The Guinness Sustainable Energy Report

Developments and trends for investors in the global energy sector

This is a marketing communication. Please refer to the prospectus and KIID for the Fund, which contain detailed information on the Fund's characteristics and objectives, before making any final investment decisions. Past performance does not predict future returns.

November 2022

GUINNESS SUSTAINABLE ENERGY FUND

The Guinness Sustainable Energy Fund is managed for capital growth and invests 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 Fund is run by co-managers Will Riley and Jonathan Waghorn, supported by Jamie Melrose (analyst). The investment philosophy, methodology and style which characterise the Guinness approach have been applied to the management of various energy equity portfolios at Guinness since 1998.

RISK

The Guinness Sustainable Energy Fund is an equity fund. 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 Fund invests only in companies involved in the energy sector; it is therefore susceptible to the performance of that one sector, and can be volatile. Details on the risk factors are included in the Fund's documentation, available on our website.

◀ Lower risk		Risk & reward				Higher risk ▶
1	2	3	4	5	**6**	7
Typically lower rewards					Typically higher rewards	

The risk and reward indicator shows where the fund ranks in terms of its potential risk and return. The Fund has been classed as 6 because its volatility has been measured as above average to high. This is based on how investments have performed in the past and you should note that the fund may perform differently in the future and its rank may change. Historic data may not be a reliable indicator for the future.

UPDATE ON THE SOLAR SECTOR

Solar power generation has become relatively more economic during 2022 as module prices have remained broadly flat while competing gas and coal-fired generation costs have inflated sharply. Reflecting the improvement, solar installations in 2022 are likely to be around 260 GW, much higher than our initially expected level of 200 GW, with further growth of around 50 GW likely in 2023. The longer-term outlook has also improved with expectations that we could see somewhere around 500 GW of installations per year by the end of the decade. Despite this rapid expansion, the solar industry must grow even more to be aligned with our net zero scenario.

EQUITIES

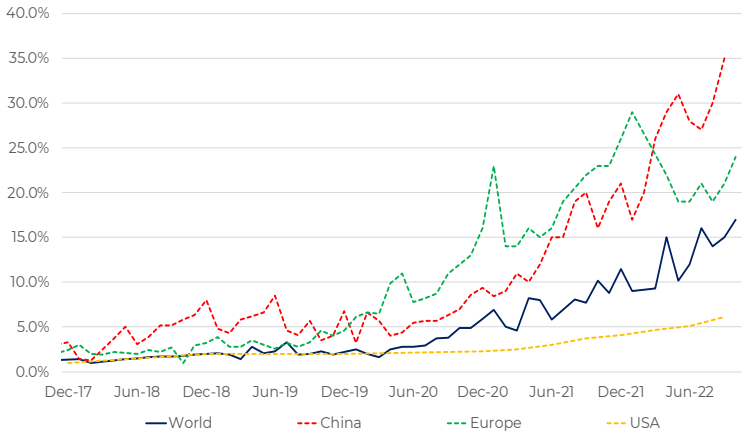
Sustainable energy equities underperformed in weaker global stock markets in October. The Guinness Sustainable Energy Fund (Class Y) delivered a return of +6.0% (in USD), behind the MSCI World at +7.2%. Year-to-date, the Guinness Sustainable Energy Fund (Class Y) has delivered -16.9% (in USD), versus the MSCI World at -20.1%. Full performance details are available in Section 3.

CHART OF THE MONTH

End of September data shows monthly global plug-in vehicle sales grew over 50% year-on-year, breaking one million units for the first time ever. Plug-in hybrids and battery electric vehicles made up 17% of auto sales, with pure electric vehicles taking 13% share. On a regional basis, September saw China's plug-in share hit 35%, followed by Europe at 24%. The US, which reports quarterly, lags with EVs making up just over 6% of unit sales in the third quarter of 2022.

Plug-in electric vehicle monthly market share

(Source: Cleantechnica. Data to 30.09.2022)



Signatory of:

PRI Principles for Responsible Investment

Contents

1. OCTOBER 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
The EU has reached a deal to effectively ban new internal combustion-engine (ICE) cars from 2035. The EU's three key institutions – its executive arm, the parliament and member states – reached a deal last week that will require carmakers to reach a zero-emission target by 2035. The agreement is related to the EU's "Fit for 55", requiring a 55% cut in emissions this decade, as the EU sets a course to reach climate neutrality by 2050.	ICE vehicles	
US residential solar installations have risen by 40% year-on-year according to consultancy Wood Mackenzie. American homeowners are adding a record number of solar panels to their rooves to help combat higher energy bills, with the EIA forecasting home electricity prices to rise by over 7% this year. Solar panels are increasingly being paired with back-up batteries to help combat extreme weather induced blackouts such as those seen in Florida, where Hurricane Ian knocked out power to 2.6m customers.	Solar generation	
Using hydrogen to heat homes would add 70% to energy bills according to energy analysts Cornwall Insight. They claim that "while hydrogen does have a part to play in the decarbonisation pathway... it is simply uneconomical to use 100% hydrogen fuel for heating our homes". Michael Liebreich, chair of Liebreich Associates and founder of Bloomberg New Energy Finance, claims that heating with hydrogen made using renewable energy is 6x less efficient than using the same electricity in a heat pump.	Heat pumps	
Benchmark Mineral Intelligence reported that lithium prices in China hit an all-time high as electric vehicle and battery manufacturers rushed to secure supplies. Prices for Lithium hydroxide, used in higher energy density batteries, have increased by nearly 150% off the back of faster than expected EV adoption.	Lithium demand	
The IEA published its World Energy Outlook for 2022. For the first time, planned investments in renewables and energy efficiency (Inflation Reduction Act, RePowerEU) in response to the Ukraine crisis are forecast to result in demand for every fossil fuel peaking or plateauing out to 2050. The share of fossil fuels in the global energy mix in the Stated Policies Scenario falls from 80% to 60% by 2050. However, if current growth rates for sustainable technologies are maintained, this would imply a much faster transition.	Energy transition	

2. MANAGER'S COMMENTS

Update on the solar sector

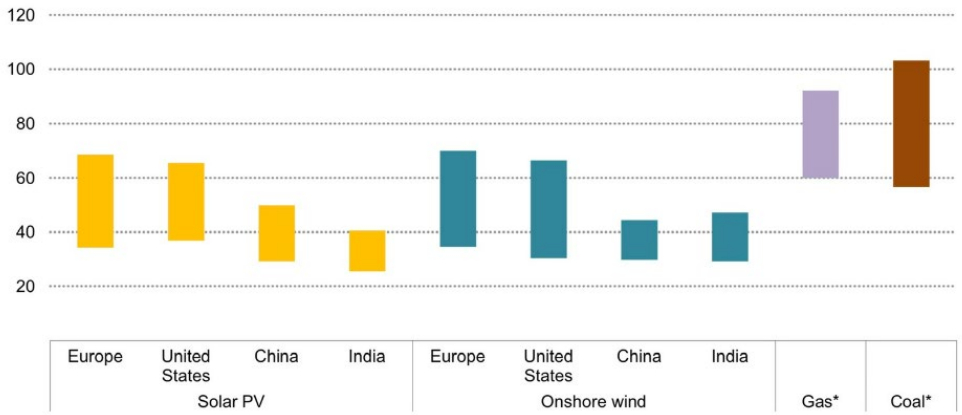
Solar power generation has become relatively more economic during 2022 as module prices have remained broadly flat while competing gas and coal-fired generation costs have inflated sharply. Reflecting the improvement, solar installations in 2022 are likely to be around 260 GW, much higher than our initially expected level of 200 GW, with further growth of around 50 GW likely in 2023. The longer-term outlook has also improved with expectations that we could see somewhere around 500 GW of installations per year by the end of the decade. Despite this rapid expansion, the solar industry must grow even more to be aligned with our net zero scenario.

Update on relative economics of solar

The relative economic attractiveness of solar power generation has continued to improve in 2022. On the one hand, the structural story of cost deflation that we have witnessed for a number of years has stalled as a result of cyclical raw material, energy and logistics cost inflation. But, on the other hand, industry growth has brought improved economies of scale, plus the relative economics of solar versus hydrocarbons continues to improve thanks to inflation in competing fossil fuel generation. According to the IEA, the levelized cost of electricity generation (LCOE) for solar in 2022 sits comfortably below competing fossil fuel-based options, meaning that solar is typically the most economic option for new supply that can also help to alleviate energy security concerns.

LCOE (USD/MWh) of utility solar and wind vs competing fossil fuels (2022E)

*Source: IEA estimates. Data sourced 30.06.2022, * Refers to same regions within the figure: Europe, United States, China and India*



Solar installations in 2022 and 2023

Solar's improved relative economics and the increased need for security of supply mean that installations in 2022 are likely to be around 260 GW, substantially higher than the 200 GW estimate that we made at the start of the year. With momentum strong, especially following the US Inflation Reduction Act (IRA) and the RePowerEU deals, we introduce an estimate for 2023 module demand of 310 GW, another record year for global installations, with growth of 50 GW versus 2022.

Regionally, the key moving parts in 2022 and 2023 are as follows:

- In the **United States** we initially expected installations in 2022 (20 GW) to be lower than 2021 (30 GW) as a result of i) the Withhold Release Order (WRO) placed on various solar product imports from China, ii) concerns around the level of residential solar support coming from a clean energy infrastructure bill and iii) the impact of new net metering rules (NEM3.0) in California which reduce the attractiveness of solar economics for residential consumers. Actual installations in 2022 are now likely to be around 25 GW as NEM3.0 appears to be less of a threat (although it is still unresolved) and the WRO has not been as negative as initially

feared. While the passing of the IRA in 2022 is a clear positive for solar, we expect the effect of the bill to be felt only from 2023 and for it to be spread over a number of years, with installations reaching the 2021 peak of 30 GW again in 2023 and growing thereafter.

- Demand in **Europe** is expected to be around 45 GW in 2022, up from 24 GW in 2021, as the region reacted to higher fossil fuel generated electricity prices (as a result of lower Russian natural gas imports) and the need for energy security. It is here that the relative economics of solar have improved the most, and the RePowerEU deal has already started to incentivise new demand for solar installations. According to BNEF, Europe imported $2.5bn of Chinese PV products in July 2022, up $1.5bn on the level from July 2021. Looking to 2023, we see further installation increases, with Europe reaching a new record of 62 GW spread well across an increasing number of countries, leading to substantially more growth in future years.

- In **China** module demand is also likely to beat our initial estimates, reaching 95 GW in 2022 (up 30 GW on 2021) as first half 2022 installations of 40 GW were more than double the levels seen in 1H 2021. Growth has come across utility, residential and commercial and we note plans for the development of significant offshore utility scale plants in 2023. As with Europe, higher power prices have been a key factor in driving stronger demand. In mid-2022, China published its 14th five year plan for renewables which suggested that solar (and wind) installations in 2021-2025 should be double the levels seen in 2015-2020. Accordingly, we expect China will see more growth in 2023, reaching around 115 GW, double the levels seen in 2020/2021, and representing around 37% global market share.

- The rest of the **non-OECD** has also seen greater than expected growth in demand, reaching around 60 GW in 2022 (up 23 GW on 2021 levels) with demand increases well spread across Latin America (especially Brazil), African and Middle Eastern countries. Indian installations look particularly impressive, but activity has been front-end loaded in response to a new import tax policy that places a 40% surcharge on imported panels from April 2022.

Considering all these factors, we believe that installations could exceed 300 GW in 2023 and are potentially biased higher, with the non-OECD (at 195 GW) still dominating with a 63% market share.

Global solar module installations, 2010-2023E (GW)

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

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022E	2023E
OECD solar installations (annual)														
North America	1	2	4	6	7	8	14	11	10	11	19	30	23	30
Germany	7	7	8	3	2	1	2	2	4	4	5	5	8	11
Spain	0	0	0	0	0	0	0	0	0	5	3	4	7	9
Rest of Europe	3	4	5	5	5	6	4	3	4	6	8	15	30	42
Australia	0	1	1	1	1	1	1	2	4	4	4	5	6	8
South Korea	0	0	0	1	1	1	1	1	2	3	4	4	5	6
Japan	1	1	2	7	10	11	8	8	7	7	9	7	9	9
Total OECD	**17**	**23**	**24**	**24**	**25**	**29**	**29**	**26**	**31**	**40**	**51**	**70**	**88**	**115**
Change in OECD annual installations	*10*	*7*	*0*	*0*	*2*	*4*	*0*	*-3*	*5*	*9*	*11*	*19*	*18*	*27*
Non-OECD solar installations (annual)														
China	0	3	3	14	13	19	30	53	44	33	52	65	95	115
India	0	0	1	1	1	2	5	10	11	12	4	12	17	18
Rest of non-OECD	1	3	3	4	6	6	11	9	22	34	37	37	60	62
Total Non-OECD	**2**	**5**	**8**	**18**	**21**	**27**	**46**	**72**	**77**	**78**	**93**	**114**	**172**	**195**
Change in non-OECD annual installations	*1*	*3*	*2*	*11*	*2*	*6*	*19*	*26*	*5*	*1*	*15*	*21*	*58*	*23*
Total solar installations (annual)	**19**	**29**	**31**	**42**	**46**	**56**	**75**	**98**	**108**	**118**	**144**	**184**	**260**	**310**
Change in world annual installations	*11*	*10*	*2*	*11*	*4*	*10*	*19*	*23*	*10*	*10*	*26*	*40*	*76*	*50*

Solar supply chain in 2022 and 2023

All parts of the solar module manufacturing chain, except polysilicon, appear to have been in oversupply again in 2022 and are likely remain so in 2023. We treat nameplate capacity estimates here with some caution because technological advances and cost improvements can bring rapid capacity obsolescence, meaning that actual supply may well be lower than nameplate capacity.

Nonetheless, significant new manufacturing capacity is planned across the entire value chain which will likely bring lower module prices and will likely help to support global solar module demand.

- **Polysilicon** is a key raw material for a solar wafer. The poly market continued to be the tightest part of the solar market in 2022, evidenced by prices rising through the year to reach nearly $40/kg in August. Poly prices have been high enough over the past two years to incentivise new supply and we can now see signs that the new supply is on the cusp of arrival. BNEF estimates that the capacity of the polysilicon industry rose to 900 Mt pa in 2022 (sufficient to support over 300 GW of solar module manufacturing) but that new capacity additions of nearly 2,500 Mt pa are being planned by either existing players or new entrants. While a number of plants will not be built, and many will take longer than expected to reach full production capacity, the scale of capacity growth leads us to believe that poly prices and associated margins for poly producers will fall in 2023 and beyond, allowing margin expansion elsewhere in the value chain as well as lower solar module prices.

- **Wafer and solar cell** manufacturing capacity, according to PV InfoLink, will reach 583 GW in Q4 2022 and to grow a further 15% in 2023. In 2022, wafer and cell companies have generally been able to pass through cost inflation and to defend reasonable margins but, similar to polysilicon, this may come under pressure in 2023 as new capacity is added. Unlike polysilicon however, the wafer business is highly concentrated, with nearly 80% of 2022 wafer capacity in the hands of the five largest producers. This may be a factor to help support prices in 2023. A consideration slightly longer-term will be the rate at which demand moves from p-type wafers to n-type wafers (with greater efficiency and lower degradation) and how this might cause some existing wafer and cell manufacturing capacity to become obsolete, effectively leaving this part of the market tighter than initially apparent.

- **Solar module** prices have moderated so far in 2022, down to around US$0.25/W currently, and are likely to average in 2022 the levels seen in 2021. With elevated polysilicon and power prices, it is the module manufacturers that have suffered the greatest margin compression so far in 2022. Module manufacturing nameplate capacity in 2022 is estimated to be around 470 GW, of which around 310 GW is newer 'Tier 1' capacity with lower costs resulting from the scale of manufacturing and new technologies. In 2023, this likely expands to 660 GW and potentially to as high as 820 GW by the end of the year.

Polysilicon and solar module pricing

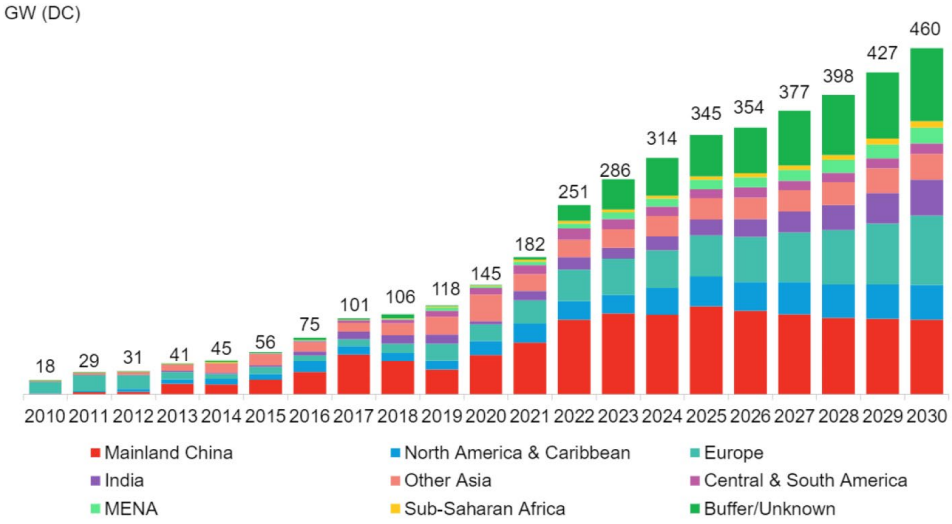
source: Bloomberg

Long-term solar outlook

The long-term outlook for solar has improved since the start of the year. In August, BNEF updated its long-term projections, increasing its 2030 module installation forecast to 460 GW from the prior year's forecast of 334 GW, an increase of 37%. The impact of the increase is that a total of 3.4 TW of solar is forecast to be installed globally this decade (up 0.8 TW, or 30%, on the previous forecast) with total capacity in 2030 being 4.2 TW (versus prior estimate of 3.4 TW).

Global solar module installations, mid case, 2010-2030E (GW)

Source: BNEF August 2022 projections



With COP27 coming up next month, it is worth considering the solar industry's growth profile in the context of a net zero or 1.5° warming target. In BNEF's net zero scenario, total installed solar capacity would need to be around 5.3 TW by 2030 (25% higher than their base case forecast of 4.2 TW). For comparison, the Guinness net zero scenario indicates that total installed capacity would need to be 5.4 TW in 2030 (a compound growth rate of 18%pa from 2021) and that reaching this level of installed capacity would require annual installations to be around 650 GW pa. While solar is a key and well-placed component of any net zero energy transition scenario, the industry still has to deliver more growth in order to be fully aligned.

We believe that the outlook for the solar industry on both a near-term and long-term basis remains very robust. Near-term cost and supply issues are being worked through and we see good reason to believe that the price of polysilicon, and consequently the price of solar modules, will fall as new manufacturing capacity comes online. We believe that underlying economics will win through, and that solar will gain increasing market share of global electricity generation (supported by storage technologies) with it becoming more dominant than coal-fired power generation in around 10 years' time.

3. PERFORMANCE

Past performance does not predict future returns.

The Guinness Sustainable Energy Fund (Class Y, 0.68% OCF) delivered a return of +6.0% in the month, while the MSCI World Index (net return) delivered +7.2% (all in USD terms).

	Ytd	1 Yr	3 Yrs	5 Yrs*	10 Yrs*
Fund (Class Y)	-16.9%	-20.7%	87.3%	88.4%	178.2%
MSCI World NR Index	-20.1%	-18.5%	19.5%	36.2%	135.3%
Out/Underperformance	*3.2%*	*-2.2%*	*67.9%*	*52.2%*	*42.9%*

Annual performance	2021	2020	2019	2018*	2017*
Fund (Class Y)	10.4%	84.1%	31.4%	-15.2%	20.2%
MSCI World NR Index	21.8%	15.9%	27.7%	-8.7%	22.4%
Out/Underperformance	*-11.4%*	*68.2%*	*3.7%*	*-6.5%*	*-2.2%*

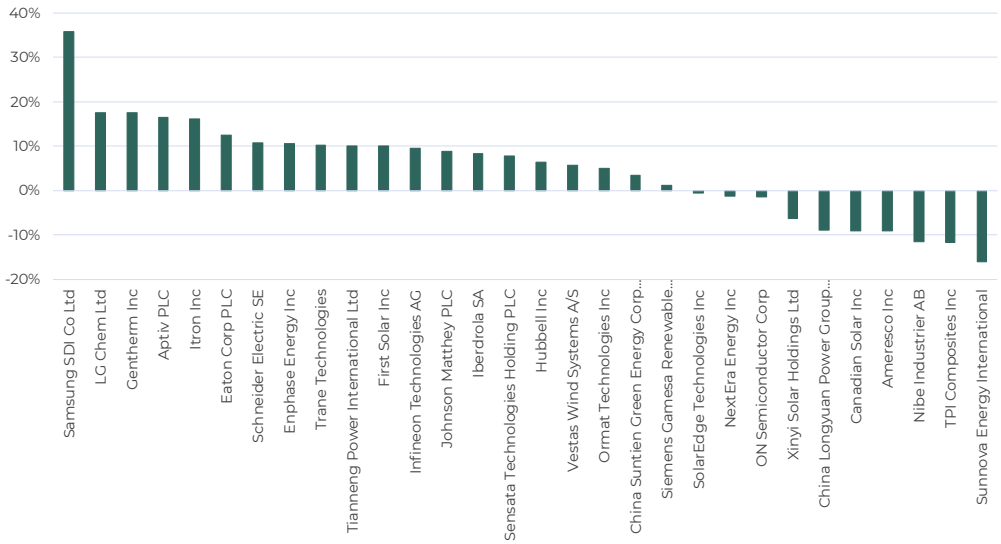
Annual performance	2016*	2015*	2014*	2013*	2012*
Fund (Class Y)	-15.4%	-12.0%	-12.1%	70.8%	-13.2%
MSCI World NR Index	7.5%	-0.9%	4.9%	26.7%	15.8%
Out/Underperformance	*-23.0%*	*-11.2%*	*-17.0%*	*44.1%*	*-29.1%*

*The Guinness Sustainable Energy 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%. Source: Financial Express, bid to bid, total return.*

Investors should note that fees and expenses are charged to the capital of the fund. This reduces the return on your investment by an amount equivalent to the Ongoing Charges Figure (OCF). The fund performance shown has been reduced by the current OCF of 0.68% per annum. Returns for share classes with different OCFs will vary accordingly. Performance returns do not reflect any initial charge; any such charge will also reduce the return.

Within the Fund, the strongest performers were Samsung SDI, LG Chem, Gentherm, Aptiv and Itron. The weakest performers were Sunnova, TPI Composites, Nibe, Ameresco and Canadian Solar.

Stock by stock performance over the month, in USD

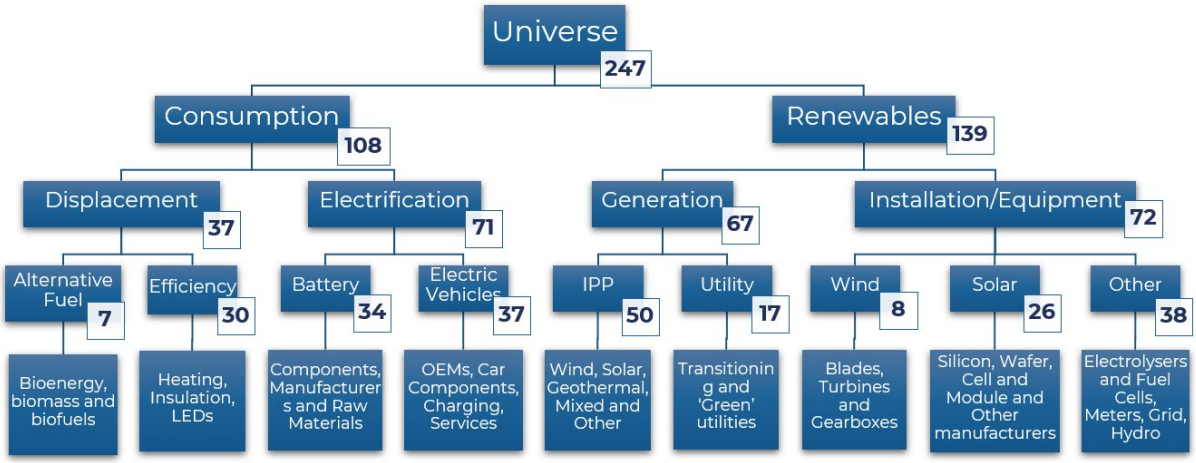


Source: Bloomberg. As of 31 October 2022

4. 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 pureplay 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 an equally weighted portfolio of 30 stocks. The portfolio is designed to create a balance between maintaining fund concentration and managing stock-specific risk.

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

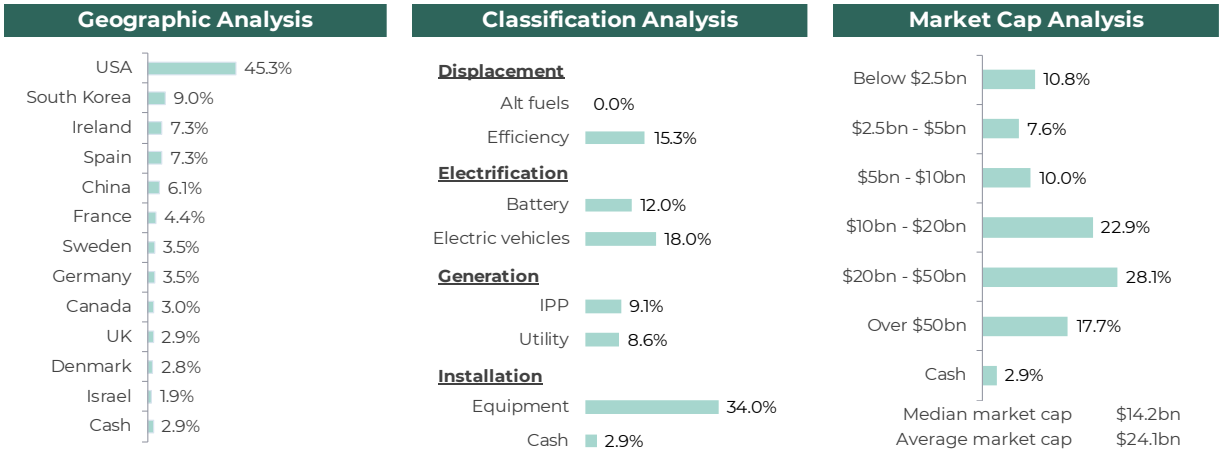
Signatory of:

PRI Principles for Responsible Investment

Buys/Sells

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

Portfolio structure analysis



Source: Guinness Global Investors

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	Year end	Previous year ends	
	Oct-22		Dec-21	Dec-20	Dec-19	Dec-18
Consumption	**45.3%**	***1.9%***	**43.4%**	**36.7%**	**41.7%**	**26.5%**
Displacement	15.3%	*3.5%*	11.8%	9.9%	13.4%	16.4%
Alternative Fuel	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*3.9%*
Efficiency	*15.3%*	*3.5%*	*11.8%*	*9.9%*	*13.4%*	*12.5%*
Electrification	30.1%	*-1.6%*	31.6%	26.8%	28.2%	10.1%
Batteries	*12.0%*	*3.2%*	*8.9%*	*10.8%*	*12.6%*	*3.9%*
Electric vehicles	*18.0%*	*-4.7%*	*22.8%*	*16.0%*	*15.7%*	*6.2%*
Renewables	**51.7%**	***0.4%***	**51.3%**	**60.4%**	**54.1%**	**69.7%**
Generation	17.8%	*-5.4%*	23.1%	24.6%	22.2%	27.3%
IPP	*9.1%*	*-5.4%*	*14.5%*	*17.0%*	*18.9%*	*26.7%*
Utility	*8.6%*	*0.0%*	*8.6%*	*7.6%*	*3.2%*	*0.6%*
Installation	34.0%	*5.8%*	28.2%	35.8%	32.0%	42.5%
Equipment	*34.0%*	*5.8%*	*28.2%*	*35.8%*	*32.0%*	*42.5%*
Cash	2.9%	*-2.3%*	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 October 2022	P/E			EV/EBITDA			Dividend Yield		EPS Growth (%pa)		CFROI*	
	2022	2023E	2024E	2022	2023E	2024E	2023E	2024E	2014-21	2021-24	2022E	2023E
Guinness Sustainable Energy Fund	22.2x	18.4x	15.0x	13.7x	11.3x	9.6x	1.7%	1.8%	5.0%	19.1%	5.5%	6.6%
MSCI World Index	15.4x	14.6x	13.6x	10.4x	10.2x	9.7x	2.4%	2.5%	6.6%	7.6%	8.0%	8.3%
Fund Premium/(Discount)	*44%*	*26%*	*10%*	*32%*	*11%*	*-1%*						

*Portfolio = median CFROI; Index data = Credit Suisse MSCI World ETF median CFROI

Source: Guinness Global Investors, Bloomberg

Portfolio holdings as at end October 2022

Our portfolio is typically allocated across 30 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 (12%) or the electrification of transportation (18% weight) while we have 15% 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 large Korean chemicals company that is a top 3 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 five 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 and Infineon are providers of power semiconductors 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, Trane Technologies), 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 18% weight to companies involved in the generation of sustainable energy and 34% 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 around a third of our generation exposure. The remaining exposure comes in the form of geothermal (Ormat), US residential solar (Sunnova) and then broad-based wind/solar renewable energy generation through 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 and Siemens Gamesa are both well placed providers of wind turbines in the world providing 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) gives exposure to companies that provide equipment and services to improve the efficiency and metering of electricity transmission and consumption.

Portfolio themes as at end October 2022

	Theme	Example holdings	Weighting (%)
1	Electrification of the energy mix		20.6%
2	Rise of the electric vehicle and auto efficiency		21.0%
3	Battery manufacturing		9.1%
4	Expansion of the wind industry		10.2%
5	Expansion of the solar industry		16.9%
6	Heating, lighting and power efficiency		15.3%
7	Geothermal		4.1%
8	Other (inc cash)		2.9%

Portfolio at end September 2022 (one month in arrears for compliance reasons)

Guinness Sustianable Energy Fund (30 September 2022)				P/E			EV/EBITDA			Price/Book			Dividend Yield		
Stock	ISIN	% of NAV	Market Cap USD	2022	2023E	2024E	2022	2023E	2024E	2022	2023E	2024E	2022	2023E	2024E
Displacement/Efficiency															
Hubbell Inc	US4435106079	4.8%	11,970	22.7x	21.2x	19.3x	16.1x	15.1x	13.7x	5.1x	4.7x	4.6x	1.9%	2.1%	2.2%
Nibe Industrier AB	SE0015988019	4.1%	18,161	49.5x	42.7x	37.7x	29.4x	26.0x	23.1x	7.7x	6.8x	6.0x	0.6%	0.7%	0.7%
Trane Technologies PLC	IE00BK9ZQ967	3.7%	33,555	20.4x	18.5x	16.7x	14.1x	13.3x	12.6x	6.2x	6.2x	5.1x	1.8%	1.9%	2.0%
Ameresco Inc	US02361E1082	3.8%	3,446	35.2x	31.9x	25.7x	19.9x	18.3x	14.9x	4.3x	3.8x	3.3x	n/a	n/a	n/a
		16.4%													
Electrification/Battery															
LG Chem Ltd	KR7051910008	3.7%	26,324	15.5x	12.3x	9.8x	5.9x	4.9x	4.1x	1.3x	1.2x	1.1x	1.9%	2.1%	2.3%
Samsung SDI Co Ltd	KR7006400006	4.0%	26,121	22.6x	18.8x	15.3x	12.8x	10.4x	8.6x	2.3x	2.0x	1.8x	0.2%	0.2%	0.2%
Johnson Matthey PLC	GB00BZ4BQC70	2.8%	3,742	7.8x	9.5x	8.9x	4.9x	6.0x	5.7x	1.2x	1.3x	1.3x	4.7%	4.2%	4.4%
Tianneng Power International Ltd	KYG8655K1094	0.1%	984	3.6x	3.0x	2.7x	1.7x	1.5x	1.5x	0.5x	0.4x	0.4x	7.2%	9.2%	9.7%
		10.6%													
Electrification/Electric Vehicles															
Aptiv PLC	JE00B783TY65	3.2%	21,190	24.3x	15.1x	11.2x	10.1x	7.6x	6.4x	2.5x	2.2x	1.9x	0.1%	0.4%	0.6%
ON Semiconductor Corp	US6821891057	4.4%	27,004	12.1x	12.4x	11.8x	8.1x	8.4x	8.1x	4.3x	3.4x	2.7x	n/a	n/a	n/a
Infineon Technologies AG	DE0006231004	3.3%	29,035	11.9x	11.9x	11.0x	7.2x	7.0x	6.3x	2.2x	1.9x	1.7x	1.4%	1.6%	1.8%
Sensata Technologies Holding PLC	GB00BFMBMT84	3.6%	5,788	11.1x	10.0x	8.0x	9.4x	8.6x	7.5x	1.9x	1.6x	1.4x	0.9%	1.2%	1.1%
Gentherm Inc	US37253A1034	2.8%	1,649	26.9x	13.9x	10.3x	13.3x	8.7x	6.5x	n/a	n/a	n/a	n/a	n/a	n/a
		17.3%													
Generation/IPP															
China Longyuan Power Group Corp Ltd	CNE100000HD4	2.4%	16,513	10.5x	8.4x	7.4x	10.6x	8.8x	7.7x	1.1x	0.9x	0.8x	1.8%	2.3%	2.6%
Ormat Technologies Inc	US6866881021	4.2%	4,821	66.2x	44.8x	36.5x	14.4x	12.0x	10.8x	2.5x	2.3x	2.2x	0.6%	0.6%	0.6%
NextEra Energy Inc	US65339F1012	4.8%	154,058	27.3x	25.2x	23.2x	19.2x	16.2x	14.8x	3.6x	3.3x	3.2x	2.2%	2.4%	2.6%
Sunnova Energy International I	US86745K1043	1.7%	2,532	n/a	n/a	n/a	58.1x	36.8x	24.8x	1.4x	1.1x	1.0x	n/a	22.6%	22.6%
China Suntien Green Energy Corp Ltd	CNE100000TW9	1.5%	3,922	4.7x	4.1x	3.6x	10.2x	9.0x	7.7x	0.5x	0.5x	0.4x	7.1%	8.2%	9.3%
		14.6%													
Generation/Utility															
Iberdrola SA	ES0144580Y14	4.1%	59,681	14.6x	13.2x	12.6x	10.8x	9.9x	9.4x	1.4x	1.3x	1.3x	4.9%	5.2%	5.5%
		4.1%													
Installation/Equipment															
Schneider Electric SE	FR0000121972	4.1%	65,381	16.4x	15.2x	13.9x	12.0x	11.3x	10.6x	2.5x	2.3x	2.1x	2.6%	2.9%	3.1%
Eaton Corp PLC	IE00B8KQN827	4.5%	53,117	17.7x	16.1x	14.8x	14.6x	13.4x	12.7x	3.1x	3.0x	2.8x	2.4%	2.5%	2.7%
Itron Inc	US4657411066	2.7%	1,901	51.9x	18.8x	12.6x	23.6x	11.8x	8.4x	1.7x	1.6x	1.4x	n/a	n/a	n/a
Xinyi Solar Holdings Ltd	KYG9829N1025	2.4%	9,417	15.8x	11.8x	9.1x	11.4x	8.5x	6.8x	2.2x	2.0x	1.8x	2.9%	4.0%	5.0%
SolarEdge Technologies Inc	US83417M1045	2.1%	12,877	41.8x	25.4x	20.0x	33.1x	20.2x	16.4x	6.1x	4.9x	4.0x	n/a	n/a	n/a
Enphase Energy Inc	US29355A1079	3.8%	37,585	68.1x	55.7x	45.1x	55.9x	42.8x	34.3x	51.0x	26.5x	14.8x	n/a	n/a	n/a
First Solar Inc	US3364331070	4.8%	14,099	n/a	50.2x	18.0x	65.9x	25.9x	14.5x	2.4x	2.2x	1.9x	n/a	n/a	n/a
Canadian Solar Inc	CA1366351098	3.8%	2,390	15.4x	8.7x	7.4x	7.1x	5.0x	4.2x	1.0x	0.9x	0.8x	n/a	n/a	n/a
Vestas Wind Systems A/S	DK0061539921	2.8%	18,830	n/a	48.1x	22.8x	56.4x	13.2x	9.3x	5.0x	4.6x	4.0x	0.2%	0.6%	1.2%
Siemens Gamesa Renewable Energy SA	ES0143416115	3.3%	11,953	n/a	n/a	46.4x	n/a	27.4x	13.1x	3.3x	3.6x	3.3x	n/a	n/a	0.4%
TPI Composites Inc	US87266J1043	0.6%	421	n/a	n/a	12.5x	17.9x	9.2x	5.6x	2.1x	2.0x	1.9x	n/a	n/a	n/a
		34.9%													

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.

5. OUTLOOK - sustainable energy & the energy transition

Sustainable energy: the long-term outlook

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

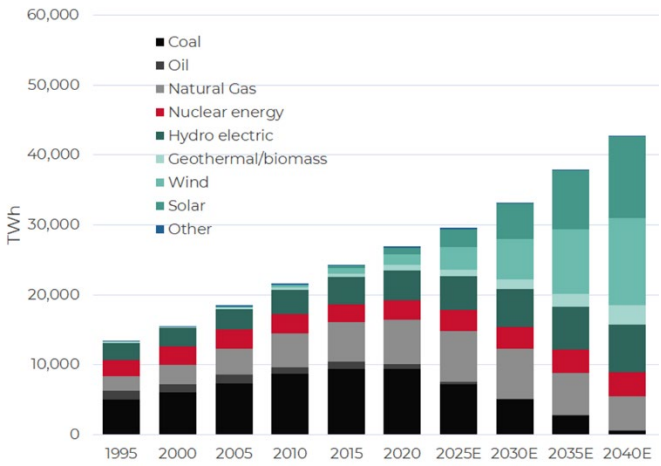
- **Population and GDP growth** putting a significant strain on today's energy supply
- **Economics** as sustainable sources of energy will be cheaper than the incumbents
- **Climate change** leading the world to reduce carbon emissions via cleaner energy
- **Pollution** forcing governments to drive 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.

Within the power generation industry, we expect a radical change in energy mix. Today, the global power mix is predominantly driven by coal and natural gas (35% and 24% respectively), whilst variable renewable generation (wind and solar) have less than a 10% share. By 2035, we expect wind and solar to have grown to around 40% of the generation mix, increasing to around 60% by 2050.

Global power generation by type (TWh, 1995-2040E)



Sources: BP Statistical Review; IEA: Guinness Global Investors estimates; as of 31.12.2021

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 the recent period include:

- **President Biden returning the US to the Paris Agreement** and announcing significantly increased 2030 GHG reduction targets. The new target - a 52% reduction in emissions by 2030 (vs 2005 levels) - was substantially ahead of the old target of a 28%

reduction by 2025.

- **The 2021 IPCC climate report.** The Intergovernmental Panel on Climate Change (IPCC) published its sixth assessment report on the physical science of climate change and the physical impacts of various carbon emission and warming scenarios

- **COP26 climate conference.** In November 2021, the COP26 climate conference was held in Glasgow. The conference produced results which we considered to be better than feared, but not as good as hoped. Key headlines included new net zero targets, additional country pledges and some 'alliances of the willing' to reduce coal usage and methane emissions.

- **Carbon pricing.** Developments in carbon pricing remain hopeful with momentum towards the introduction of emissions trading schemes (ETS) as a tool for decarbonisation. At the start of 2021, China commenced a new national ETS scheme which immediately became the world's largest carbon market (covering around 2,225 entities in the power generation industry with annual emissions of around 4,000 MtCO2e) while Canada introduced a federal carbon tax that will increase by 2030 to around US$130/tonne.

While policy towards stimulus plans continues to be positive, the passage of actual investment into the energy transition has been slower than expected and still remains a positive catalyst from here. The influential US "Build Back Better" (BBB) infrastructure package is the clearest example of the delay between policy announcement and actual investment. After it passed the House of Representatives in November, Democrat Senator Joe Manchin announced on December 19th that he would not be supporting the $1.75trn BBB bill (as currently written) thus delaying the passage of the bill through the House of Congress. A compromise bill, the Inflation Reduction Act (IRA) which includes $369bn of support for clean energy investment was passed in summer 2022 but was significantly smaller than Biden's initial proposed support package. In addition, the REPowerEU deal that was announced in March 2022 has a similar quantum of investment support but is unlikely to yield new investments until 2023/2024 and well into the second half of this decade. Both the IRA and the RePowerEU deal were direct responses to the Russian invasion of Ukraine and will both help to accelerate the energy transition.

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 de-carbonisation. 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 thirty years of around 1%pa. This assumes significant efficiency improvements relative to an historical energy demand growth rate of around 2%pa. For our base case scenario to be achieved, per capita energy demand over the next thirty years needs to stay broadly flat, whilst the energy intensity of global GDP needs to fall by around 40%.

Within the energy displacement sector, key areas of focus are **efficiency** and **alternative fuels**.

Energy efficiency

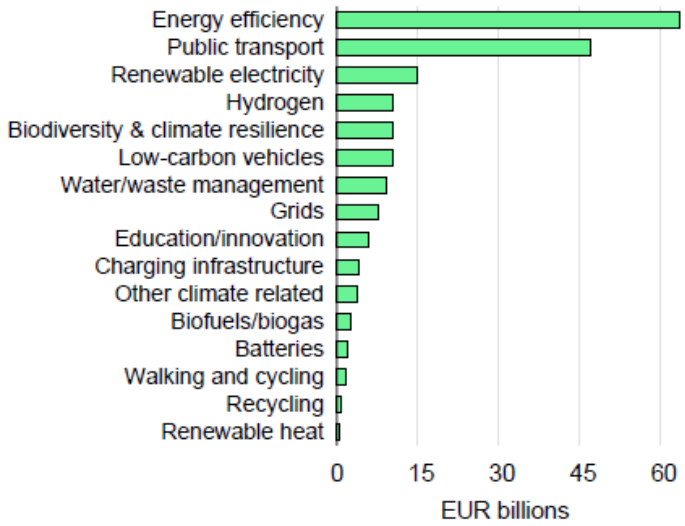
Energy efficiency measures were negatively impacted by Covid in 2020, as projects and investments were disrupted, but it appears that governments are turning their attention to efficiency measures as part of post-Covid stimulus measures. There is urgency to do this as current government policies imply that annual energy efficiency improvements need to increase by around 50% from a long-term historic 1.5%pa to a forecast level of 2.3%pa.

Energy efficiency measures are typically employment-intensive and offer a cheap form of carbon abatement. These factors help explain why the efficiency sector has received around US$144bn of stimulus spending since the start of Covid, the largest allocation within clean

energy spending globally. The renovation of public and private buildings and energy efficiency investment in the industrial sector are the largest beneficiaries of the allocated spending.

Despite the acceleration of energy efficiency spending for buildings, current spending plans will only be enough to keep total building heat consumption flat over the next few years, as per square foot efficiency gains are offset by an expanding stock of buildings.

EU Recovery and Resilience Facility (RFF) fund allocation



source: IEA World Energy Outlook 2022

Based on current government policies, the IEA estimates that energy efficiency spending needs to increase this decade from around $250bn pa to around $375bn pa, rising to $550bn in the 2030s. Within REPowerEU, the European Commission recognises that energy efficiency is the cheapest, cleanest, and quickest way to reduce the bloc's reliance on fossil fuel imports and reduce energy bills and the EU has increased energy efficiency targets from 9% to 13% accordingly.

However, current activity, plus recent subsidy announcements, are not sufficient to deliver even the IEA's base case, which is far from net zero.

Alternative fuels

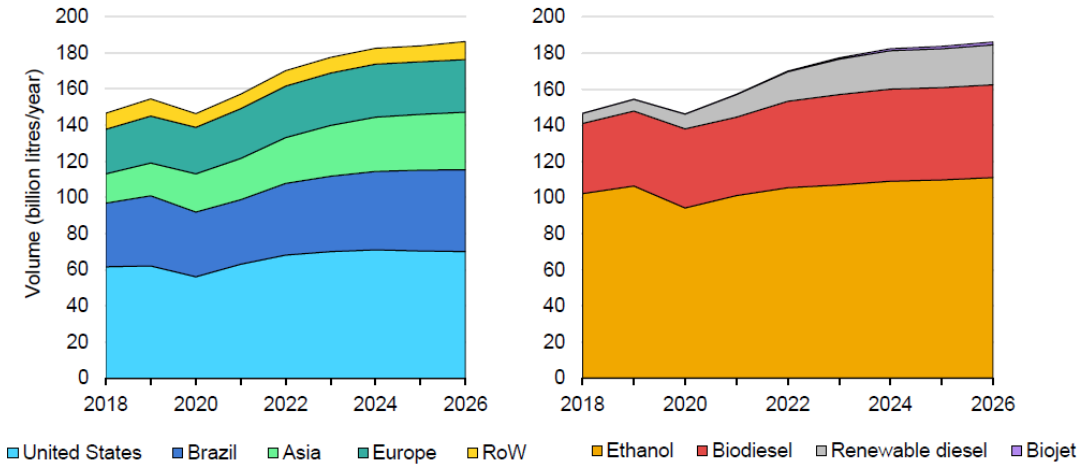
Alternative fuels such as ethanol (which displaces gasoline), biodiesel and renewable diesel (which displace conventional diesel) and Sustainable Aviation Fuels (SAF, which displace conventional jet fuel) serve a role in displacing existing fossil fuel demand, predominantly in transportation. In 2021, the global alternative fuel demand was nearly 160bn litres (over 2.5m b/day), representing nearly 3% of world oil transportation demand. The US has the largest alternative fuel market, at around 60bn litres (40% of the global market) where around 10% of all road fuel consumed is classified as alternative.

Alternative fuels consumption in 2021 grew by 10% versus 2020 and 3% versus 2019. Demand growth was significantly stronger than the underlying 6% increase in global oil demand, underlining the policy support for increased blending of alternative fuels in the transportation mix. Renewable diesel demand in the US and biodiesel demand in Asia were the biggest growth drivers. Over the next five years, alternative fuel demand is likely to grow at around 4%pa, reaching 186bn litres and continuing to outgrow global oil demand growth.

With regard to product mix, we see ethanol having the largest absolute demand growth, but its market share recedes to around 60% as demand for renewable diesel (using feedstocks such as used cooking oil, corn oil or rendered animal fats) accelerates and overtakes the current leading biodiesel technology. Combined, ethanol and renewable diesel satisfy 80% of the demand growth over the next five years.

We expect Asia to be the fastest growing market, driven for example by India's 20% ethanol blending target for 2025. However, North America will remain the largest market (40% market share) followed by Latin America (27% market share, driven by ethanol in markets like Brazil) and Asia (17% market share) and overtaking Europe (<15%).

Alternative fuel demand by region (left) and fuel (right) (2018-2026)



source: IEA World Energy Outlook 2022

On an unsubsidised basis, alternative fuels typically look expensive. Reliance on government subsidies increases the risk around the medium-term growth outlook. For example, in the US, there was significant uncertainty in 2021 around the Renewable Volume Obligation (RVO), a volume-driven subsidy. Various price-related subsidies in the US have also been volatile. In October 2021, the aggregate value of the subsidies, including Renewable Identification Numbers (RINs), Low Carbon Fuel Standards credits (LCFS) and the biodiesel Blenders Tax Credit (BTC), was around $4/gallon. With wholesale conventional diesel prices at around $2.50/gallon, it is clear how important subsidy is in delivering the growth of the biodiesel and renewable diesel industry in the US.

Electrification

The energy transition is seeing energy demand being 'electrified' as it moves away from predominantly hydrocarbon fuels and gases towards the consumption of electricity. Our 'electrification' sector includes some key enablers of this transition: the lithium-ion battery and the electric vehicle industries. The battery industry is critical here in that it will serve electric vehicles and also provide a stationary energy storage solution in electricity grids, allowing variable renewable energy (i.e. solar & wind) to play an expanding role in the global power stack.

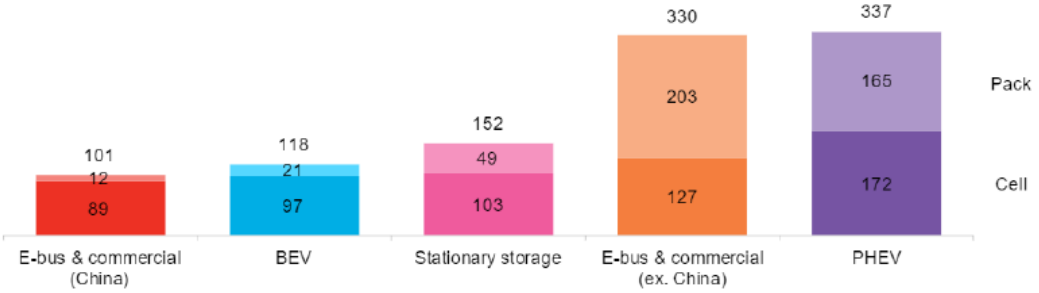
Batteries

The catalyst for greater **lithium-ion battery** use has been sharp falls in the cost of manufacturing. According to BNEF, battery pack costs are down 89% over the period 2010 to 2021 (an implied 'learning rate' of around 18%) with the average cost being $132/kWh in 2021 (split $101/kWh for the cell itself and an additional $31/kWh for the pack).

The $132/kWh survey outcome for 2021 is an average calculated across a wide range of uses and regions. China was typically the lowest-cost manufacturer with some individual passenger EV battery packs at below $100/kWh (and e-bus and commercial vehicle packs at $101/kWh on average) while BNEF calculated that Tesla's estimated average pack price in 2021 was around $112/kWh. The survey also includes stationary storage solutions which saw a fall in cost of around 16% in 2021, to $152/kWh, as manufacturers turned to simple and cheaper battery chemistries, such as lithium-ion phosphate, to offset raw material inflation.

BNEF lithium-ion battery survey 2021 ($/kWh)

source: BNEF



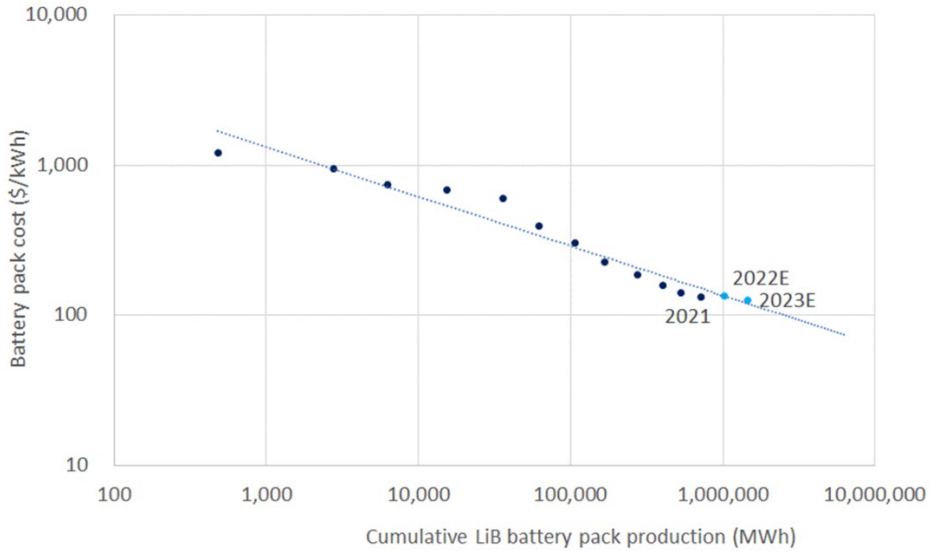
Raw materials make up around 50% of the cost of a lithium-ion battery pack, with cathode materials alone representing around 30% of the total cost. The key catalyst material is lithium carbonate, whose price in China rose by 270% in 2021. While battery manufacturers have long-term contracts and approaches in place to mitigate such inflation, they ultimately have little choice but to pass on the costs to consumers. In Q4 2021, BYD increased its battery prices by 20%.

Raw material cost inflation will continue to have an impact in 2022 and we see the likelihood that the cost of manufacturing may exceed levels seen in 2020. Rapidly increasing manufacturing capacity, (bringing further efficiencies of scale) together with reduced supply chain disruptions should help to alleviate the cost pressures in subsequent years and allow the average cost of producing a lithium-ion battery for an EV is likely to fall towards $100/kWh in the mid-2020s, somewhat later than we previously expected.

While the $100/kWh cost level is a key target, we note that in 2021 the battery and EV industry started focusing on manufacturing costs well below $100/kWh. EV manufacturers started to vertically integrate with battery manufacturers and form battery manufacturing JVs such as BlueOvalSK (Ford/SK) and Ultium Cells (GM/LG Energy Solutions) in efforts to improve manufacturing efficiencies with $60/kWh targets discussed for the end of the decade. The US Department of Energy also set $60/kWh as its 'stretch' goal, a level would be achieved by 2030 if the current 18% learning rate is maintained.

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

source: Bloomberg, Guinness Global Investors



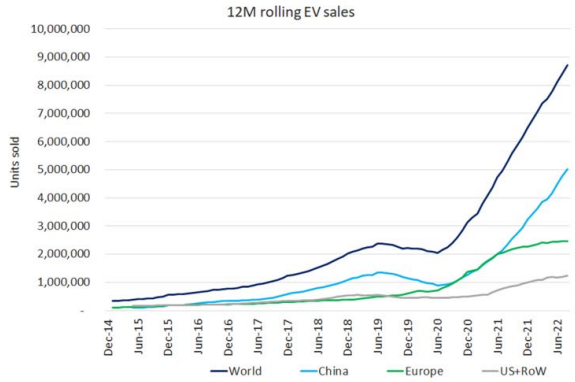
Electric Vehicles

Electric vehicle (EV) adoption continues apace in 2022. Based on data from Cleantechnica, around 5.8 million plug-in vehicles were sold from January to August this year, more than was sold in all of 2019 and 2020 combined. At the current rate, we could see EV sales for the full year exceeding 10 million units. August was a particularly strong month for EVs, with the battery electric (BEV)

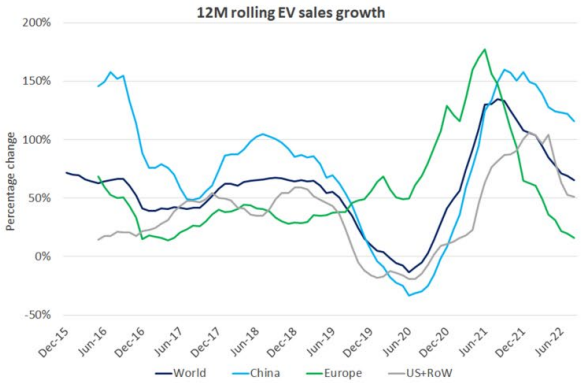
global market share reaching 11% and the share of all plug-in vehicles reaching 15%. This strong performance takes year-to-date plug-in penetration to approximately 13%, split around 9% for BEVs and 4% for plug-in hybrids (PHEVs).

Global sales growth is around 60% year over year (down from 130% last year) with China increasing its market share to around 60%, up from 40% in 2021. Just in the last 12 months, China has significantly extended its lead over the European market which is now in a distant second place with around one quarter of overall EV sales. The US continues to lag behind, making up just under 10% of global EV sales.

Global EV sales (rolling 12-months)



Global EV sales growth (rolling 12-months)



Source: Guinness, Cleantechnica. Data to 31.08.2022

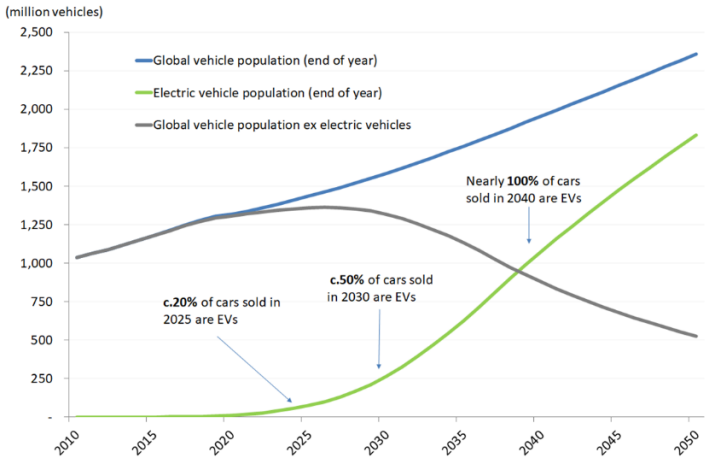
Policy support, both in terms of incentives to purchase new EVs and legislation to ban the sale of ICE vehicles, continues to underpin the uptake of EVs. The IEA estimates that governments around the world provided nearly $30bn of incentives in 2021 to support $250bn of consumer spending on electrified transport. Despite this headline number being nearly double 2020's figure, government support is slowly being reduced with incentives now making up around 10% of spending on electric cars, down from around 20% only five years ago. To support the transition, over 40 countries now have some form of legislation that either bans internal combustion engine sales or restricts tailpipe emissions.

Looking ahead, 2022 looks like it may be the first year where EVs claim over 10% of annual passenger vehicle sales driven by improving economics, driving range, and charging times.

On a global basis, we expect EVs will represent around 20% of new vehicle sales in 2025 (concurrent with the cost of EV lithium-ion batteries falling to around $100/kWh), 50% of new vehicle sales in 2030 and nearly all new vehicle sales by 2040. At that point, it implies an overall EV population of around 1bn vehicles, over sixty-five times greater than the global population of around 15m EVs at the end of 2021. With EVs using roughly one third of the energy of a typical internal combustion engine vehicle, this transition alone will have substantial impact on global energy efficiency and global decarbonisation.

Global EV population (to 2050)

Source: IEA; Guinness Global Investors



Despite these rapid EV growth assumptions, we calculate that oil demand from passenger vehicles will not peak until around 2024/25 and that, even by 2030, passenger vehicle oil demand will be similar to 2021 levels. With transportation generating just over 7bn tonnes of carbon emissions in 2020, accelerating the transition and reducing associated oil demand is critical to achieving a net zero 2050 scenario.

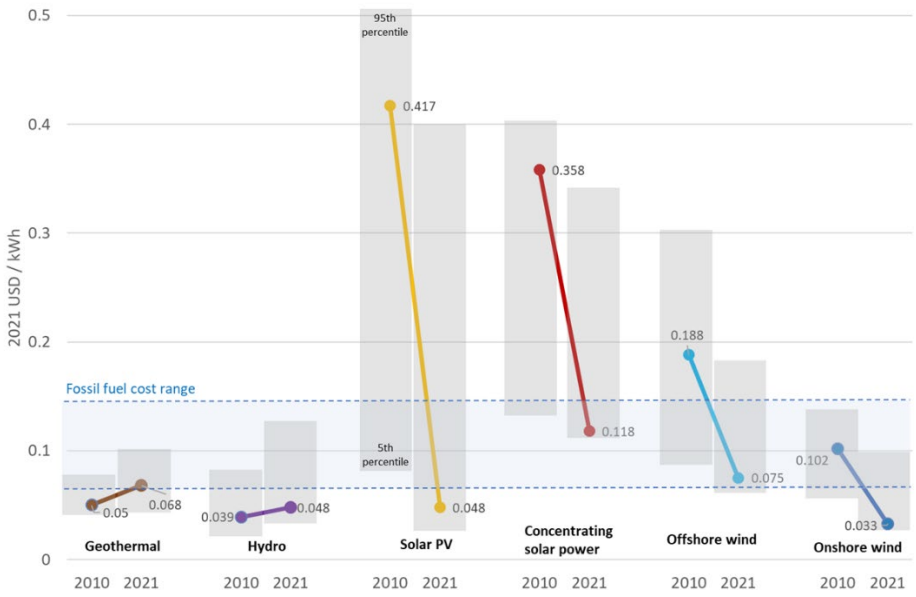
Generation & installation (equipment)

Before considering the detailed dynamics of key renewable power generation markets of wind and solar, it is worth considering the significant changes that have occurred to the economics of various renewable power generation technologies since 2010. Onshore wind and solar PV have joined hydro and geothermal power to sit at the lower end of, or below, the cost range for new fossil fuel power generation.

The structural story of cost reduction that we have witnessed for a number of years has recently been complicated by cyclical raw material, energy and logistics cost inflation. However, while the cost of renewable power generation is likely biased upwards short-term, the **relative economics of renewables versus hydrocarbons** continue to improve thanks to fossil fuel generation inflation.

Global LCOE of utility-scale renewable power generation technologies (2010–2021)

source: IRENA, Guinness Global Investors estimates



The solar sector

Solar's improved relative economics and the increased need for security of supply mean that installations in 2022 are likely to be around 260 GW, substantially higher than the 200 GW estimate that we made at the start of the year. With momentum strong, especially following the US Inflation Reduction Act (IRA) and the RePowerEU deals, we introduce an estimate for 2023 module demand of 310 GW, another record year for global installations, with growth of 50 GW versus 2022.

Regionally, the key moving parts in 2022 and 2023 are as follows:

- In the **United States** we initially expected installations in 2022 (20 GW) to be lower than 2021 (30 GW) as a result of i) the Withhold Release Order (WRO) placed on various solar product imports from China, ii) concerns around the level of residential solar support coming from a clean energy infrastructure bill and iii) the impact of new net metering rules (NEM3.0) in California which reduce the attractiveness of solar economics for residential consumers. Actual installations in 2022 are now likely to be around 25 GW as NEM3.0 appears to be less of a threat (although it is still unresolved) and the WRO has not been as negative as initially feared. While the passing of the IRA in 2022 is a clear positive for solar, we do not expect the effect of the bill to be felt until 2023 and for it to be spread over a number of years, with installations reaching the 2021 peak of 30 GW again in 2023 and growing thereafter.

- Demand in **Europe** is expected to be around 45 GW in 2022, up from 24 GW in 2021, as the region reacted to higher fossil fuel generated electricity prices (as a result of lower Russian natural gas imports) and the need for energy security. It is here that the relative economics of solar have improved the most and the RePowerEU deal has already started to incentivise new demand for solar installations. According to BNEF, Europe imported $2.5bn of Chinese PV products in July 2022, up $1.5bn on the level from July 2021. Looking to 2023, we see further installation increases, with Europe reaching a new record of 62 GW spread well across an increasing number of countries, leading to substantially more growth in future years.

- In **China** module demand is also likely to beat our initial estimates, reaching 95 GW in 2022 (up 30 GW on 2021) as first half 2022 installations of 40 GW were more than double the levels seen in 1H 2021. Growth has come across utility, residential and commercial and we note plans for the development of significant offshore utility scale plants in 2023. As with Europe, higher power prices have been a key factor in driving stronger demand. In mid 2022, China published its 14th five year plan for renewables which suggested that solar (and wind) installations in 2021-2025 should be double the levels seen in 2015-2020. Accordingly, we expect China will see more growth in 2023, reaching around 115 GW, double the levels seen in 2020/2021, and representing around 37% global market share.

- The rest of the **non-OECD** has also seen greater than expected growth in demand, estimated to reach around 60 GW in 2022 (up 23 GW on 2021 levels) with demand increases well spread across Latin America (especially Brazil), African and Middle Eastern countries. Indian installations look particularly impressive but activity was front-end loaded in response to a new import tax policy that placed a 40% surcharge on imported panels from April 2022.

Considering all these factors, we believe that installations could exceed 300 GW in 2023, and are potentially biased higher, with the non-OECD (at 195 GW) still dominating with a 63% market share.

Global solar module installations, 2010-2023E (GW)

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

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022E	2023E
OECD solar installations (annual)														
North America	1	2	4	6	7	8	14	11	10	11	19	30	23	30
Germany	7	7	8	3	2	1	2	2	4	4	5	5	8	11
Spain	0	0	0	0	0	0	0	0	0	5	3	4	7	9
Rest of Europe	3	4	5	5	5	6	4	3	4	6	8	15	30	42
Australia	0	1	1	1	1	1	1	2	4	4	4	5	6	8
South Korea	0	0	0	1	1	1	1	1	2	3	4	4	5	6
Japan	1	1	2	7	10	11	8	8	7	7	9	7	9	9
Total OECD	**17**	**23**	**24**	**24**	**25**	**29**	**29**	**26**	**31**	**40**	**51**	**70**	**88**	**115**
Change in OECD annual installations	*10*	*7*	*0*	*0*	*2*	*4*	*0*	*-3*	*5*	*9*	*11*	*19*	*18*	*27*
Non-OECD solar installations (annual)														
China	0	3	3	14	13	19	30	53	44	33	52	65	95	115
India	0	0	1	1	1	2	5	10	11	12	4	12	17	18
Rest of non-OECD	1	3	3	4	6	6	11	9	22	34	37	37	60	62
Total Non-OECD	**2**	**5**	**8**	**18**	**21**	**27**	**46**	**72**	**77**	**78**	**93**	**114**	**172**	**195**
Change in non-OECD annual installations	*1*	*3*	*2*	*11*	*2*	*6*	*19*	*26*	*5*	*1*	*15*	*21*	*58*	*23*
Total solar installations (annual)	**19**	**29**	**31**	**42**	**46**	**56**	**75**	**98**	**108**	**118**	**144**	**184**	**260**	**310**
Change in world annual installations	*11*	*10*	*2*	*11*	*4*	*10*	*19*	*23*	*10*	*10*	*26*	*40*	*76*	*50*

Solar supply chain in 2022 and 2023

All parts of the solar module manufacturing chain, expect polysilicon, appear to have been in oversupply again in 2022 and are likely remain so in 2023. We treat nameplate capacity estimates here with some caution because technological advances and cost improvements can bring rapid capacity obsolescence meaning that actual supply may well be lower than nameplate capacity. Nonetheless, significant new manufacturing capacity is planned across the entire value chain which will likely bring lower module prices and will likely help to support global solar module demand.

- **Polysilicon** is a key raw material for a solar wafer and the poly market continued to be the tightest part of the solar market in 2022, evidenced by polysilicon prices rising through the year to reach nearly $40/kg in August. Poly prices have been high enough over the past two years to incentivise new supply and we can now see signs that the new supply is on the cusp of arrival. BNEF estimates that the capacity of the poly silicon industry rose to 900 Mtpa in 2022 (sufficient to support over 300 GW of solar module manufacturing) but that new capacity additions of nearly 2,500 Mtpa are being planned by either existing players or new entrants. While a number of plants will not be built and many will take longer than expected to reach full production capacity, the scale of capacity growth leads us to believe that poly prices and associated margins for poly producers will fall in 2023 and beyond, allowing margin expansion elsewhere in the value chain as well as lower solar module prices.

- **Wafer and solar cell** manufacturing capacity, according to PV InfoLink, will reach 583 GW in Q4 2022 and to grow a further 15% in 2023. In 2022, wafer and cell companies have generally been able to pass through cost inflation and to defend reasonable margins but, similar to polysilicon, this may come under pressure in 2023 as new capacity is added. Unlike polysilicon however, the wafer business is highly concentrated with nearly 80% of 2022 wafer capacity is in the hands of the five largest producers. This may be a factor to help support prices in 2023. A consideration slightly longer term will be the rate at which demand moves from p-type wafers to n-type wafers (with greater efficiency and lower degradation) and how this might cause some existing wafer and cell manufacturing capacity to become obsolete, effectively leaving this part of the market tighter than initially apparent.

- **Solar module** prices have moderated so far in 2022, down to around US$0.25/W currently, and are likely to average in 2022 the levels seen in 2021. With elevated polysilicon and power prices, it is the module manufacturers that have suffered the greatest margin compression so far in 2022. Module manufacturing nameplate capacity in 2022 is estimated to be around 470 GW, of which around 310 GW is newer 'Tier 1' capacity with lower costs resulting from the scale of manufacturing and new technologies. In 2023, this likely expands to 660 GW and potentially to as high as 820 GW by the end of the year.

Polysilicon and solar module pricing

source: Bloomberg

The wind sector

The long-term outlook for the wind industry remains very positive as wind power will play a critical role in global decarbonisation and the energy transition. Global wind generation capacity today is around 700GW with annual installations in 2022 expected to be around 105GW.

However, the wind industry is suffering short-term pressures as recent sharp peaks in installation demand (a 50% increase to 98 GW in 2020, driven by tax incentives and policy changes) have moderated and have been compounded by Covid-related project delays, raw material cost inflation, logistics issues and permitting constraints.

Wind turbine manufacturing is raw material intensive. According to Vestas in December 2021, steel plate prices were up 2x and resin up 2.5x versus the start of 2020. In terms of logistics, the cost of shipping containers was up 4x and the cost of delivery vessels was up 2x in 3Q 2021 vs 2020. While these cost increases are significant, they were compounded by supply chain issues, such as a 4x increase in the average time that equipment spent waiting in Chinese ports and a 50% reduction in the reliability of scheduling.

Below, we consider the key factors for the onshore and offshore wind markets in 2021 and beyond, concluding that the near-term issues are likely a bump in the road on the journey to delivering wind as the second most significant renewable power generation source.

Annual onshore and offshore wind installations (GW)

source: BP, IEA, BNEF, Guinness Global Investors estimates

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022E
Onshore wind installations (annual)															
North America	9	11	6	8	15	2	7	10	9	8	8	10	17	16	10
Latin America	0	0	0	0	0	0	5	3	3	3	4	4	2	5	3
Europe	6	9	9	10	12	11	11	11	12	13	8	9	12	15	19
China	6	14	17	18	14	15	21	29	22	17	19	26	54	41	48
India	2	1	1	1	2	2	2	3	4	4	2	2	1	3	4
RoW	3	3	3	4	4	3	4	5	5	5	4	4	5	3	8
Total onshore	**27**	**38**	**35**	**40**	**46**	**33**	**49**	**61**	**55**	**49**	**46**	**55**	**91**	**83**	**92**
Change in onshore annual installations		*12*	*-3*	*5*	*6*	*-14*	*17*	*11*	*-6*	*-6*	*-3*	*9*	*36*	*-8*	*9*
World ex China	*21*	*24*	*18*	*22*	*32*	*18*	*29*	*32*	*33*	*32*	*27*	*29*	*37*	*42*	*44*
Offshore wind installations (annual)															
China	0	0	0	0	0	0	0	1	1	1	2	3	4	14	6
UK	0	0	1	0	1	1	0	1	0	1	2	2	1	1	2
Germany	0	0	0	0	0	0	0	2	0	2	0	2	0	1	2
RoW	0	0	0	0	0	1	0	0	0	1	0	1	2	1	3
Total offshore	**0**	**0**	**1**	**0**	**2**	**2**	**1**	**4**	**1**	**4**	**4**	**8**	**7**	**17**	**13**
Change in onshore annual installations		*0*	*1*	*-1*	*1*	*1*	*-1*	*4*	*-4*	*3*	*0*	*3*	*-1*	*11*	*-4*
World ex China	0	0	1	0	1	2	1	3	0	4	3	5	3	3	7
Total wind installations (annual)	**27**	**38**	**36**	**40**	**48**	**35**	**50**	**65**	**56**	**53**	**50**	**63**	**98**	**100**	**105**
Change in world annual installations		*12*	*-2*	*4*	*8*	*-13*	*16*	*15*	*-9*	*-3*	*-2*	*12*	*35*	*3*	*5*

Onshore wind

Global onshore wind installations in 2021 were around 83 GW, down 8 GW from the record level seen in 2020 but still up 28 GW on the pre-pandemic installation level of 55 GW in 2019.

Onshore wind installations had been growing very steadily since 2008, averaging an increase of around 3 GW pa, with China representing around 70% of the annual growth. Chinese demand peaked sharply in 2000 and we expect installations to moderate to the longer-term trend resulting in around 41 GW of installations in 2022.

Outside China, onshore installations reached a new high in 2021, averaging 42 GW, up 5 GW on 2020 levels. Onshore installations outside China are expected to be slightly higher again in 2022, achieving a new record level of around 44 GW.

Combined with underlying new project increases, we note that by 2030 around one third of the world's total installed capacity will be more than 13 years old and will be strong candidates for refurbishing.

Offshore wind

Offshore wind remains a nascent industry, at only 17% of the size of onshore (by annual installations in 2021), but one where the growth trajectory is becoming increasingly visible.

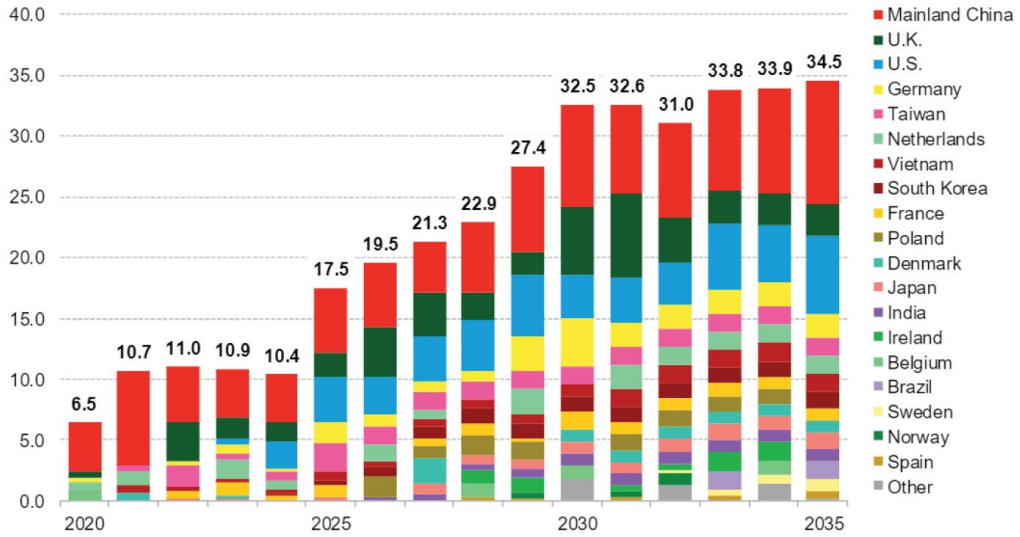
Annual installations of offshore wind capacity have increased from 0.9GW in 2010 to a new high of 17 GW in 2021. Chinese offshore installations reached 14 GW in 2021 while ex-China installations are likely to grow from 3 GW in 2021 to a new high of 7 GW in 2022.

The economics of offshore wind continue to improve and there was further constructive cost data in 2021 suggesting that the LCOE for the median offshore wind project halved between 2010 and 2020, and now sits at the bottom end of the competing fossil fuel generation cost range. The growing interest underlines the significant potential of the offshore industry which benefits from better operational (higher and more reliable wind speed) and visual characteristics as well as being close to key demand areas which are often coastal.

In the later part of this decade, we expect annual offshore wind installations to represent around 20% of the total wind market with cumulative installations in offshore between 2020 and 2030 likely to be around 140 GW. A broader spread of countries including the United States, Chinese Taipei, Korea, Vietnam and Japan means that cumulative installations will be split around 30 GW in the Americas, 90 GW in Europe, Middle East and North Africa and around 20 GW in Asia Pacific. The current European market will continue to grow, as excess offshore wind generation will be utilised for the generation of green hydrogen via electrolysers, and while the Chinese market will also grow it will not be as dominant globally as it is in the onshore market.

The outlook for offshore wind installations

source: BNEF projections August 2022



IMPORTANT INFORMATION

Issued by Guinness Global Investors, a trading name of Guinness Asset Management Limited, which is authorised and regulated by the Financial Conduct Authority.

This report is primarily designed to inform you about recent developments in the energy markets invested in by the Guinness Sustainable Energy Fund. It also provides information about the Fund's portfolio, including recent activity and performance. This document is provided for information only and all the information contained in it is believed to be reliable but may be inaccurate or incomplete; any opinions stated are honestly held at the time of writing, but are not guaranteed. The contents of the document should not therefore be relied upon. It is not an invitation to make an investment nor does it constitute an offer for sale.

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.guinnessgi.com or free of charge from:-

- the Manager: Link Fund Manager Solutions (Ireland) Ltd (LFMSI), 2 Grand Canal Square, Grand Canal Harbour, Dublin 2, Ireland; or,
- the Promoter and Investment Manager: Guinness Asset Management Ltd, 18 Smith Square, London SW1P 3HZ.

LFMSI, as UCITS Man Co, has the right to terminate the arrangements made for the marketing of funds in accordance with the UCITS Directive

Investor Rights

A summary of investor rights in English is available here:

https://www.linkgroup.eu/policy-statements/irish-management-company/

Residency

In countries where the Fund is not registered for sale or in any other circumstances where its distribution is not authorised or is unlawful, the Fund should not be distributed to resident Retail Clients. **NOTE: THIS INVESTMENT IS NOT FOR SALE TO U.S. PERSONS.**

Structure & regulation

The Fund is a sub-fund of Guinness Asset Management Funds PLC (the "Company"), an open-ended umbrella-type investment company, incorporated in Ireland and authorised and supervised by the Central Bank of Ireland, which operates under EU legislation. If you are in any doubt about the suitability of investing in this Fund, please consult your investment or other professional adviser.

Switzerland

This is an advertising document. The prospectus and KIID for Switzerland, the articles of association, and the annual and semi-annual reports can be obtained free of charge from the representative in Switzerland, Carnegie Fund Services S.A., 11, rue du Général-Dufour, 1204 Geneva, Switzerland, Tel. +41 22 705 11 77, www.carnegie-fund-services.ch. The paying agent is Banque Cantonale de Genève, 17 Quai de l'Ile, 1204 Geneva, Switzerland.

Singapore

The Fund is not authorised or recognised by the Monetary Authority of Singapore ("MAS") and shares are not allowed to be offered to the retail public. The Fund is registered with the MAS as a Restricted Foreign Scheme. Shares of the Fund may only be offered to institutional and accredited investors (as defined in the Securities and Futures Act (Cap.289)) ('SFA') and this material is limited to the investors in those categories

Telephone calls will be recorded and monitored.