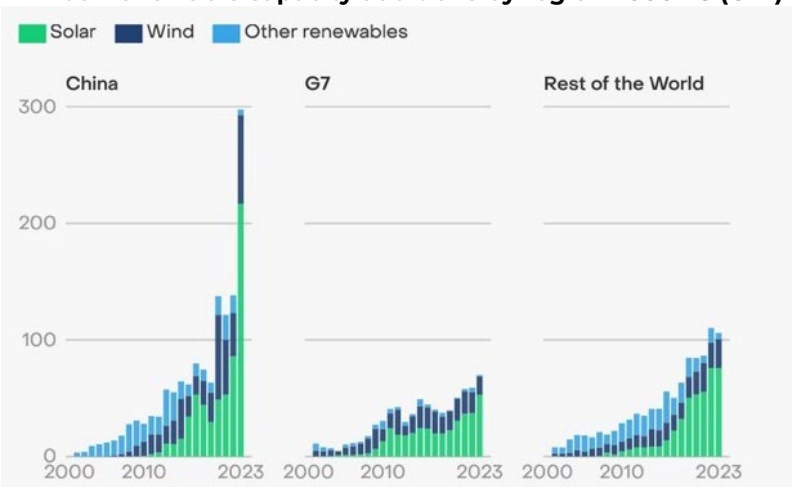
Investments announced under the IRA ($bn)

bubble colour = party of Governor (Red = Republican, Blue = Democrat), Prior to 2024 elections

Source: Clean Economy Works, JP Morgan, October 2024

China continued to reap benefits from decades of investment in sustainable energy technologies, building nearly twice as much wind and solar capacity as the rest of the world combined in 2024, delivering the lowest clean energy costs globally (with onshore wind being the cheapest) and supplying over 60% of the world's demand for electric vehicles. We will likely look back and see that China achieved its target of 1,200 GW in wind and solar installations in mid-2024, around six years ahead of schedule. We view China's ability to offer comprehensive, long-term demand-side and supply-side policy support as a key differentiator, allowing it to increasingly dominate the global clean tech environment. We expect this rapid growth to continue as renewable energy (alongside grid modernisation) was again listed among the "strategic industries" whose development is expected to be supported by policymakers.

Annual renewable capacity additions by region 2000-23 (GW)



Source: Ember, 2024

In contrast, there seemed to be little real progress from **Europe** around commitment and investment as part of the Net Zero Industrial Act. Amendments to the European Climate Law (which targets net zero greenhouse emissions by 2050) were made to reduce the EU's net greenhouse gas emissions by 90% by 2040 (relative to 1990). This new interim target was designed to accelerate the transition and put the EU on a path towards a healthier and safer future, to avoid wasted investments in fossil fuels, boost the competitiveness of Europe's businesses and to make Europe more resilient.

As has often been the case in Europe, we found the bloc to be 'long' on targets but 'short' on actual support to help establish the supply chains and domestic manufacturing to allow the targets to be achieved. The Green Deal Industrial Plan, the Net Zero Industry Act and Critical Raw Materials Act (all passed in 2023) do not yet appear to be catalysing investment in the EU as little new central funding was announced to support these ambitions.

Compared with previous events, **COP 29** in November in Azerbaijan was lightly attended and appeared to do little to progress broader decarbonisation goals. Notable wins included Mexico setting a 2050 net zero target, Indonesia (operator of the fifth largest coal fleet in the world) announcing a 2040 coal phase-out target (16 years earlier than the prior target) and progress was also made towards a global carbon credit platform. The COP was billed in advance as having a particular focus on climate finance, but the ultimate agreement that developed nations pay $300bn per year to developing nations was seen by many as being insufficient.

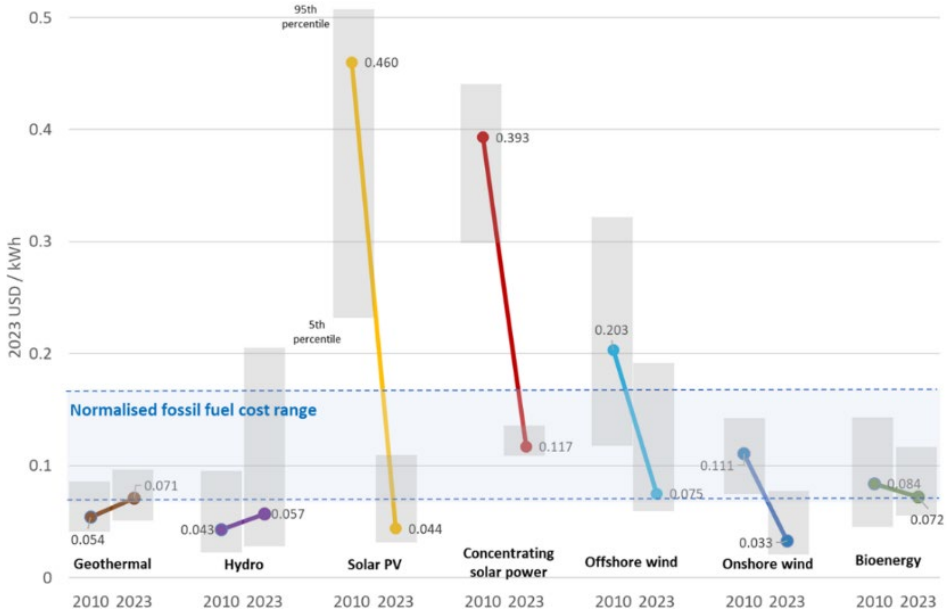
On a positive note, **global investment in clean technologies** grew and is likely to have hit nearly $2 trn in 2024 according to the IEA – almost twice the spend on coal, oil and gas in the year, and up from $1.7 trn in 2023. Higher-than-anticipated borrowing costs have been offset by easing supply chain pressures and falling prices, especially for solar PV and battery technologies. The greater investment means that clean energy is becoming a greater share of global GDP growth (having averaged 10% in 2023) with the number of clean energy jobs growing and accounting for more than half of employment in the global energy sector

Renewable electricity is the cheapest form of new electricity supply in most situations. According to Levelized Cost of Electricity (LCOE) estimates from the International Renewable Energy Agency (IRENA), the cost of wind and solar projects

commissioned in 2023 ranged from $0.03-0.11/kWh, well below the fossil fuel cost range of $0.08-0.17/kWh. Despite increases in project financing costs and inflation across the broader economy, the LCOE of solar and onshore wind projects fell by 12% and 3% respectively, vs 2022. This illustrates that renewables remain cost competitive, and this keeps the long-term driver of renewables adoption intact.

Global LCOE of newly commissioned utility-scale renewable power generation technologies (2010–2023)

LCOE = levelized cost of electricity



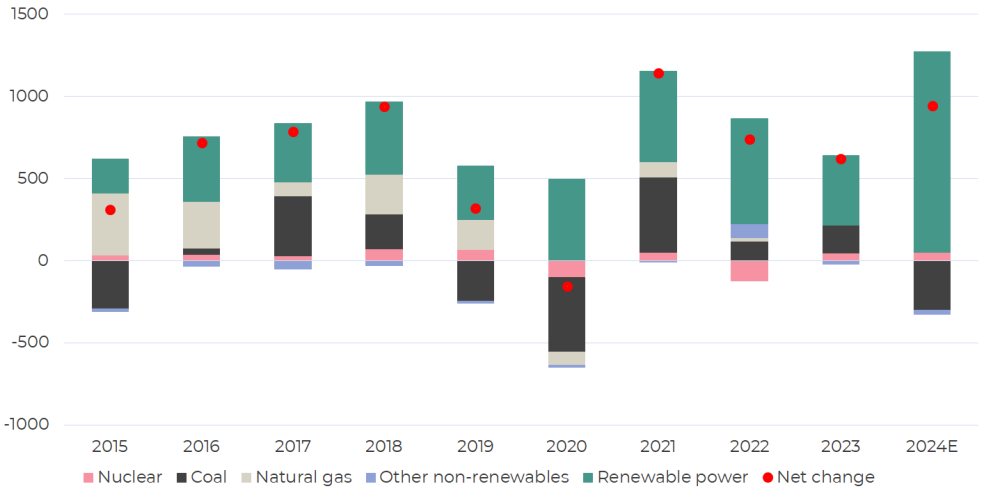
Source: IRENA; Guinness Global Investors, December 2024

Installations and power generation

Around 690 GW of **new renewable generation capacity** was installed in 2024, 170 GW higher than the record installations in 2023 and more than triple the 194 GW installed pre-COVID in 2019. At around 460 GW, solar represented around three quarters of the new capacity additions. Wind came next, at around 110 GW, followed by hydropower, then bioenergy.

Renewable electricity generation in 2024 is likely to have increased by 1,300 TWh (around 13%), reaching over 10,600 TWh and outpacing global electricity demand (estimated 970 TWh or 3% growth in 2024). Most of the rise in renewable power generation can be attributed to the increase in installed solar and wind capacity, although it was also boosted by a strong recovery in hydro output after drought conditions in various regions the year before. The growth in renewable power generation implies a 2% fall in global fossil fuel generation (-330 TWh).

Change in electricity generation (TWh) 2015-2024E



Sources: IEA; EMBER; Guinness Global Investors

More than half of the electricity demand growth in 2024 came from five technologies: electric vehicles (EVs), heat pumps, electrolysers, air conditioning and data centres. The spread of these technologies is accelerating the growth in electricity demand, but overall energy demand is not growing as fast, since electrification is more efficient than fossil fuels.

Energy displacement: efficiency and alternative fuels

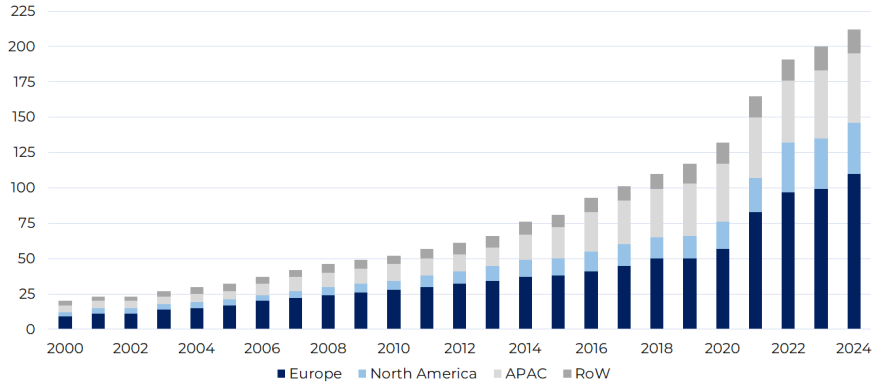
It is a common misconception that achieving rapid growth in renewable power generation will be enough to deliver government targets for pollution, energy security and decarbonisation. Renewable power generation is a key part of the solution, but we see the displacement and more efficient use of existing 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

It is hard to understate the importance of **energy efficiency**. Energy efficiency and energy security raced up the political agenda following the spike in energy prices following the Russian invasion of Ukraine in 2022.

National policies in force targeting building efficiency



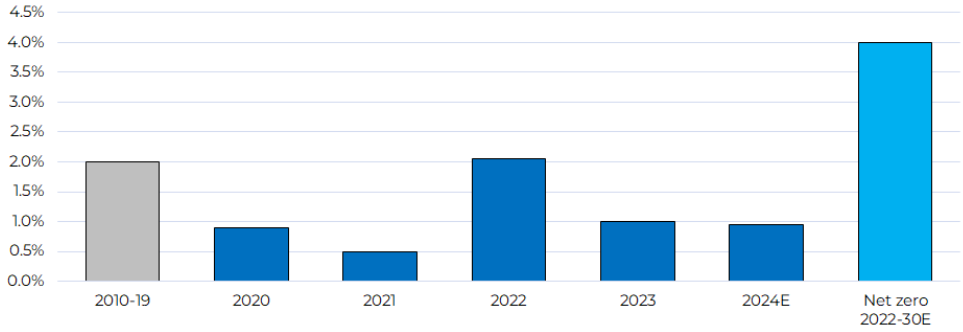
Source: IEA, Guinness Global Investors, December 2024

The increase was most pronounced in Europe, where the REPowerEU plan aimed to rapidly reduce dependence on Russian natural gas imports and fast-track the green transition. In 2024, the EU set new goals to achieve 100% zero-emission buildings by 2050, adding to existing targets to install 10 million heat pumps by 2027 and reduce final energy consumption by 13% by 2030.

Elevated energy prices drove three years of double-digit growth in global efficiency spending from 2020 to 2022. Investment then retreated 7% in 2023 as higher interest rates weighed on housebuilders and renovation activity and a 16% decline in Chinese construction significantly impacting the delivery of green buildings globally. In 2024, despite continued headwinds, spending is expected to have remained resilient, falling just 3% to $270bn, 35-40% higher than 2019 levels.

We believe that Europe's decision to end its reliance on Russian gas is likely to lead to structurally higher natural gas (and therefore electricity) prices in Europe and Asia. Higher energy prices should support efficiency project economics, ultimately providing a tailwind to the COP28 goal to double the global average annual rate of energy efficiency improvements from around 2% to over 4% every year until 2030.

Global annual improvement in primary energy intensity



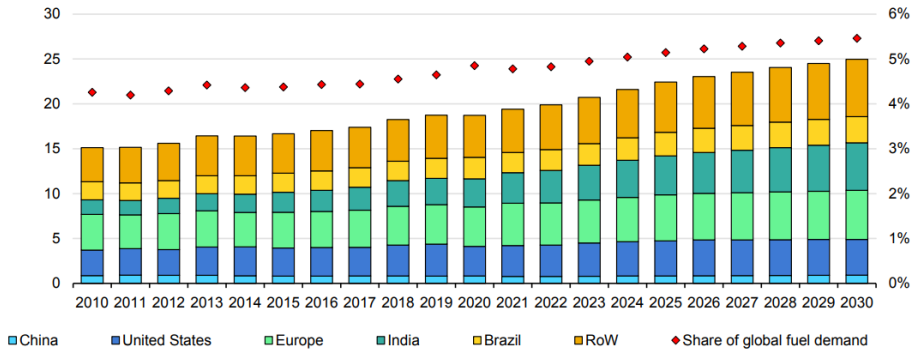
Source: IEA, Guinness Global Investors, December 2024

Alternative Fuels

Alternative (or renewable) fuels are set to play an important role in tackling emissions in carbon-intensive, hard-to-abate sectors. Global demand for these fuels in 2024 was around 21.5 exajoules (EJ) across industry, buildings and transportation, satisfying around 5% of their energy needs. Solid biofuels were the most prominent, making up 75% of alternative fuel consumption globally, followed by liquid biofuels at 20%, and biogas trailing at 5%. Four countries – the United States, India, Brazil, and China – represented over 50% of global demand.

Alternative fuel consumption is expected to grow steadily at around 2.5% per year out to 2030, reaching 25EJ, with over 65% of demand growth coming from India, China, Brazil, the US and Europe. Solid bioenergy contributes over 60% of the total demand growth with liquid biofuels, used predominantly in transportation, representing around 25% of the total growth.

Global renewable fuel demand (EJ)



Source: IEA (incl. estimates), December 2024

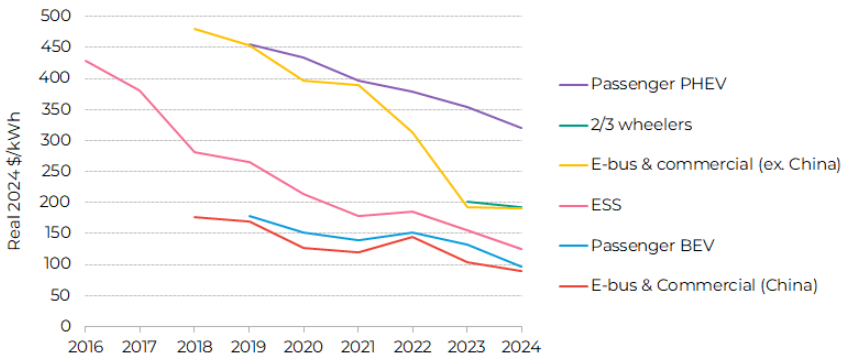
It is important to remember that alternative fuels broadly remain more expensive than their fossil fuel counterparts, meaning that policy support is key to underpinning future growth. For example, the $2/litre cost of producing biojet (often known as Sustainable Aviation Fuel, SAF) is nearly three times as much as the $0.75/litre cost of producing traditional jet fuel. Blending targets will still be needed to encourage the uptake of liquid biofuels while limiting the financial impact to consumers.

Electrification: batteries and electric vehicles

Global **battery demand** is expected to have reached 1.2TWh in 2024, up 29% year-on-year and up nearly 500% since 2020. Battery prices (across all applications) fell a further 20% to $115/kWh in 2024, due to rapid growth of lower-cost Chinese manufacturing. Assuming a continuation of the 18% historic learning rate, Bloomberg New Energy Finance forecasts battery prices could fall to around $70/kWh by 2030.

The battery market is primarily driven by passenger electric vehicles (EVs), representing 70% of demand, with energy stationary storage (ESS) a distant second at 14%. Looking ahead, we expect passenger vehicles to remain the dominant driver, with emergent demand from commercial vehicles acting as a tailwind, resulting in an average annual growth in battery demand of around 20% per year out to 2030. The price of batteries for EVs fell below $100/kWh for the first time in 2024, driven by economies of scale and an increase in the adoption of lithium iron phosphate (LFP) chemistries. Thanks to its greater stability and lower cost, LFP's share of the global cathode mix has grown from 17% in 2020 to 44% in 2024. China now boasts the lowest battery pack prices globally at $94/kWh, 20-30% lower than the US and Europe, and is the only region to see average prices below $100/kWh.

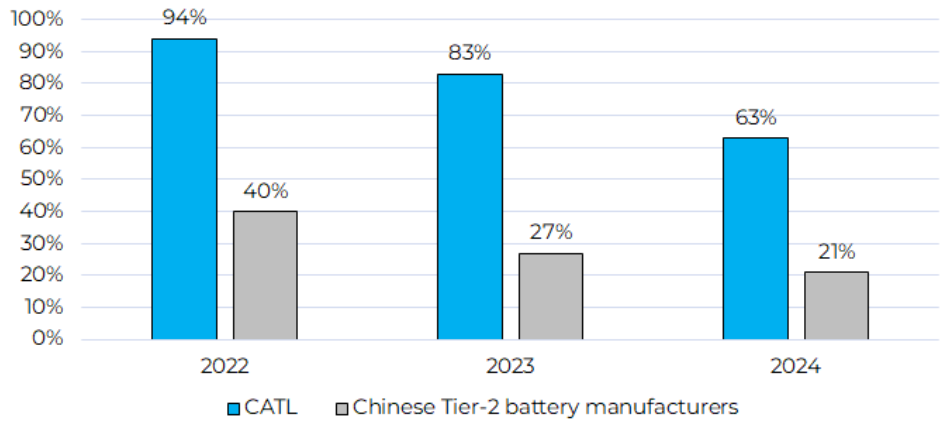
Historical volume-weighted average pack prices by sector



Source: BNEF, Guinness Global Investors, December 2024

Weaker-than-expected EV demand in 2024 led to falling battery manufacturing utilisation rates across the industry, falling as low as 21% for tier 2 manufacturers in China compared to 63% for industry leader CATL. Smaller players facing persistently low utilization and weak profitability are starting to respond by curtailing investment or exiting the industry entirely. Benchmark Minerals noted that at least 25 gigafactory projects across China and Europe were cancelled or postponed in 2024, leading to downward revisions to long-term supply estimates. With EV penetration due to accelerate across the West in 2025 and 2026, we expect utilization rates at tier 1 manufacturers to inflect positively, helping to boost margins and profitability.

Chinese battery capacity utilization

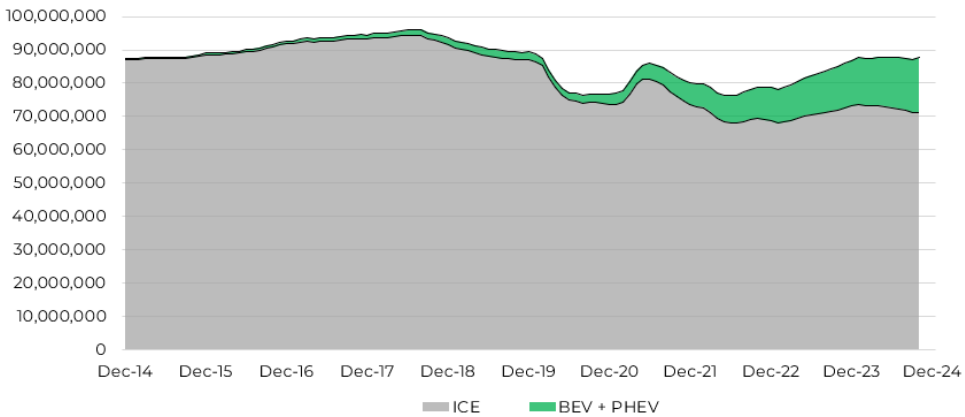


Source: Bernstein, Guinness Global Investors, December 2024

2024 saw rising trade tensions after the Biden administration more than tripled tariffs on Chinese imports of lithium-ion batteries (7.5% to 25%) and quadrupled tariffs on Chinese EVs (25% to 100%) in an attempt to shield domestic manufacturers from China's "unfair economic practices". With the election of Donald Trump, trade barriers look set to rise further in 2025 and beyond. Given Trump's hostile stance towards China, we see it as highly likely that the US will incentivise 'friendly' countries to bring their technology and build battery manufacturing capacity in the US, presenting an opportunity for Japanese and South Korean manufacturers.

Electric vehicles continued to gain popularity in 2024, growing 20% year-over-year to 17 million units (a 20% penetration rate). Meanwhile, internal combustion engines (ICEs) continue to lose share, with sales having fallen by around 25% since their peak in 2017.

Rolling 12-month light vehicle sales by drivetrain

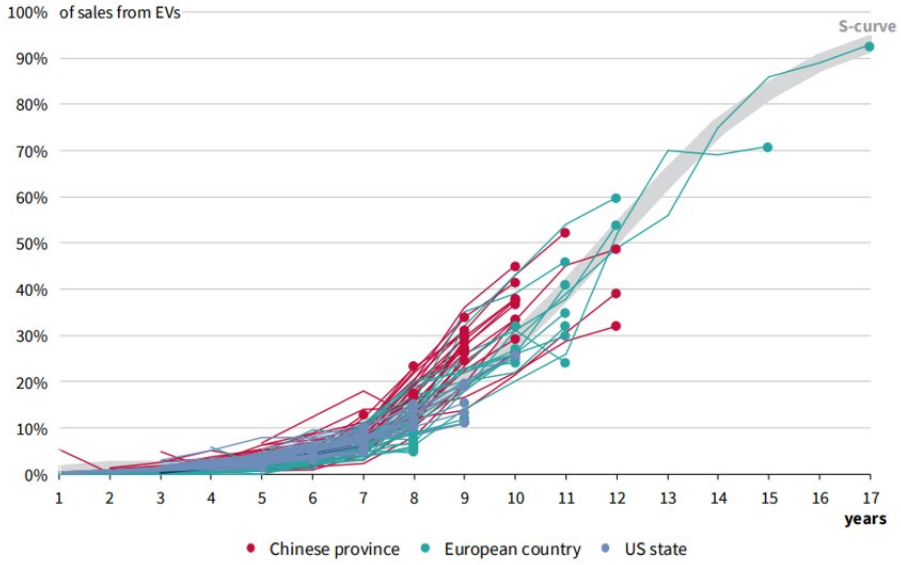


Source: LMC, Cleantechnica, Guinness Global Investors, December 2024

Slowing EV sales growth was largely attributable to higher financing costs, a post-COVID inflationary spike in vehicle prices and a weakening macroeconomic environment. Lower interest rates and cheaper batteries will improve EV affordability and should act as further positive catalysts for the sector.

We take confidence from Norway, which has banned ICE vehicle sales this year after seeing EV penetration rise from just 10% in 2013 to over 90% in 2024. While Norway is a small high-income country, it is interesting that its EV adoption curve is being tracked very closely by China, which achieved EV penetration rates of over 50% in the second half of 2024. Indeed, RMI analysis covering over 110 countries, states, and provinces across Europe, the US, and China found a universal S-curve pattern in EV deployment, with EV sales taking six years to get to 5%, and only another six years to get to 50%. If growth continues along these S-curves, **RMI estimates that electric vehicles will make up over 80% of new vehicle sales in China and Europe by 2030 with the United States reaching that level by 2035.**

EV share of car sales



Source: RMI, December 2024

Ultimately, we believe EVs will be cheaper to buy, cheaper to run and cheaper to maintain, driving the journey towards 50% global EV sales penetration in 2030 and over 90% sales penetration in 2040. Whilst regulatory and policy-based initiatives have been necessary to grow the EV industry to critical size, EVs can ultimately offer better technology (Chinese battery manufacturer CATL has developed a lithium iron phosphate battery with a 1,000km range), better efficiency (EVs convert over 85% of energy stored into motion, compared to less than 40% for ICE vehicles) and better economics (60% of all EVs sold in China in 2023 were cheaper than the ICE equivalent) that will allow them to dominate.

Renewable installations: solar, wind, power grids and nuclear

Solar

Solar deployments grew significantly again in 2024, with global installations of around 600 GW, up around four times (40% per year) since 2020 and nearly double the 22% annual growth achieved between 2014 and 2019. The rapid uptake is undoubtedly due to the vast improvements in both solar technology and solar economics, with module prices continuing to tumble, falling by 90% over the past 10 years to a record low of just 9 cents per watt in 2024. The profitability of module manufacturers suffered as oversupply caused modules prices to fall below the cash cost of manufacturing at times.

Solar continues to become more efficient. Around 20 years ago, solar modules were 5% efficient, 10 years ago they were 15% efficient, current modules are around 25% efficient and current research suggests that we may achieve 50% efficiency over the longer term. This could open the door to solar power costs falling 50-75% to as little as 1-3 cents per kilowatt hour (c/kWh), thereby cementing its position at the bottom of the electricity cost curve.

Looking to 2025, we expect growth across all major geographies to result in full-year global installations of around 670 GW. China will continue to dominate, making up approximately 50% of the global market as it attempts to decarbonize its power grid and achieve peak emissions before 2030. Growth should remain robust in North America driven by hyperscalers looking to lock in solar power purchase agreements which offer zero-carbon electricity with long-term price visibility and one of the fastest times to power. Data centres also provide a tailwind in Europe, which is expected to grow at a more restrained pace after more than doubling over the previous three years.

Global solar module installations, 2010-2025E (GW)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025E
OECD solar installations (annual)																
North America	1	2	4	6	7	8	15	12	12	15	22	26	26	40	48	53
Germany	7	7	8	3	2	1	1	2	4	4	5	6	7	15	15	16
Spain	0	0	0	0	0	0	0	0	0	5	4	6	9	9	8	9
Rest of Europe	3	4	5	5	5	8	5	7	9	14	15	21	28	46	55	56
Australia	0	1	1	1	1	1	1	1	4	3	4	6	4	6	4	5
South Korea	0	0	0	1	1	1	1	1	2	4	6	4	3	3	3	4
Japan	1	1	2	7	10	11	8	7	7	7	9	6	6	5	4	5
Total OECD	**17**	**23**	**24**	**24**	**25**	**31**	**32**	**31**	**39**	**53**	**65**	**75**	**86**	**128**	**141**	**152**
Change	*10*	*7*	*0*	*0*	*2*	*5*	*1*	*0*	*7*	*14*	*12*	*10*	*18*	*42*	*55*	*25*
Non-OECD solar installations (annual)																
China	0	3	3	14	13	19	30	53	44	33	52	69	107	260	309	330
India	0	0	1	1	1	2	5	10	11	11	4	13	19	14	27	29
Rest of non-OECD	1	3	3	4	6	4	8	7	12	21	29	26	40	42	123	156
Total Non-OECD	**2**	**5**	**8**	**18**	**21**	**27**	**46**	**72**	**67**	**65**	**85**	**107**	**172**	**316**	**458**	**515**
Change	*1*	*3*	*2*	*11*	*2*	*6*	*19*	*26*	*-5*	*-2*	*20*	*22*	*58*	*144*	*286*	*198*
Total solar installations (annual)	**19**	**29**	**31**	**42**	**46**	**56**	**75**	**101**	**106**	**118**	**150**	**182**	**252**	**444**	**599**	**667**
Change	*11*	*10*	*2*	*11*	*4*	*10*	*19*	*26*	*5*	*12*	*32*	*32*	*76*	*192*	*347*	*223*

Source: BP, BNEF, PV InfoLink, IEA and Guinness Global Investors estimates, December 2024

Thinking longer-term, solar power sits at the bottom end of the power generation cost curve, and significant increases in solar power generation are inevitable and necessary in a low-carbon energy system. Record-low module prices will only improve the volume outlook and the down cycle in pricing will end, providing opportunities for manufacturers to regain normalised profitability levels. To offset the intermittency, we will need to see solar & storage projects being more broadly economic in order to displace new build fossil fuel power generation. Storage project costs have dropped by 89% between 2010 and 2023 meaning that, over the last couple of years, the cheapest solar & storage projects (LCOEs in the range of 4.6-6.0 c/kWh) are already competitive with the cheapest new gas/coal-fired power projects (LCOEs in the range of 3.9-4.5 c/kWh and 6.8-6.9 c/kWh respectively). Higher-cost projects still require subsidy and incentives but costs are likely to fall.

Wind

Turning to the **wind industry**, manufacturing capacity grew by 21 GW in 2024, vs 12 GW in 2023. Total installations grew to a record 124 GW as manufacturers continued to recover from supply chain bottlenecks, raw material and labour market cost inflation and onerous non-profitable contracts that were priced before inflationary conditions hit in 2021. Wind operators also saw greater stabilisation in 2024 with no new significant project cancellations as the interest rate easing cycle started to improve project economics. In addition, power purchase agreements (PPAs) for wind reached record highs in the US ($65/MWh in Q3 2024 according to Levelten) and remain near all-time highs in Europe (€89/MWh). This sustained pricing, as interest rates started to decline, shored up new project economics and provided much-needed certainty to operators who have sat on the sidelines for the last two or three years.

Looking into 2025, we estimate a record level around 145 GW of new installations, an increase of around 21 GW versus 2024. Encouragingly, well over half of that increase is ex-China, suggesting a material ramp in growth in the sector in the key North American and European regions.

Global wind installations, 2010-2025E (GW)

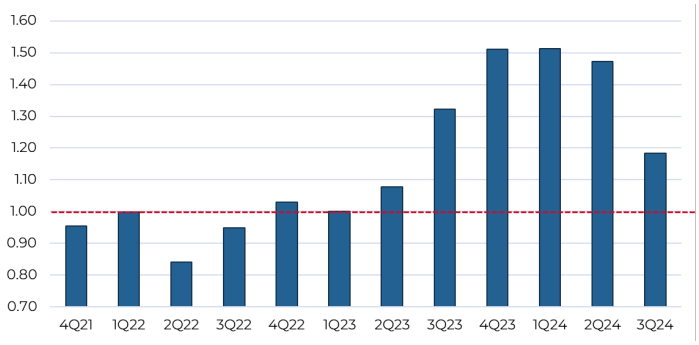
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025E
Onshore wind installations (annual)																
North America	6	8	15	2	7	10	9	8	8	10	17	14	10	8	8	10
Latin America	0	0	0	0	5	3	3	3	4	3	3	6	4	6	6	4
Europe	9	10	12	11	11	11	12	13	8	9	14	14	15	16	11	18
China	17	18	14	15	21	29	22	17	19	26	54	42	44	54	77	81
India	1	1	2	2	2	3	4	4	2	2	1	2	2	3	3	5
RoW	3	4	4	3	4	5	5	5	4	4	4	8	5	4	5	8
Total onshore	**35**	**40**	**46**	**33**	**49**	**61**	**55**	**49**	**46**	**55**	**93**	**84**	**79**	**91**	**110**	**126**
Change	*-3*	*5*	*6*	*-14*	*17*	*11*	*-6*	*-6*	*-3*	*9*	*38*	*-9*	*-5*	*12*	*19*	*16*
World ex China	*18*	*22*	*32*	*18*	*29*	*32*	*33*	*32*	*27*	*29*	*40*	*43*	*36*	*38*	*33*	*45*
Offshore wind installations (annual)																
China	0	0	0	0	0	1	1	1	2	3	4	14	5	8	7	12
UK	1	0	1	1	0	1	0	1	2	2	1	1	3	1	0	3
Germany	0	0	0	0	0	2	0	2	0	2	0	1	0	1	1	1
RoW	0	0	0	1	0	0	0	1	0	1	2	1	1	2	6	3
Total offshore	**1**	**0**	**2**	**2**	**1**	**4**	**1**	**4**	**4**	**8**	**7**	**17**	**9**	**12**	**14**	**19**
Change	*1*	*-1*	*1*	*1*	*-1*	*4*	*-4*	*3*	*0*	*3*	*-1*	*10*	*-8*	*3*	*2*	*5*
World ex China	1	0	1	2	1	3	0	4	3	5	3	3	4	4	7	6
Total wind installations	**36**	**40**	**48**	**35**	**50**	**65**	**56**	**53**	**50**	**63**	**100**	**101**	**88**	**103**	**124**	**145**
Change	*-2*	*4*	*8*	*-13*	*16*	*15*	*-9*	*-3*	*-2*	*12*	*38*	*1*	*-13*	*15*	*21*	*21*

Source: BP, IEA, BNEF, Guinness Global Investors estimates, December 2024

We see a near 60% increase in installations to around 200 GW by the end of the decade, with onshore growing at 6%pa and offshore growing at 20% pa. The starting point for the industry is healthy, with industry-level book to bill (the ratio of new orders to existing sales) at c.1.2x on a trailing 12-month basis as of Q3'24, comfortably above 1.0x. This suggests that the industry has a strong pipeline of work.

We finally remain encouraged by the potential of the Offshore sector to drive growth in the wind industry, as we enter the second half of the decade. Within Europe alone, there is c.26 GW of awarded and approved capacity set to come on-stream by 2030, the equivalent of 2-3 years of onshore growth globally. We would expect this to grow and note that there are 9.2 GW of projects tendered offshore France in November 2024 that will soon join this backlog.

Trailing 12-month European wind book to bill



Source: company data, Guinness Global Investors estimates, December 2024

Global power grids

Global power grids will have to be substantially upgraded and extended to cope with higher wind and solar generation as electricity demand inflects upwards. This includes high-voltage transmission (covering large distances), medium-voltage distribution (covering shorter distances) and low-voltage equipment (used within buildings). Within high and medium-voltage applications, we continue to see strong growth in transmission and distribution (T&D) spending. The Edison Electric Institute calculated US T&D investment at $95bn in 2024, up 9% versus 2023. We expect a healthy outlook for US grid investment, averaging 8-10% growth per year to 2030, as network owners and operators look to replace and upgrade ageing infrastructure (typically 30-50 years old or over), harden the grid against extreme weather and build out new capacity.

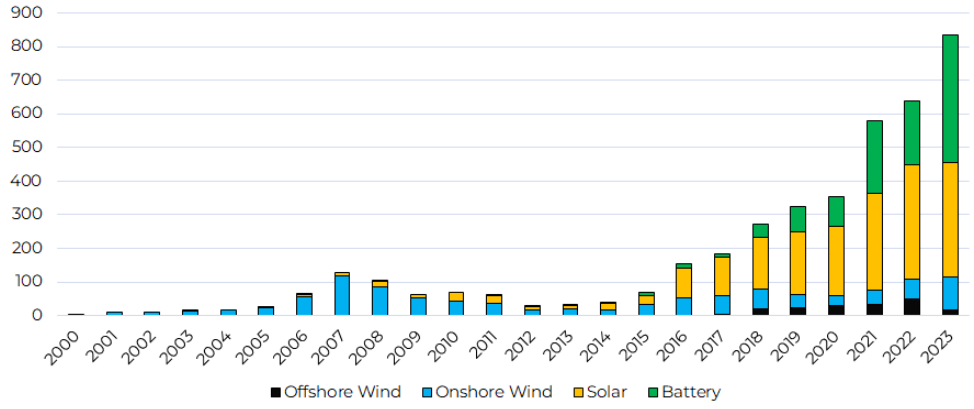
After 20 years of flat electricity consumption, we see demand growth of around 2-3% per year due to data centres, AI querying, reindustrialization and electrification. Political support will be required to make this happen and we stress that the outlook here is very robust regardless of what President Trump achieves with the IRA. The inflection started in 2024 in the US, but we expect pressure in Europe as well, where – despite the region being 12-24 months behind the US – data centre capacity is still forecast to grow at 20% per year to reach 35 GW in 2030. Three meaningful bottlenecks to this growth exist, relevant both in a US and a global context, and provide opportunities for companies to make superior margins:

- **Labour:** Bernstein estimates that the US will need 50% more linemen by 2035, forecasting a 12,000-worker shortage if the industry continues to grow at its historic rate. Experienced engineers are in short supply.

- **Transformers:** The average US transformer is 35-40 years old and the US imports around 80% of its large transformers. Supply chains are stretched with prices up 60-80% since early 2020 and lead times tripling to c.150 weeks since 2021. Electrical equipment manufacturers, especially US domestic manufacturers, are well placed.

- **Permitting:** The Lawrence Berkley National Laboratory sees the US interconnection queue at its highest level on record, while WoodMac expects that permit applications from as far back as 2020 will not be approved until later this decade. The opportunity for superior margins could last for a few years.

US cumulative interconnection queue



Source: Generation, Lawrence Berkeley National Laboratory, December 2024

These are long-term trends that will require multi-year investment programmes and it is therefore not surprising that **nuclear power** came back into consideration in the US as concerns grew about grid stability. While not necessarily considered to be a 'renewable' power source, and despite its chequered past, nuclear power will play a role in the global energy transition and there is no credible net zero scenario which doesn't forecast growth in 'carbon-free' nuclear. The 2024 nuclear renaissance saw hyperscalers sign deals to restart old reactors, support small modular reactors (SMRs) and invest in start-up companies developing nuclear fusion technologies.

A key focus remains SMRs, which are frequently touted as a solution to provide baseload low-carbon power generation. However, 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. From what we know, we think SMRs in the US will not 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 9 c/kWh to be economic, after a 3 c/kWh IRA subsidy) and its start date slipped (back to 2029, from an original plan of 2026). While carbon-free baseload power at $9 c/kWh could certainly be considered 'economic', we would expect project delays and cost overruns to take this substantially higher.

So, beyond restarting idled nuclear plants, nuclear power does not appear to be set for meaningful growth. We expect the first power from new SMR facilities to come after 2032, but even then, it is unlikely that SMRs have any meaningful impact until the late 2030s, in our opinion. This leads to a situation where global power grids will need to be extended and strengthened in order to cope with higher levels of variable renewable power.

IMPLICATIONS OF A NET ZERO SCENARIO

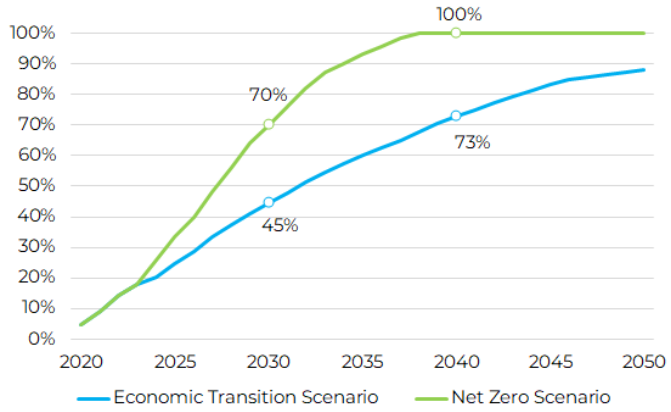
Throughout this document, we refer to our base-case energy transition scenario that reflects our understanding of the industry's current capacity and plans to provide decarbonisation solutions. This scenario is not consistent with net zero and we highlight the following changes across our subsectors that would be required to deliver a net zero transition:

- Within **efficiency**, annual improvements in energy intensity would need to quadruple from 1% in 2024 to average 4% per year out to 2030 globally. For buildings, this translates into efficiency, electrification and end-use investment increasing to around $850bn per year this decade (from $340bn today). For industry, investment must step up from $50bn in 2024 to $125bn per year out to 2030. It is worth noting that our base case scenario already assumes significant energy efficiency gains with world energy demand forecast to grow at 1% per year, half the historic rate of 2% per year.

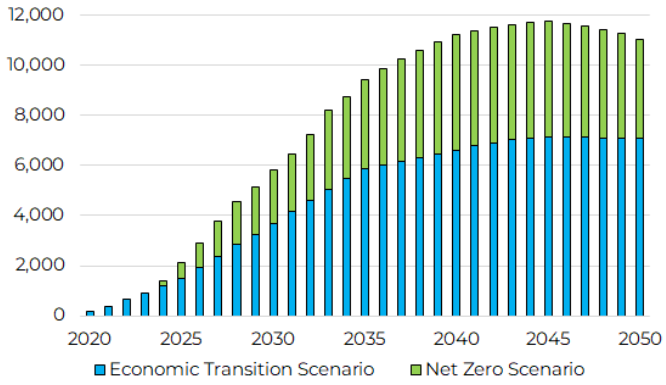
- **Alternative fuel** production growth would need to more than double by 2030 from 2023 levels (implying 11% per year growth) and then double again by 2050. SAF would have to grow from 0.3% of global jet fuel in 2024 to around 10% in 2030 (substantially higher than our base case 2030 estimate of around 2%).

- For **electric vehicles** and **batteries**, BNEF estimate that in a net zero scenario, global EV penetration rates must hit 70% by 2030 with 100% of vehicles sold being electric by 2040 (versus their current 'base case' economic transition estimates of 45% and 73% respectively). This translates into global battery demand of 5.8 TWh in 2030 compared to 1.2 TWh today, almost 60% higher than their base case assumptions, which themselves imply an annual growth rate of 20% per year from current levels.

EV sales penetration forecasts (%)



Lithium-ion battery demand forecasts (GWh)



Source: BNEF, Guinness Global Investors, December 2024

- **Solar** and **wind** generation by 2050 would need to be more than double the levels anticipated under our base case scenario, which already assumes a 4x increase in the wind generation base and a 10x increase in the solar base.

- For **power grids**, net zero would require global grid investment to grow at around 14% per year to the end of the decade, more than doubling from around $370bn today to over $800bn by 2030, 50% higher than our base case estimate.

- Under a net zero scenario, **nuclear** power capacity needs to expand by around 15 GW every year to the end of the decade, reaching 545 GW by 2030. Despite this only constituting 30% growth from current levels, new installations must outpace a wall of retirements from power plants installed in the 1970s and 1980s which are now coming to the end of their useful lives.

- According to McKinsey, annual **investment** on low-emissions technologies would need to increase from about $1.5trn to around $7trn over the next three decades, while annual investment in renewable capacity in 2025-2030 would need to be triple the 2023 levels in order to achieve 16%pa renewable growth required near term to achieve a NZE trajectory.

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General Enquiries: 0345 922 0044
E-Mail: wtas-investorservices@waystone.com.

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GUINNESS SUSTAINABLE ENERGY UCITS ETF

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