Guinness Sustainable Energy

Investment Commentary – June 2024

RISK

This is a marketing communication. Please refer to the prospectuses, KIDs and KIIDs 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
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 the combined effects of strong demand growth, improving economics and both public and private support and that this will provide attractive equity investment opportunities. The Funds are actively managed and use the MSCI World Index as a comparator benchmark only.

CONTENTS

COMMENTARY

ELECTRIC VEHICLES IN 2024 AND BEYOND

The path to mass adoption of electric vehicles (EVs) remains a bumpy one, with low operating margins, volatile battery prices, affordability concerns, and the phase-out of purchase incentives in some countries sparking concerns around growth prospects in the industry. Nevertheless, global EV sales figures remain robust and are expected to reach around 17m units in 2024, up more than 20% versus 2023 and taking EV sales penetration to over 20%. In this month's managers' comments, we discuss developments in the EV market, the economics of EVs versus internal combustion engine (ICE) vehicles, and the evolution of EV range and charging infrastructure.

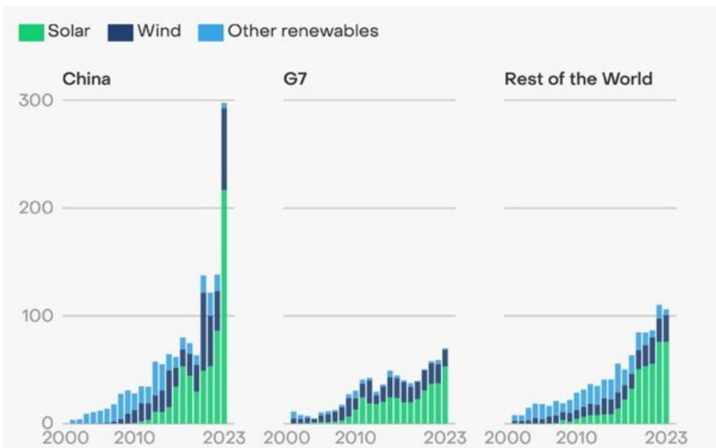
EQUITIES

The Guinness Sustainable Energy Fund (Class Y) delivered a return of 9.3% (in USD) in May, ahead of the MSCI World at 4.5%. Among the top performers were First Solar and Canadian Solar, as the importance of utility solar in the provision of power to data centres came to the fore. Weaker names included LG Chem and Samsung SDI, which suffered from subdued battery demand in the short term.

CHART OF THE MONTH – CHINA LEADING THE WAY

According to Ember, China more than doubled its annual renewable capacity additions in 2023, up to nearly 300GW. The bulk of the additions was solar. The G7 and other parts of the world are also showing a positive trajectory, but the step change in the level of activity in China stands out versus other nations.

Annual renewable capacity additions, GW



Source: Ember, May 2024

MAY 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
On May 14, President Biden announced an increase in US tariffs on around $18bn of Chinese imported goods, including electric vehicles, batteries, semiconductors and solar cells. For EVs, tariffs are increasing from 25% to 100%, with US administration citing “extensive subsidies and non-market practices leading to substantial risks of overcapacity”. The US Trade Representative's Office said plug-in hybrid electric vehicles will be covered by the new tariffs, but not hybrid vehicles. Tariffs on lithium-ion EV batteries will increase from 7.5% to 25% in 2024, while the tariff rate on lithium-ion non-EV batteries will increase from 7.5% to 25% in 2026. The tariffs on solar cells will double to 50% in 2024 to “protect against China’s policy-driven overcapacity that depresses prices and inhibits the development of solar capacity outside of China”.	US clean energy policy	→
According to the CEO of First Solar, speaking in late May, power demand growth from hyperscaler cloud service providers such as Microsoft is likely to go significantly beyond current expectations of 25% a year. This is positive news for US utility solar, with data centres now expected to be as much as 40-50% of the utility scale market, up from previous expectations of around 20%. In this environment, hyperscalers and other corporates have become less price sensitive versus 3-4 years ago, leading to rising prices in power purchase agreements (PPAs).	Utility solar	↗
After facing project cancellations and delays due to spiralling cost inflation, the offshore wind market is starting to recover, according to the CEO of Portugal’s largest utility, EDP. The company is seeing a major reset in PPAs with companies and government backed contracts, achieving price levels that are now high enough to make projects economically viable again. To meet climate targets, many countries are relying on a huge and rapid build-out of offshore wind farms which have high upfront costs but can provide cheaper energy than fossil fuel plants over the long term.	Offshore wind	↗
Delivery of green hydrogen appears to be falling behind expectations. In 2021, the International Energy Agency estimated that to keep the world on track for net zero by 2050, around 70Mtpa of green hydrogen capacity would be needed by 2030. Europe alone set itself a 2030 capacity target of 20Mtpa. Today, however, final investment decisions have been taken on only around 3Mtpa of production capacity. A recent report from BNEF suggests that the achievable capacity figure globally by 2030 might be closer to 16Mtpa. The shortfall can be attributed to rising costs, and the growing success of competing technologies such as heat pumps and lithium-ion batteries.	Hydrogen	↘
The International Energy Agency released its Global Electric Vehicle Outlook for 2024. The agency expects electric car sales of c.17 million units this year, accounting for more than one in five cars sold worldwide. According to the report, 60% of EVs sold in China in 2023 were already cheaper than internal combustion engine equivalents, but electric cars remain 10% to 50% more expensive in Europe and the United States. Improving affordability, thanks to improving battery technology, falling prices and increased competition, is expected to spur global penetration to 50% by 2035.	Electric vehicles	↗

MANAGERS' COMMENTS

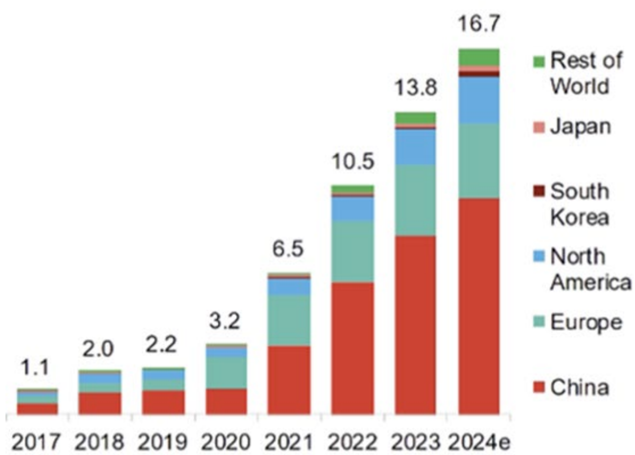
Electric vehicle sales in 2024 and the outlook

The path to mass adoption of electric vehicles remains a bumpy one, with low operating margins, volatile battery prices, affordability concerns, and the phase-out of purchase incentives in some countries sparking concerns around growth prospects in the industry. Nevertheless, global EV sales figures remain robust. In the first quarter of 2024, EV car sales were around 25% higher than the first quarter of 2023, a similar rate of year-on-year growth to early 2023 versus early 2022.

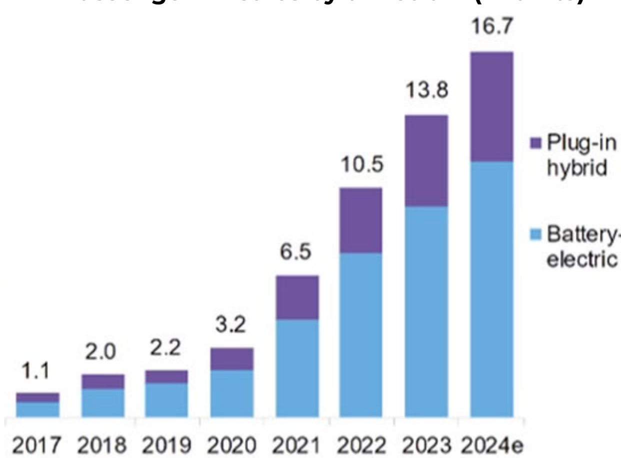
The growth expectations for EVs in 2024 are founded on a record year in 2023, when around 14m units were sold, representing 18% of global light auto sales (up from 14% in 2022). Putting this into context, over 250,000 EVs were sold every week last year, more than the number sold in a year just a decade ago. In 2024, EV sales are expected to reach around 17m units, up over 20% versus 2023, and taking EV sales penetration to over 20%.

The vast majority of electric car sales in 2023 were in China (60%), Europe (25%) and the United States (10%). By comparison, these regions accounted for around 65% of total car sales worldwide, demonstrating that sales of EVs remain more geographically concentrated than those of conventional vehicles. And while EV sales in emerging economies have been lagging those in the three big markets, we did see an acceleration in growth in certain key emerging markets in 2023 such as Vietnam (around 15% of all cars sold) and Thailand (10%).

Passenger EV sales by region (m units)



Passenger EV sales by drivetrain (m units)



Source: Bloomberg New Energy Finance, May 2024

In 2024, the market share of electric cars could reach up to 45% in China, 25% in Europe and over 11% in the United States, underpinned by competition among manufacturers, falling battery and car prices, and ongoing policy support.

Affordability remains key

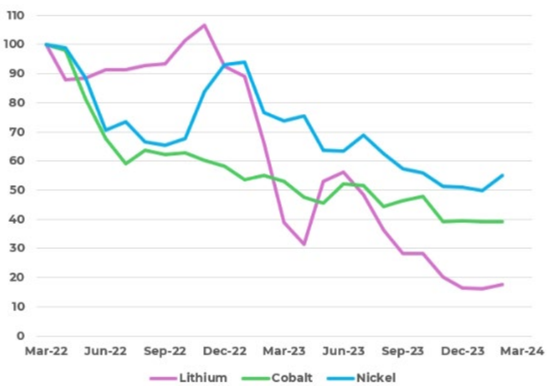
The price of EVs is falling as competition intensifies, particularly in China, but they remain more expensive than ICE vehicles in other markets. This has been less of a problem in recent years where much of EV penetration, especially in Europe and North America, has been in the less price-sensitive premium end of the auto market. However, for rapid penetration of EVs in the mass market for autos, there is a need for more affordable models.

In China, the IEA estimates that more than 60% of electric cars sold in 2023 were already cheaper than their average ICE equivalent. However, electric cars remain 10% to 50% more expensive than combustion engine equivalents in Europe and the United States, depending on the country and car segment.

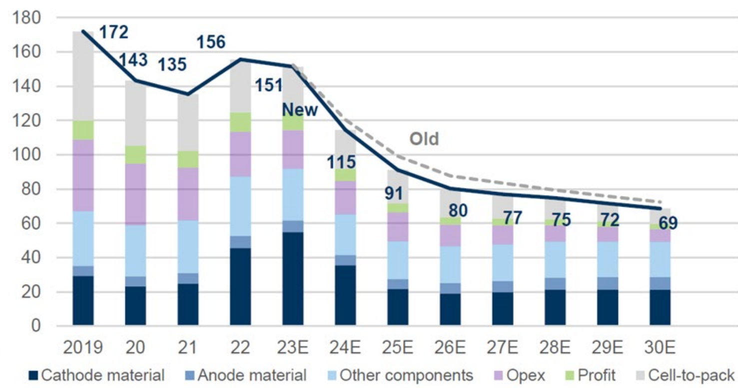
The pricing strategies of car manufacturers will be crucial for improving affordability, as will the pace of EV battery price decline. With regard to batteries, the positive news is that deflation in global average lithium-ion battery pack prices, which stalled in 2022 and 2023, is now picking up again. A key driver is lithium and nickel prices, which have dropped by around 85% and 45% respectively since March 2022. Falling metal prices and surging economies of scale are helping to deflate the cost of this key enabling technology. Historically, there has been an expectation of average battery prices falling below

$100/kWh in 2027. Some commentators, such as Goldman Sachs, now expect this key tipping point in price to occur as early as 2025.

Battery metal prices rebased (Mar22 = 100)



Global average lithium ion battery pack prices , forecast to 2030 (US$/kWh)

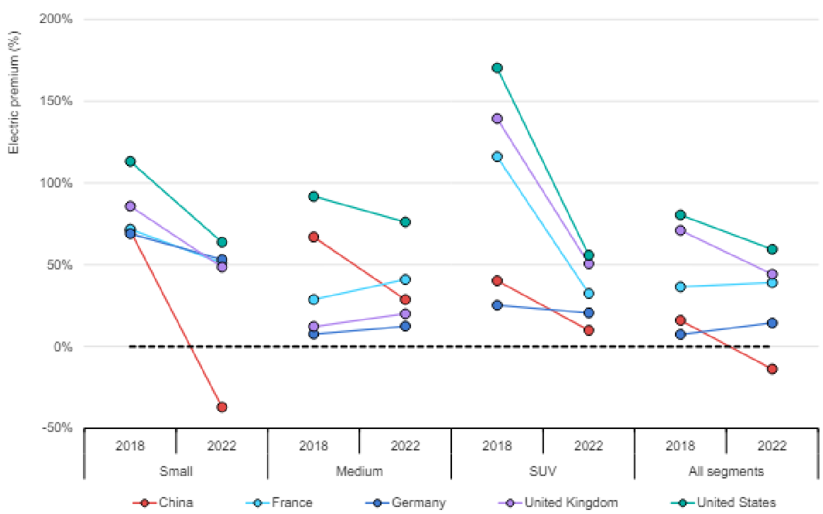


Source: Bloomberg; Goldman Sachs; Guinness Global Investors, May 2024

A shift in chemistry, especially for smaller EVs, towards lithium iron phosphate (LFP) batteries, is also having a positive effect. LFP batteries, which are significantly cheaper than those based on lithium, nickel, manganese and cobalt oxide, accounted for more than 40% of global EV sales by capacity in 2023, more than double their share in 2020.

Whilst a consumer's decision to choose an EV over an ICE vehicle should logically be based on the total cost of over the lifetime of ownership (i.e. upfront costs plus running costs), it is clear that an important milestone in the curve for EV adoption will be EVs reaching upfront cost parity with ICE vehicles.

Price gap between average price (sales-weighted) of EVs versus ICE vehicles, by size, 2018-22



Source: IEA, 2023

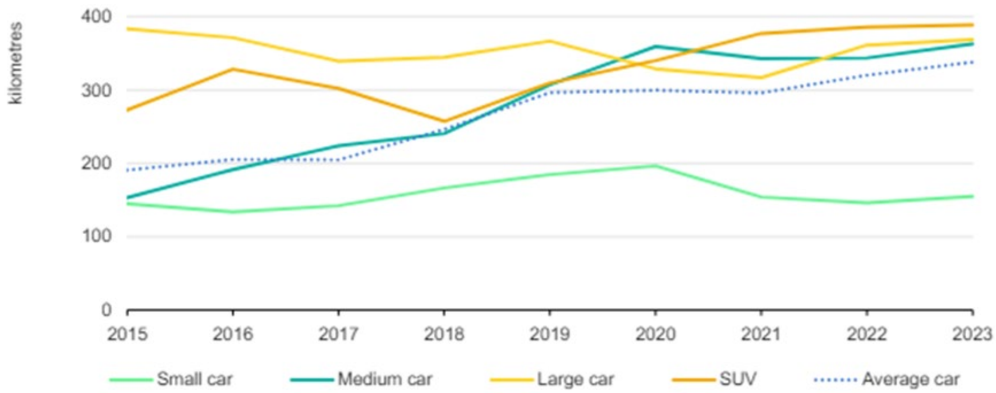
In China, the upfront retail cost of a small EV is already lower than the ICE equivalent, with SUVs not far from achieving price parity. Elsewhere in the world, the position varies significantly by region. In the US, for example, the price premium for an EV remains around 50% for most categories of light vehicle. The IEA estimates that average price parity in the US between electric and conventional SUVs could be reached by 2030, but may take longer for smaller cars.

By contrast, Germany's electric premium ranks among the lowest in the West, with the average electric premium sitting at 15% in 2022 and falling since then. And looking at total sales in Germany, over 25% of the electric cars sold in 2022 were already cheaper than their average ICE equivalent.

Range anxiety

Improvements in battery technology, vehicle design and the deployment of larger batteries have contributed to a significant increase in average EV range. The sales-weighted average range of battery electric cars (or BEVs) grew by nearly 75% between 2015 and 2023, although trends vary by segment. The average range of small cars in 2023, at around 150 km, is close to what it was in 2015, suggesting that this range is already 'fit for purpose' in urban areas. Larger models already offered higher ranges than average in 2015, and their range is up to around 360-380 km.

Sales-weighted average range of BEVs by segment 2015-23



Source: IEA, 2024

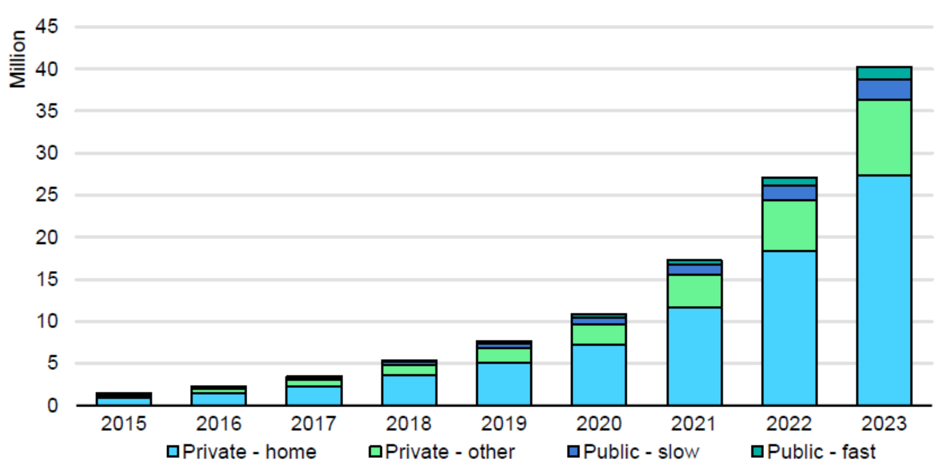
Since 2020, growth in the average range of vehicles has been slower than over the 2015-2020 period. This could result from a number of factors, including fluctuating battery prices, carmakers' attempts to limit additional costs as competition intensifies, and technical constraints (such as energy density or battery size). It could also reflect that beyond a certain range at which most driving needs are met, consumers' willingness to pay for a marginal increase in battery size and range is limited. Looking ahead, however, the average range may start increasing again as novel battery technologies mature and prices fall.

Charging infrastructure

Broad, affordable access to public charging infrastructure is needed for a mass-market adoption of EVs and to enable longer journeys – even if most charging continues to take place privately in residential and workplace settings.

Despite the perception of a shortage of EV charging infrastructure, particularly in Europe, the deployment of charging points in major EV markets is continuing apace thanks to targeted policies. Globally, the number of installed public charging points was up 40% in 2023 relative to 2022, with growth for fast chargers outpacing that of slower ones. At the end of 2023, fast chargers represented over 35% of the public charging stock.

Installed public and private light auto charging points 2015-23



Source: IEA, 2024

Unsurprisingly, China is leading the way, with around 85% of the world's fast chargers and around 60% of slow chargers. The Chinese government is targeting full coverage in cities and on motorways by 2030, in addition to better rural coverage.

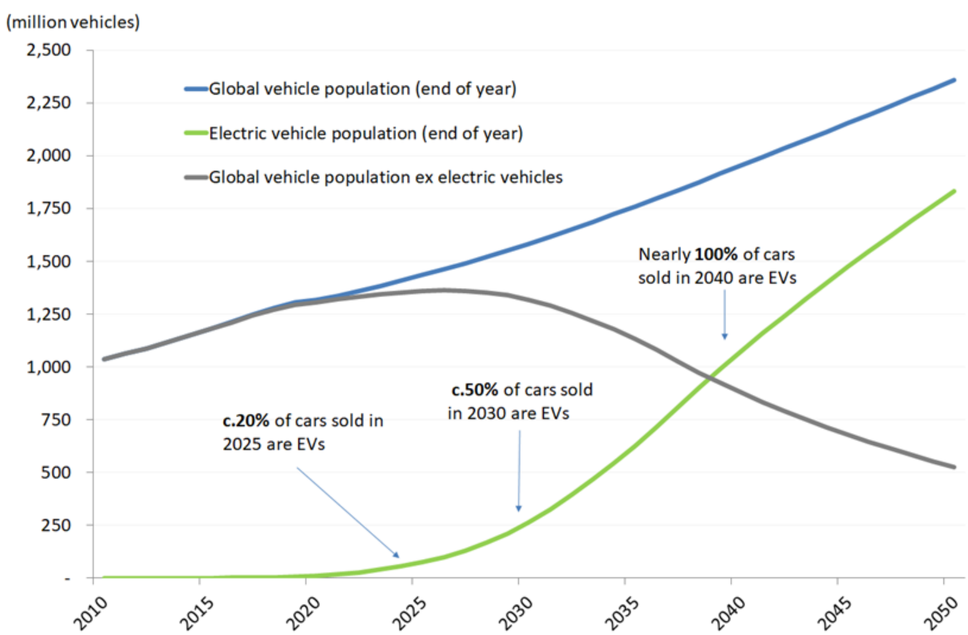
In late 2023, the EU agreed on new alternative fuels infrastructure regulation, which will require public fast chargers every 60km along the EU's main transport routes. The UK continues to incentivise private and public charging installations, with over 50,000 installed in 2023, and over 300,000 public chargers expected by 2030. And in the US, over 180,000 public chargers are already in place, with the goal of 500,000 public points in place by 2030.

Importantly, as the number of public chargers grows, attention is also turning to the interoperability of charging infrastructure. In the US, regulators announced last year that Tesla's charging connector (J3400) would be adopted as the standard under the North American Charging Standard. The aim is to ensure that any supplier or manufacturer is able to use and deploy the connector, providing EV drivers with more options for reliable, convenient charging across the continent.

Long-term growth expectations

We believe that the hurdles to deeper EV penetration will be overcome and EVs will achieve a broader mass-market appeal. We maintain a view that close to 50% of light auto sales in 2030 will be EV, with predominantly all new auto sales by 2040 being electric of some form.

Global auto population by type, 2010-2050E



Source : US DoE (actual), Guinness Global Investors (estimates) as of April 2024

Today's global EV population remains small, only around 4% of the total light auto fleet, but this is likely to grow to around 15-20% in 2030 and around 50% by 2040.

At that point, it implies an overall EV population of nearly one billion vehicles, over 20 times greater than the global stock in 2024 of around 40m.

PERFORMANCE

Past performance does not predict future returns.

The Guinness Sustainable Energy Fund (Class Y, 0.66% OCF) delivered a return of 9.3% in the month, while the MSCI World Index (net return) delivered 4.5% (all in USD terms).

Guinness Sustainable Energy Fund	Ytd	1 Yr	3 Yrs	5 Yrs	10 Yrs*
Fund (Class Y)	5.2%	-0.6%	-1.7%	120.7%	52.5%
MSCI World NR Index	9.5%	24.9%	21.4%	82.3%	139.6%
Out/Underperformance	*-4.4%*	*-25.5%*	*-23.1%*	*38.4%*	*-87.2%*

	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 6.4% in the month in GBP, while the MSCI World Index (net return) delivered 2.7%.

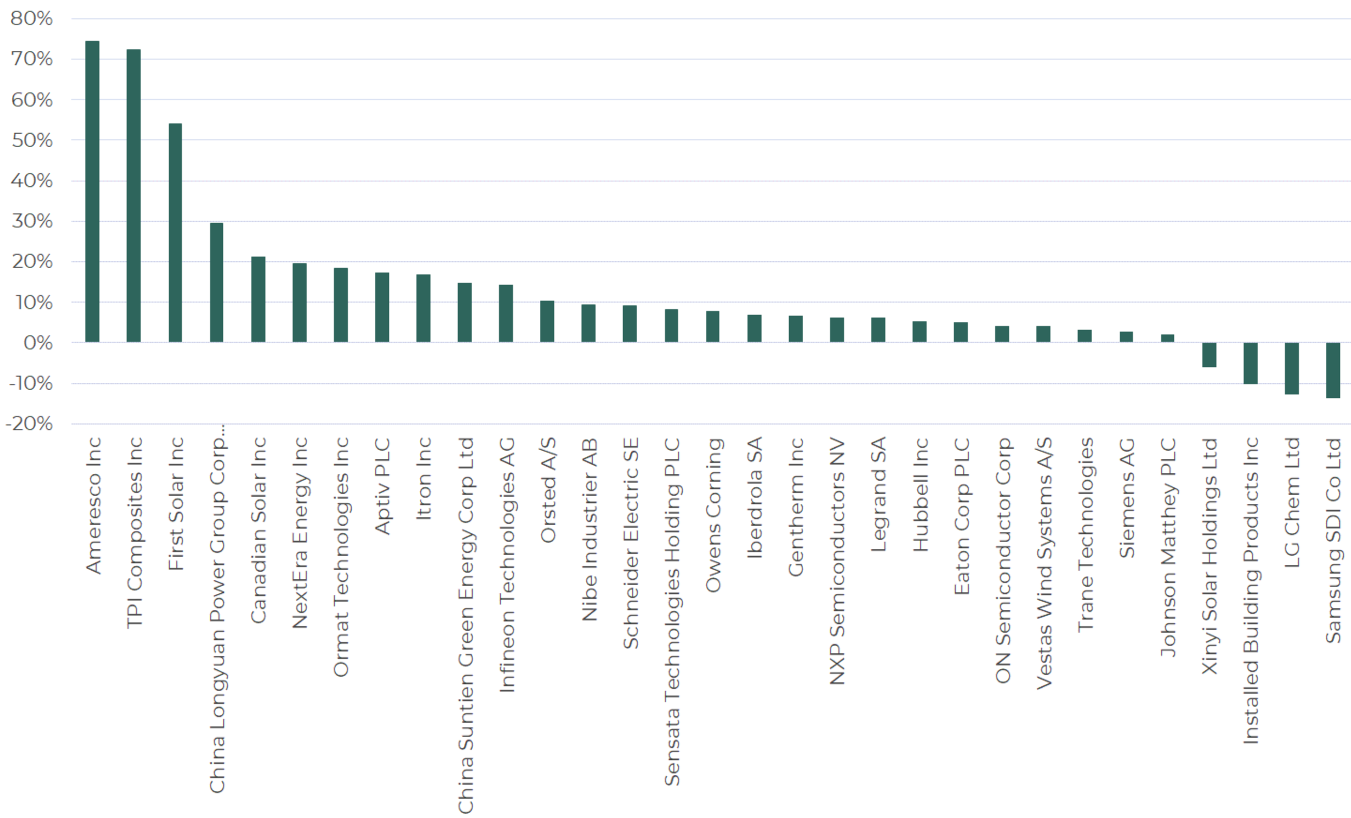
WS Guinness Sustainable Energy Fund	Ytd	1 Yr
Fund (Class Y)	4.0%	-4.5%
MSCI World NR Index	9.7%	21.6%
Out/Underperformance	*-5.7%*	*-26.1%*

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

Data as of 31.05.2024. 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.

Within the Fund, the strongest performers were TPI Composites, Ameresco, First Solar, China Longyuan and Canadian Solar, while the weakest performers were Samsung SDI, LG Chem, Installed Building Products, Xinyi Solar and Johnson Matthey.

Stock by Stock performance over the month, in USD

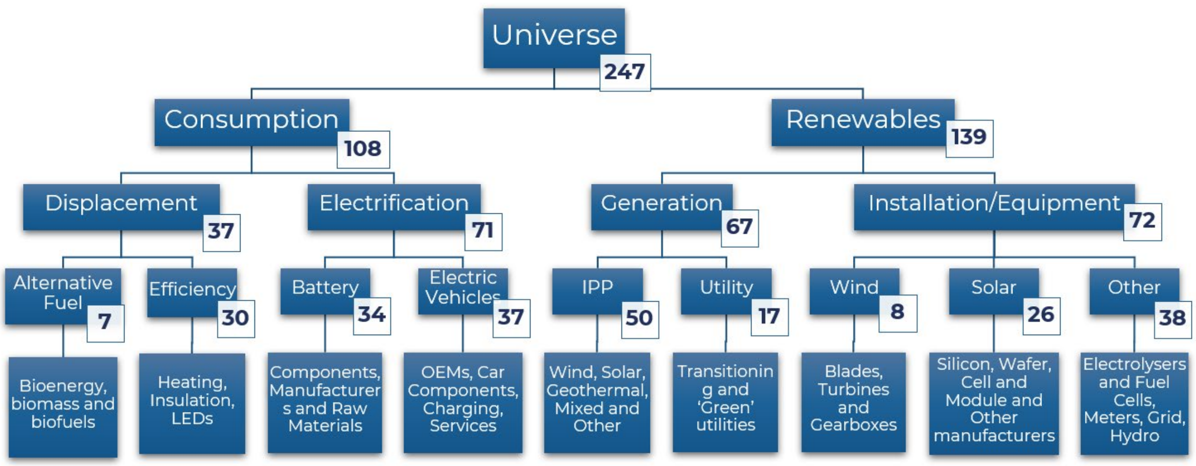


Source: Bloomberg. As of 31st May 2024

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. 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

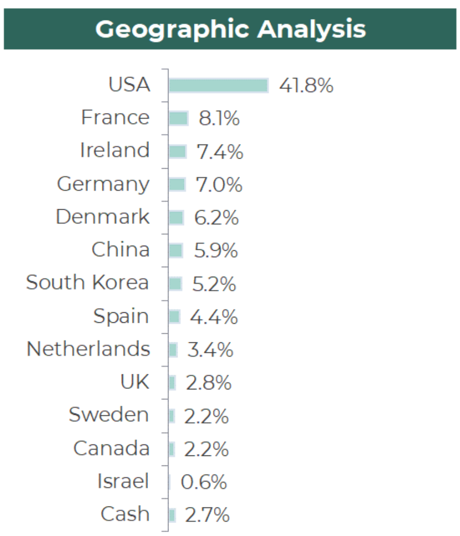
During the month we initiated positions in Owens Corning and Siemens, and sold our position in Sunnova.

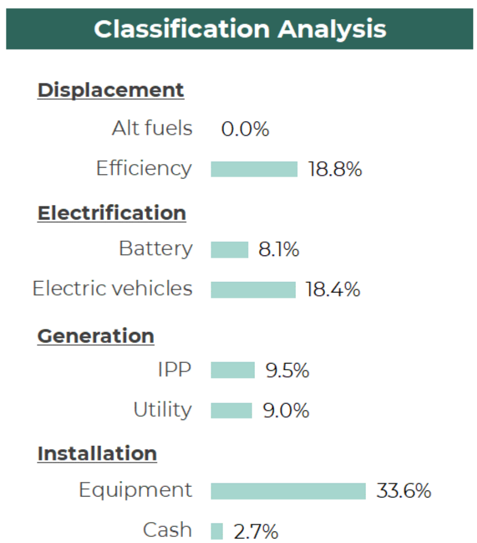
Owens Corning is a leading global manufacturer of insulation and roofing products. Their products are pivotal in reducing heat loss from properties and thus improving energy efficiency, which is a trend we expect to accelerate over time. In addition to that the company is a direct beneficiary of the US new build housing cycle, which we expect to improve as a function of midcycle activity levels and housing inventories sat at record lows. The stock trades at an 11x forward P/E multiple (versus a long term average of 14x), with expected 3 year EPS growth of 9%pa.

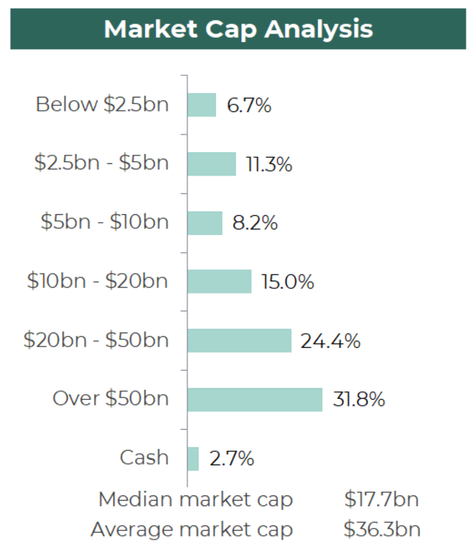
Siemens is a German industrial conglomerate with a focus on Smart Infrastructure (low and medium voltage products), Factory Automation, and Trains. As such it is a key "electrification" enabler. The company has historically suffered from a "conglomerate discount" as a function of its exposure to various non-core businesses. We view this as an opportunity and would argue that the company has made consistent efforts over the last decade to simplify and streamline their business, with greater focus on key electrification and efficiency themes. With this, we would expect to see the valuation discount unwind, which coupled with a 15% EPS CAGR should lead to material upside in the shares.

Sunnova's business model has struggled over the last couple of years as a function of higher financing costs, which has pressured the roll out of residential solar in the US. In part because of this, but also because of liquidity reasons we took advantage of share price strength in the month to exit and redeploy capital to Siemens and Owens Corning.

Portfolio structure analysis







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				
	May-24		Dec-23	Dec-22	Dec-21	Dec-20	Dec-19	Dec-18
Consumption	**45.2%**	***1.3%***	**43.9%**	**44.9%**	**43.4%**	**36.7%**	**41.7%**	**26.5%**
Displacement	18.8%	*3.5%*	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	*18.8%*	*3.5%*	*15.3%*	*15.0%*	*11.8%*	*9.9%*	*13.4%*	*12.5%*
Electrification	26.4%	*-2.1%*	28.5%	29.9%	31.6%	26.8%	28.2%	10.1%
Batteries	*8.1%*	*-2.1%*	*10.2%*	*11.6%*	*8.9%*	*10.8%*	*12.6%*	*3.9%*
Electric vehicles	*18.4%*	*0.0%*	*18.4%*	*18.2%*	*22.8%*	*16.0%*	*15.7%*	*6.2%*
Renewables	**52.1%**	***0.2%***	**51.9%**	**49.3%**	**51.3%**	**60.4%**	**54.1%**	**69.7%**
Generation	18.5%	*-1.0%*	19.5%	17.7%	23.1%	24.6%	22.2%	27.3%
IPP	*9.5%*	*-1.4%*	*10.9%*	*8.7%*	*14.5%*	*17.0%*	*18.9%*	*26.7%*
Utility	*9.0%*	*0.4%*	*8.6%*	*9.0%*	*8.6%*	*7.6%*	*3.2%*	*0.6%*
Installation	33.6%	*1.2%*	32.4%	31.6%	28.2%	35.8%	32.0%	42.5%
Equipment	*33.6%*	*1.2%*	*32.4%*	*31.6%*	*28.2%*	*35.8%*	*32.0%*	*42.5%*
Cash	2.7%	*-1.5%*	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 31 May 2024	PE			EV/EBITDA			Dividend Yield		EPS Growth (%pa)		CFROI	
	2023	2024E	2025E	2023	2024E	2025E	2024E	2025E	2018-23	2023-26	2024E	2025E
Guinness Sustainable Energy Fund	19.0x	17.9x	14.5x	4.8x	4.9x	4.2x	1.6%	1.6%	7.5%	16.2%	8.9%	11.3%
MSCI World Index	20.5x	19.2x	17.3x	14.1x	12.8x	11.5x	1.9%	2.1%	5.1%	8.8%	8.6%	9.5%
Fund Premium/(Discount)	*-7%*	*-7%*	*-16%*	*-66%*	*-61%*	*-64%*						

*2023 P/E = Latest month-end price / 2023 earnings; Portfolio = median CFROI; Index data = Credit Suisse MSCI World ETF median CFROI

Source: Guinness Global Investors, Bloomberg

Portfolio holdings as at end May 2024

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

We hold c.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 (10%) or the electrification of transportation (19% weight), while we have 16% 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 manufacturing installation (Installed Building Products and 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 20% weight to companies involved in the generation of sustainable energy and 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 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 May 2024

	Theme	Example holdings	Weighting (%)
1	Electrification of the energy mix	Iberdrola, legrand	28.1%
2	Rise of the electric vehicle and auto efficiency	Sensata Technologies, APTIV	21.2%
3	Battery manufacturing	Samsung SDI	5.2%
4	Expansion of the wind industry	Vestas	10.0%
5	Expansion of the solar industry	First Solar	10.8%
6	Heating, lighting and power efficiency	NIBE Industrier, Trane Technologies	18.8%
7	Geothermal	Ormat	3.1%
8	Other (inc cash)		2.7%

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

Guinness Sustainable Energy Fund (30 April 2024)			P/E			EV/EBITDA			Price/Book			Dividend Yield		
Stock	**ISIN**	**% of NAV**	**2023**	**2024E**	**2025E**	**2023**	**2024E**	**2025E**	**2023**	**2024E**	**2025E**	**2023**	**2024E**	**2025E**
Displacement/Efficiency														
Hubbell Inc	US4435106079	4.3%	25.7x	22.6x	21.1x	17.2x	16.3x	15.3x	6.9x	6.1x	5.3x	1.2%	1.3%	1.4%
Nibe Industrier AB	SE0015988019	2.2%	20.7x	29.2x	22.9x	13.6x	18.3x	14.7x	3.2x	3.2x	2.9x	1.3%	1.1%	1.3%
Trane Technologies PLC	IE00BK9ZQ967	5.1%	35.1x	30.7x	27.5x	21.8x	21.2x	19.4x	10.3x	9.6x	8.6x	0.9%	1.0%	1.1%
Installed Building Products Inc	US45780R1014	3.3%	27.4x	20.3x	18.4x	14.4x	13.5x	12.4x	10.0x	7.3x	5.6x	0.9%	1.0%	0.8%
Ameresco Inc	US02361E1082	1.3%	16.8x	15.4x	11.1x	16.2x	11.9x	9.5x	1.2x	1.1x	1.0x	0.0%	n.m.	n.m.
		16.2%												
Electrification/Battery														
LG Chem Ltd	KR7051910008	3.1%	19.3x	17.2x	8.6x	7.5x	6.6x	4.4x	0.8x	0.9x	0.8x	0.9%	1.3%	1.9%
Samsung SDI Co Ltd	KR7006400006	3.5%	13.7x	16.4x	12.4x	9.5x	8.8x	6.5x	1.4x	1.5x	1.3x	0.2%	0.2%	0.2%
Johnson Matthey PLC	GB00BZ4BQC70	3.2%	10.6x	12.0x	10.2x	6.8x	7.1x	6.5x	1.3x	1.2x	1.2x	4.2%	4.4%	4.5%
		9.7%												
Electrification/Electric Vehicles														
Aptiv PLC	JE00B783TY65	3.2%	16.4x	12.6x	10.0x	8.5x	7.6x	6.8x	1.7x	1.6x	1.4x	0.0%	0.2%	0.2%
ON Semiconductor Corp	US6821891057	2.9%	13.8x	17.4x	14.7x	9.5x	11.8x	10.2x	3.8x	3.2x	2.7x	0.0%	0.0%	0.0%
Infineon Technologies AG	DE0006231004	3.1%	13.7x	16.3x	12.9x	8.2x	9.3x	7.5x	2.7x	2.3x	2.0x	1.1%	1.1%	1.3%
NXP Semiconductors NV	NL0009538784	3.4%	19.0x	18.5x	16.4x	12.7x	13.9x	12.7x	7.6x	6.6x	6.1x	1.6%	1.6%	1.8%
Sensata Technologies Holding PLC	GB00BFMBMT84	3.7%	11.2x	10.3x	9.1x	8.0x	9.4x	8.7x	1.9x	1.8x	1.6x	1.2%	1.3%	1.3%
Gentherm Inc	US37253A1034	2.6%	23.8x	17.5x	14.3x	10.0x	8.7x	7.5x	2.5x	n.m.	n.m.	0.0%	n.m.	n.m.
		18.9%												
Generation/IPP														
China Longyuan Power Group Corp Ltd	CNE100000HD4	1.9%	5.4x	5.6x	4.7x	9.7x	9.2x	8.1x	0.6x	0.6x	0.5x	4.5%	5.1%	5.8%
Ormat Technologies Inc	US6866881021	3.1%	30.9x	29.9x	26.9x	14.1x	10.6x	9.6x	1.7x	1.5x	1.4x	0.8%	0.8%	0.8%
NextEra Energy Inc	US65339F1012	5.0%	21.4x	19.7x	18.2x	13.9x	14.3x	13.4x	2.9x	2.5x	2.5x	2.8%	3.1%	3.4%
Sunnova Energy International I	US86745K1043	0.6%	n.m.	n.m.	n.m.	203.0x	14.4x	9.6x	0.3x	0.3x	0.2x	0.0%	0.0%	0.0%
Orsted A/S	DK0060094928	2.8%	28.6x	17.1x	12.6x	7.7x	8.8x	7.1x	2.8x	2.2x	1.8x	0.0%	3.9%	3.7%
China Suntien Green Energy Corp Ltd	CNE100000TW9	1.5%	5.3x	4.9x	4.2x	10.4x	8.7x	7.5x	0.6x	0.5x	0.5x	7.4%	7.8%	9.3%
		14.9%												
Generation/Utility														
Iberdrola SA	ES0144580Y14	4.7%	15.0x	14.2x	13.8x	9.9x	9.1x	8.8x	1.6x	1.5x	1.5x	4.8%	5.0%	5.1%
		4.7%												
Installation/Equipment														
Schneider Electric SE	FR0000121972	4.7%	29.8x	25.7x	22.9x	17.7x	17.0x	15.5x	4.5x	4.2x	3.8x	1.6%	1.8%	1.9%
Legrand SA	FR0010307819	4.5%	20.8x	20.8x	19.6x	13.1x	13.6x	13.0x	3.7x	3.5x	3.2x	2.0%	2.2%	2.4%
Eaton Corp PLC	IE00B8KQN827	4.8%	38.2x	30.8x	27.5x	26.0x	23.7x	21.6x	6.7x	6.6x	6.1x	1.1%	1.2%	1.2%
Itron Inc	US4657411066	3.7%	51.9x	25.6x	21.3x	23.7x	18.4x	15.3x	3.2x	2.8x	2.4x	0.0%	n.m.	n.m.
Xinyi Solar Holdings Ltd	KYG9829N1025	2.6%	11.6x	9.3x	7.3x	8.0x	6.8x	5.7x	1.5x	1.4x	1.3x	4.1%	5.0%	6.4%
SolarEdge Technologies Inc	US83417M1045	0.7%	44.0x	n.m.	14.4x	16.9x	n.m.	9.7x	1.4x	1.5x	1.4x	0.0%	0.0%	0.0%
Enphase Energy Inc	US29355A1079	1.8%	33.6x	37.7x	21.5x	25.8x	30.5x	17.5x	15.0x	12.9x	8.3x	0.0%	0.0%	0.0%
First Solar Inc	US3364331070	4.0%	20.9x	13.0x	8.5x	13.7x	8.7x	5.7x	2.8x	2.3x	1.8x	0.0%	0.0%	0.0%
Canadian Solar Inc	CA1366351098	1.9%	3.7x	5.2x	3.6x	5.9x	5.2x	4.0x	0.4x	0.3x	0.3x	0.0%	0.0%	0.0%
Vestas Wind Systems A/S	DK0061539921	4.0%	196.5x	43.1x	20.8x	20.8x	14.2x	9.7x	8.1x	7.2x	5.7x	0.0%	0.5%	1.2%
TPI Composites Inc	US87266J1043	0.1%	n.m.	n.m.	n.m.	n.m.	33.0x	6.3x	n.m.	n.m.	n.m.	0.0%	n.m.	n.m.
		32.9%												
Cash	Cash	**2.8%**												

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

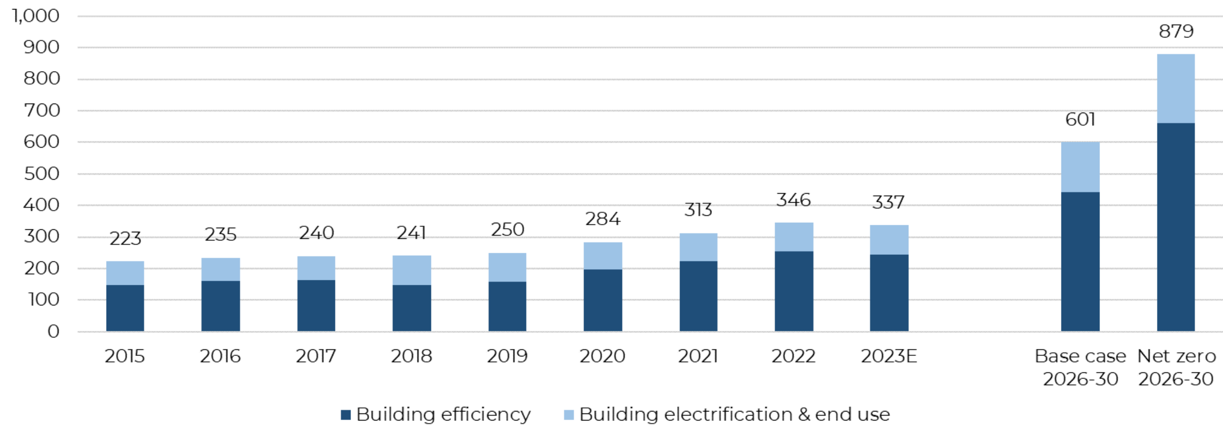
It is a common misconception that achieving rapid growth in renewable power generation will be enough to deliver government targets for pollution, energy security and decarbonisation. Renewable power generation is a key part of the solution, but we see the displacement and more efficient use of existing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



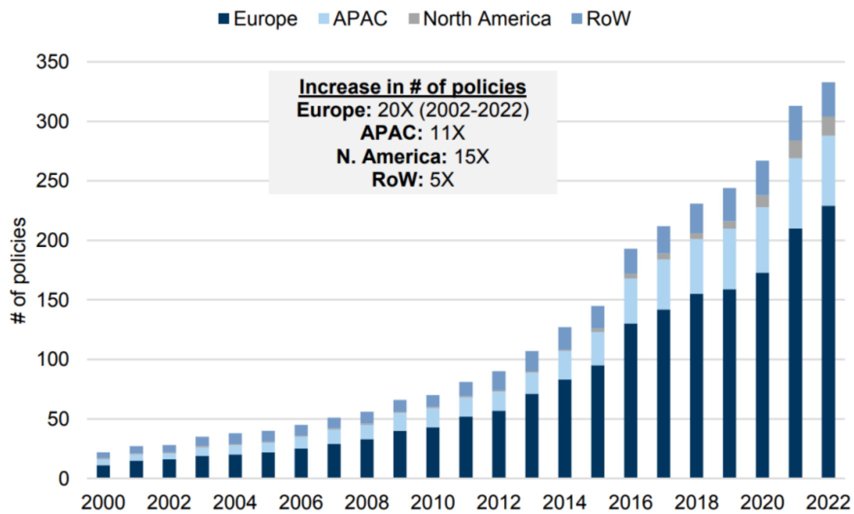
Source: IEA, Guinness Global Investors; December 2023

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

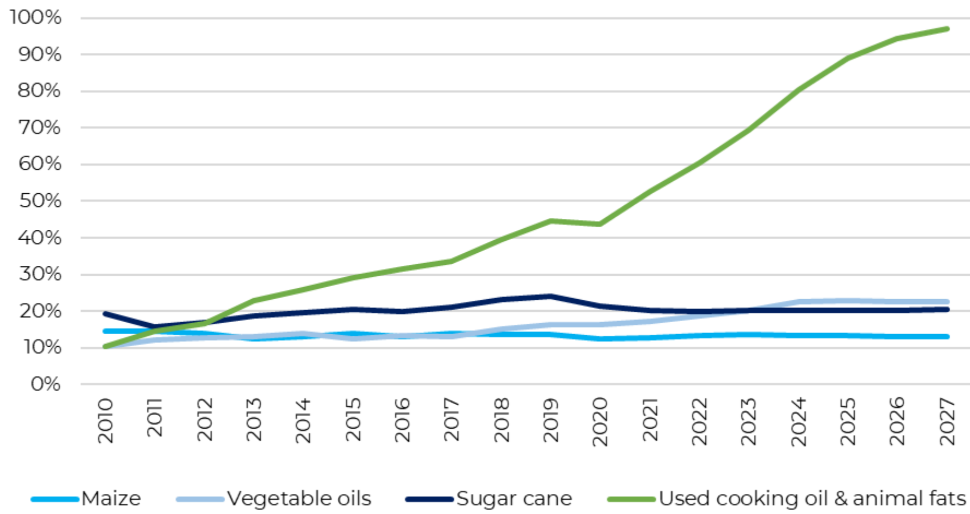
Global biofuel consumption is expected to be just under 180bn litres in 2023, displacing around 2 million barrels of oil per day, equating to 4% of oil demand from transportation. The market continues to be dominated by the USA, Brazil, Europe and Indonesia, which make up 85% of global consumption.

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.

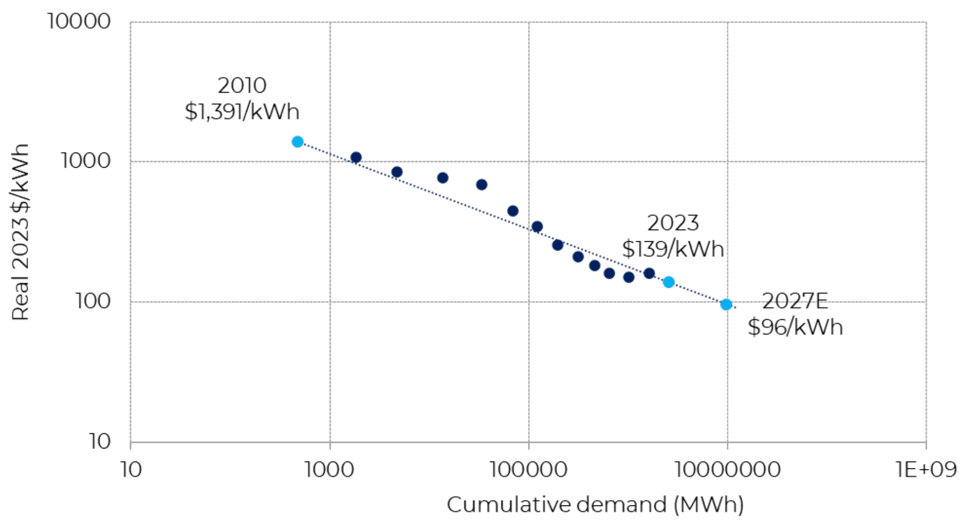
Electrification

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.

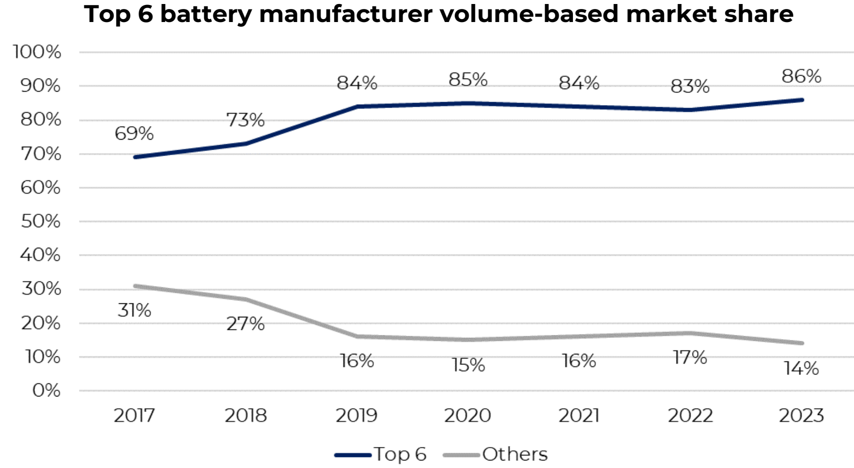
Cumulative demand for LiB packs (MWh) vs battery pack price ($/kWh)



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



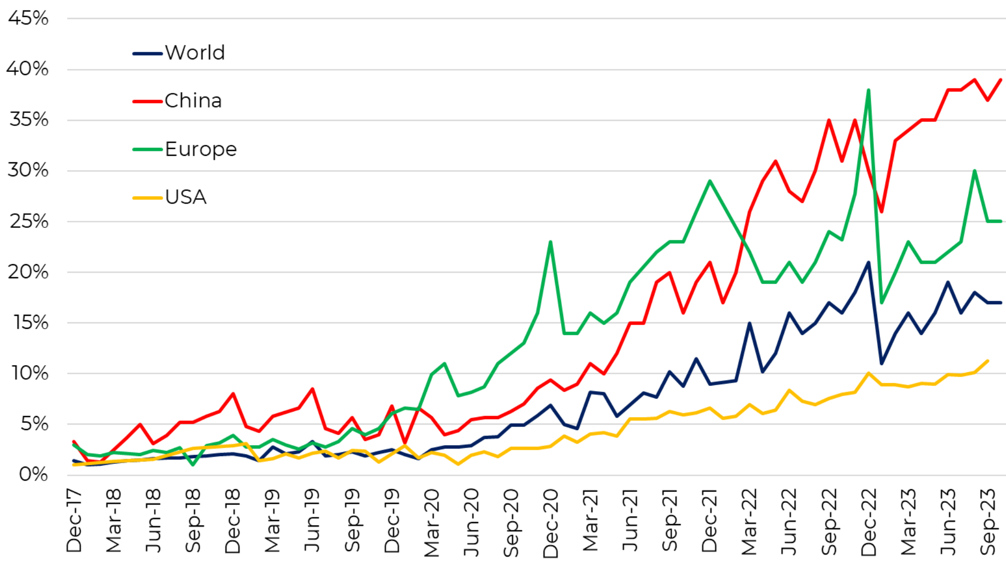
Source: EV-Volumes, HSBC, Guinness Global Investors, December 2023

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

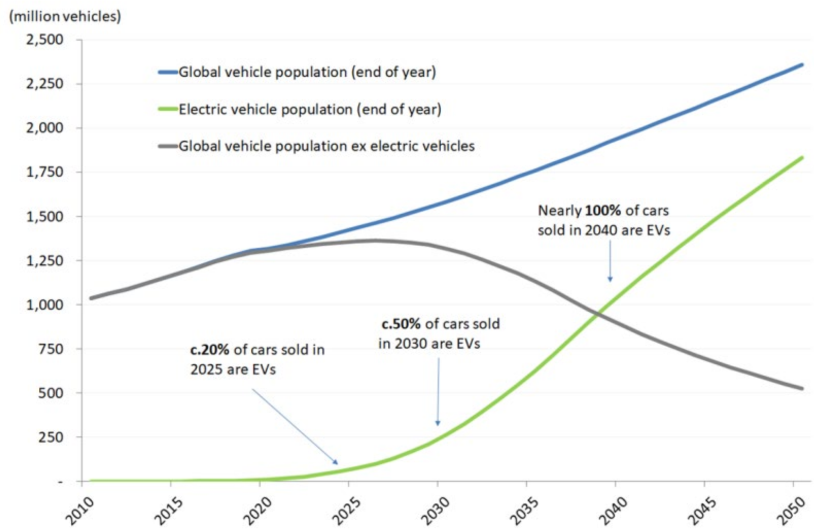
These regional differences largely reflect the main driver of adoption: affordability.

- **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

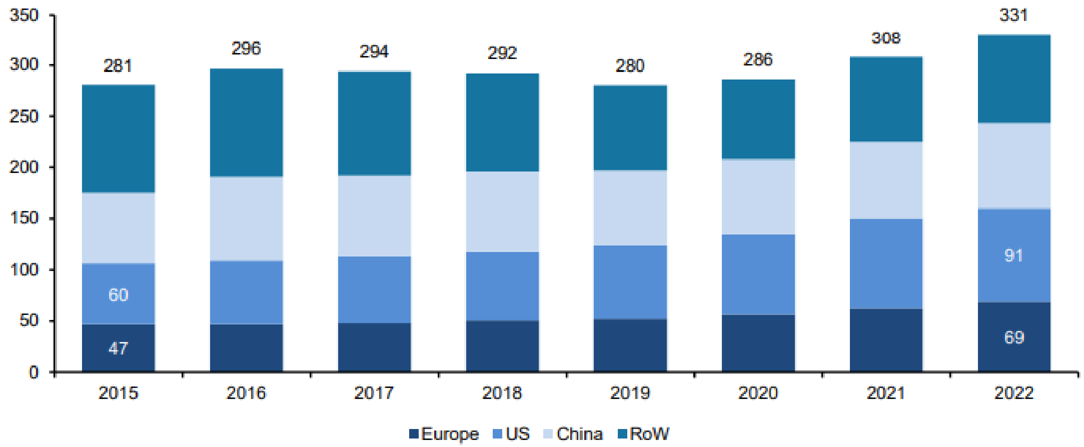
The decline in battery prices (and commensurate improvement in EV affordability) observed over recent years has coincided with climbing expectations of EV sales (Bloomberg New Energy Finance has upgraded its electric vehicle sales estimates by 100% and 50% for 2025 and 2030 in the past five years alone). 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.

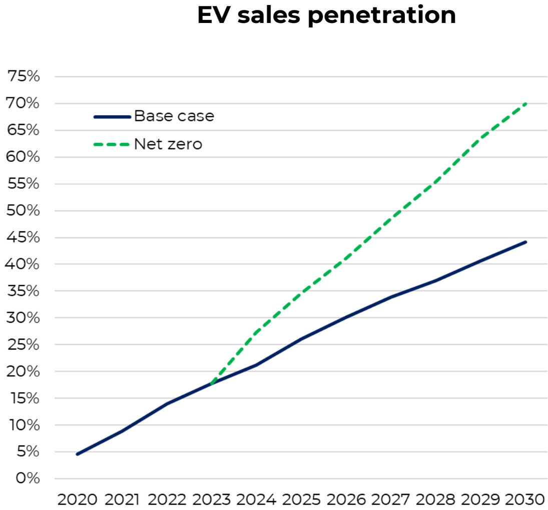
Greater residential adoption of heat pumps and electric vehicles leads us to expect that **distribution** will attract a higher proportion of the investment than transmission. Heat pumps and EVs increase residential electricity demand by c.90% and c.50% respectively. Moreover, the addition of EVs requires 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.

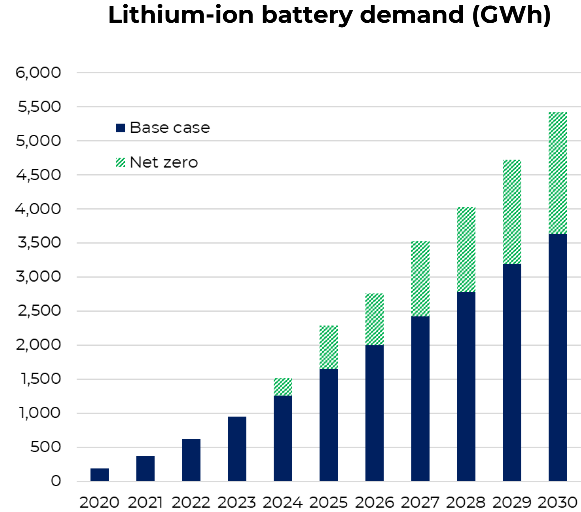
- The continued adoption of renewables, characterised by smaller and more distributed power plants, will drive demand for more **transmission** lines. We see transmission investment enjoying a further tailwind from the building of more interconnectors to facilitate the international trade of electricity. 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.





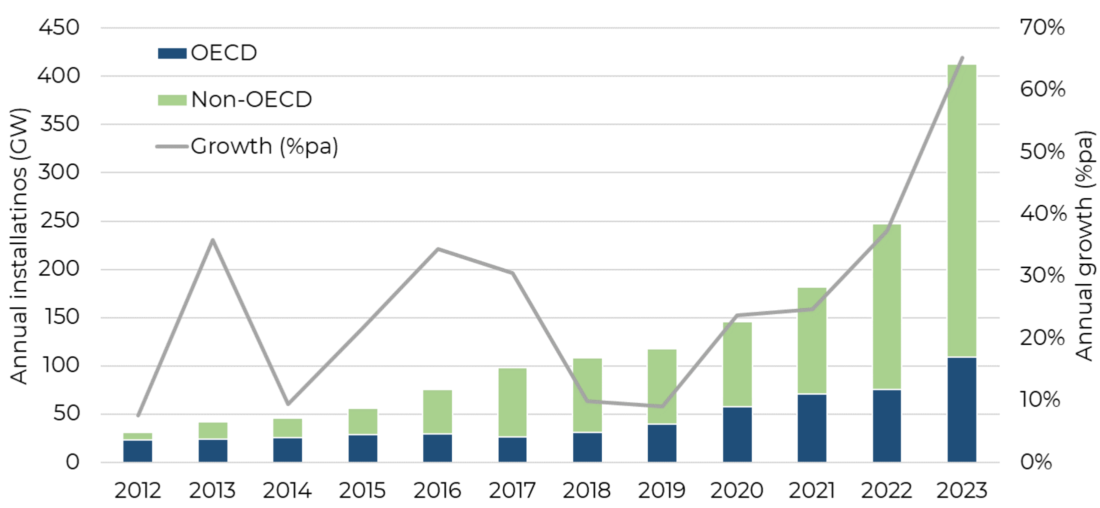
Source: BNEF, Guinness Global Investors, December 2023

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



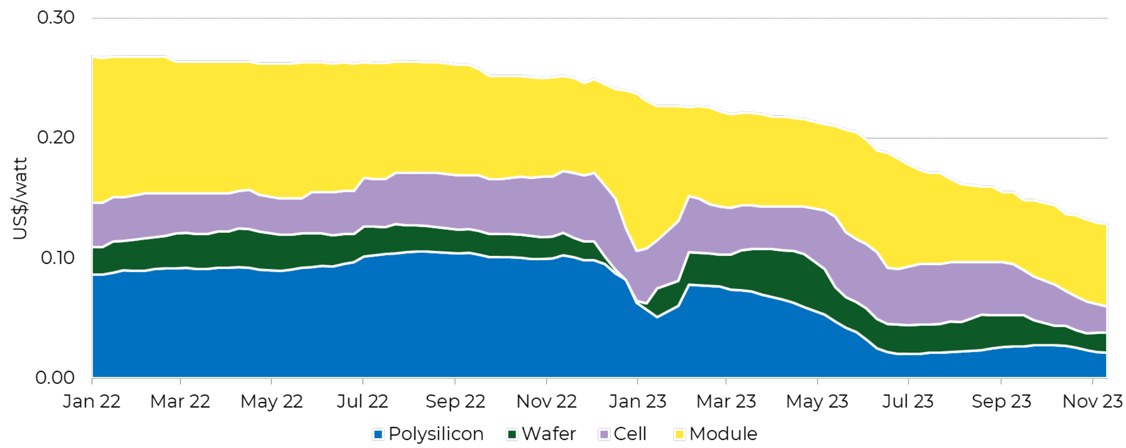
Source: BP, BNEF, PV InfoLink, IEA and Guinness Global Investors estimates, December 2023

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).

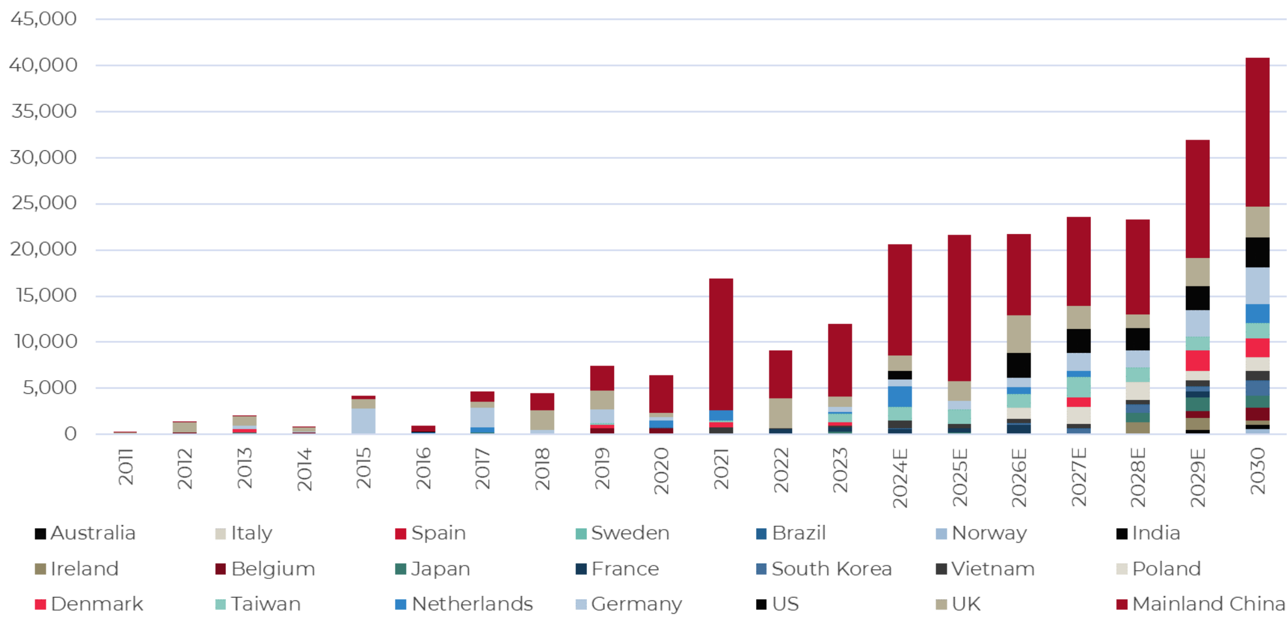
In the US, the combination of cost pressures and the lack of clarity on the IRA tax credits has caused a temporary lull in activity meaning installations are likely to be down in 2023. That said, the US Treasury has now provided finalised guidance for the wind industry, and we are beginning to see rising 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.

Offshore wind installations (MW)



Source: BNEF, Guinness Global Investors estimates, December 2023

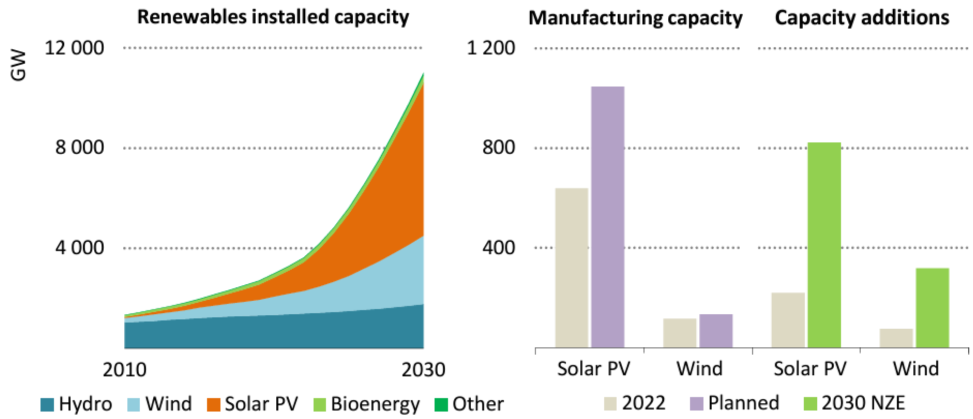
Implications of a net zero scenario on our solar and wind outlook

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

Documentation
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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WS GUINNESS SUSTAINABLE ENERGY FUND

Documentation
The documentation needed to make an investment, including the Prospectus, the Key Investor Information Document (KIID) and the Application Form, is available in English from www.waystone.com/our-funds/waystone-fund-services-uk-limited/ or free of charge from Waystone Fund Services (UK) Limited, 64 St James's Street, Nottingham, NG1 6FJ. General enquiries: 0115 988 8200. Dealing Line: 0115 988 8285.
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