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 before making any final investment decisions. Past performance does not predict future returns.

February 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 lower rewards	

The risk and reward indicator shows where the fund ranks in terms of its potential risk and return. The fund is ranked as higher risk as its price has shown high fluctuations historically. 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.

HIGHLIGHTS FOR JANUARY

UPDATE ON PERFORMANCE AND OUTLOOK FOR SUSTAINABLE ENERGY

Global stock markets delivered a weak start to 2022, with the MSCI World Net Return Index down 5.3% and growth-oriented stock market indices performing poorly. The weakness resulted from concerns about a faster than expected interest rising cycle, with market expectations for US interest rate rises in the next 12 months increasing from three at the start of January, to five at the end of the month. In light of the weakness, this month we provide an update on general market performance and an outlook for the sustainable energy sector.

EQUITIES

Over the month, the MSCI Alternative Energy Index was down 12.2% while the MSCI World Net Return Index was down 5.6%.

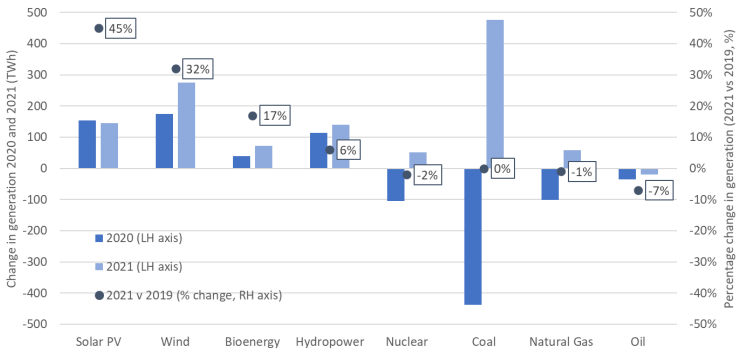
In the portfolio, the strongest performers included LG Chem, benefitting from the separate listing of its lithium-ion battery business LG Energy on the Korean stock exchange, and Gentherm which reacted positively to promising new product sale news. Weaker performers included our wind equipment manufacturers and a number of our solar equipment manufacturers.

CHART OF THE MONTH

Renewable electricity generation increased by around 6% in 2021 to over 7,900 TWh, outpacing global electricity demand growth (4.5% in 2021). Comparing to pre-COVID levels in 2019, solar generation grew by 45%, wind by 32% and bioenergy by 17%. Fossil fuel generation lagged, with coal flat, natural gas down 1% and oil down 7%.

Change in electricity generation (2020 & 2021 vs 2019

source: IEA



Signatory of:

PRI Principles for Responsible Investment

Contents

1. JANUARY NEWS AND EVENTS IN REVIEW 2
2. MANAGER'S COMMENTS 3
3. PERFORMANCE 5
4. PERFORMANCE Guinness Global Energy Fund 6
5. OUTLOOK - sustainable energy & the energy transition 10

1. JANUARY NEWS AND EVENTS IN REVIEW

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

News	Sub Sector	Impact
Global stock markets weakened in January on concerns about a faster than expected interest rising cycle, with market expectations for US interest rate rises in the next 12 months increasing from three at the start of January, to five at the end of the month. The sustainable energy sector suffered in the sell-off, in particular the higher growth parts of the universe.	Sustainable energy equities	
In offshore wind, a tender in Scotland planned for 10 GW saw such demand from developers that ultimately 25 GW of total capacity was awarded while China reported that offshore wind installations in 2021 were nearly 17 GW - substantially higher than expected and nearly double the country's previously installed total offshore capacity.	Offshore wind	
A new 'net zero 2050' report by McKinsey estimates that $9.2tn will need to be invested across various sectors annually to limit the global temperature rise to 1.5°C by 2050. The report estimates this to be a 60% increase on current investment levels.	Energy transition investment	
In early February, the California Public Utility Commission announced a delay to its decision on changes to solar 'Net Metering' policy until further notice. A new commissioner is reviewing the current proposed terms which, if enacted, would negatively impact residential solar economics.	US residential solar	
According to the IEA, around 290 GW of new renewable generation capacity was installed in 2021, 10 GW higher than the record installations seen in 2020 and nearly 100 GW higher than the 194 GW installed in 2019. Solar represented nearly two-thirds of the new capacity additions, followed by wind then hydro.	Renewable capacity	
Renewable electricity generation increased by around 6% in 2021 to over 7,900 TWh, outpacing global electricity demand growth (4.5% in 2021). Comparing to pre-COVID levels in 2019, solar generation grew by 45%, wind by 32% and bioenergy by 17%. Fossil fuel generation lagged, with coal flat, natural gas down 1% and oil down 7%	Renewable generation	

2. MANAGER'S COMMENTS

Update on performance and outlook for sustainable energy

Global stock markets delivered a weak start to 2022, with the MSCI World Net Return Index down 5.3% and growth-oriented stock market indices such as the Nasdaq Composite and the MSCI World Growth Index being down 9.0% and 9.3% respectively. January 2022 was the weakest first month of the year for stock markets in general since 2009.

The weakness resulted from concerns about a faster than expected interest rising cycle, with market expectations for US interest rate rises in the next 12 months increasing from three at the start of January, to five at the end of the month. As a result, growth-oriented companies and sectors were among the weaker performers over the month. The sustainable energy sector suffered in the sell-off, in particular the higher growth parts of the universe.

We have in fact seen three months of relative underperformance from the sustainable energy sector. In addition to the broader market concerns mentioned above, the sector has also had to contend with a number of specific issues, including:

- The blocking of Joe Biden's **"Build Back Better" (BBB) bill** by Democratic Senator Joe Manchin. The bill is a cornerstone spending plan of the current US administration which includes various clean energy related provisions designed to accelerate the transition. Manchin represents West Virginia, a major coal producing state, and claims the bill will "*risk the reliability of our electric grid and increase our dependence on foreign supply chains*". Also in December, the California Public Utilities Commission proposed new net metering rules (**NEM3.0**) that, if enacted, will reduce the attractiveness of solar economics for residential consumers

- **Inflationary conditions** and **supply chain pressures** across the breadth of the sustainable energy sector. Energy transition technologies and equipment are typically raw material intensive (leaving them exposed to raw material inflation) and are dominated by Chinese manufacturing (50% of all wind turbines and 70% of all solar panels are manufactured in China), leaving importers exposed to supply chain inefficiencies and higher freight costs.

These factors have caused sustainable energy sector indices to fall sharply over the three months to the end of January, with the MSCI Alternative Energy index down by 25.0% and the iShares Clean Energy index down by 25.4%, versus the MSCI World Net Return index down by only 3.4%.

Within our sustainable energy universe of around 250 companies, only 51 stocks delivered a positive return over the three months to the end of January, with nearly half of those being utility companies (average return of 9%). Other positive sectors included battery raw materials and cathode materials companies (average return of 13%) and ethanol producers (average return of 24%) that benefitted from the strength in oil and oil product prices.

Performance divergence within the universe has been extreme with nine stocks down more than 50% and 39 stocks down more than 30% over the three-month period. Over half of the weaker performers were equipment (installation) companies with wind, solar and hydrogen-oriented companies all suffering. Higher growth independent power producers suffered (especially US residential solar and Japanese IPPs) while utilities and alternative fuel companies were not among the poor performers.
Likewise within the fund, the weaker sectors and stocks included the wind equipment manufacturers (as a result of raw material cost inflation and supply chain issues impacting company revenue growth and margin guidance); a number of efficiency companies that saw profit taking; and solar equipment companies that reacted to concerns around the final outcome of the California net metering debate (NEM 3.0), the blockage of Biden's BBB programme and also the US Withhold or Release activities designed to stop the import of Chinese products made with forced labour.

As managers of the fund, the key issue for us is to understand whether the fundamentals of any of the companies in the fund have been impacted or whether the market has simply de-rated the stocks in line with broader market sentiment. Looking back over last three months, we can see that the average CFROI change in the fund was -0.5%, although this was heavily affected by weakness in the wind companies.

Consistent with performance over the period, the wind sector suffered the weakest near-term CFROI progression as a result of slowing growth plus the inflation and supply chain factors mentioned above. While fund holdings such as Vestas and Siemens Gamesa guided down near-term profit expectations, it is interesting to note the same period also saw an announcement from Joe Biden for 30 GW of offshore wind installations on the US east and west coasts, an offshore wind tender in Scotland planned for 10 GW that grew to 25 GW as a result of strong demand and an announcement from China that offshore installations in 2021 were nearly 17 GW (1.8x the country's previously installed total offshore capacity). Events and announcements like these lead us to believe that the long-term structural outlook appears to be robust and attractive, especially in the offshore, although of course we remain concerned about the near-term delivery.

We believe that many of the factors that have caused the sustainable energy sector to de-rating are likely to be short-term in nature:

- **Gas and power prices** will likely moderate as the post-pandemic demand spike recedes, the weather normalises and the industry is economically incentivised to deliver a supply response. Gas and power are key input costs for renewable energy manufacturing, so a moderation should ease margin pressures.

- **Raw material cost inflation** is likely already at a peak as many metal prices are already starting to retreat. While near-term trends are difficult to predict, we expect, over the medium term, that these increases are offset by continued technology, scale and manufacturing improvements.

- **Freight and logistics issues** are likely to persist in the start of 2022 as China's zero COVID policy threatens to impact freight handling and exports, but we would expect these issues to subside as the year progresses.

- While the **BBB bill** in its current form will not proceed, there is increasing hope that the $555bn investment included in the BBB for climate-related issues will be agreed upon. Senator Manchin commented in early January 2022 that "*the climate thing is one that we probably can come to an agreement much easier than anything else*".

- The **NEM3.0** proposals for residential solar customers in California to face high fixed costs for selling surplus power back to the grid, have met significant opposition. On February 3, it was announced that the proposals have been postponed. Whilst just one state, California represents an important bellwether in the US for the take up of residential solar power.

Recent changes in valuation leave the fund, at the end of January, on a 2022 P/E ratio of 21.7x, falling to 18.3x for 2023. As illustrated below, the P/E premium of the fund to the MSCI World index has also compressed, falling from a peak of around 35% at the end of October to around 17% (on a one year forward basis), similar to the level seen through late 2020 and most of 2021.

P/E premium of fund versus MSCI World (1yr fwd)
source: Guinness Global Investors estimates, Bloomberg

Broader valuation, growth and quality characteristics of the fund versus MSCI World as summarised in the table below:

Guinness Sustainable Energy fund valuation summary
source: Guinness Global Investors estimates, Bloomberg

As at 31 January 2022	P/E			EV/EBITDA			Dividend Yield		EPS Growth (%pa)		CFROI*	
	2021	2022E	2023E	2021	2022E	2023E	2022E	2023E	2014-21	2021-23	2021E	2022E
Guinness Sustainable Energy Fund	25.1x	21.7x	18.3x	13.8x	12.1x	10.3x	1.4%	1.5%	5.3%	21.2%	7.2%	8.2%
MSCI World Index	21.4x	18.5x	17.0x	13.9x	12.3x	11.6x	1.9%	2.0%	5.9%	12.7%	8.9%	9.2%
Fund Premium/(Discount)	*17%*	*17%*	*8%*	*-1%*	*-2%*	*-11%*						

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

In the short-term (2022 and 2023), we see EPS growth for the portfolio of 21% per annum, which compares to the MSCI World at 13% per annum, so significantly higher. On a five year view, we believe our portfolio will deliver 13-14%pa normalised earnings per share growth, which again we see as significantly higher than MSCI World. If we are correct in this analysis, the one year forward P/E multiple of the fund falls from around 22x in 2022 to around 11x in 2027.

We believe that this is an attractive valuation level for a basket of companies that are well placed to benefit from the twenty to thirty-year growth opportunity presented by the global energy transition. Looking into the year ahead, we

see a supportive outlook for the sector with policy support and stimulus investment driving attractive growth and a backdrop that should provide potential for good equity returns.

3. PERFORMANCE

Past performance should not be taken as an indicator of future performance. The value of this investment and any income arising from it can fall as well as rise as a result of market and currency fluctuations as well as other factors. You may lose money in this investment.

1 year rolling performance to	Jan-22	Jan-21	Jan-20	Jan-19*	Jan-18*
Fund (Class Y)	-7.0%	97.0%	13.9%	-8.0%	20.8%
MSCI World NR Index	16.5%	15.5%	17.7%	-6.5%	25.8%
Outperformance/Underperformance	*-23.5%*	*81.5%*	*-3.8%*	*-1.5%*	*-5.0%*
1 year rolling performance to	**Jan-17***	**Jan-16***	**Jan-15***	**Jan-14***	**Jan-13***
Fund (Class Y)	0.8%	-19.4%	-18.8%	56.0%	-11.5%
MSCI World NR Index	17.1%	-5.1%	7.0%	16.1%	15.9%
Outperformance/Underperformance	*-16.4%*	*-14.3%*	*-25.8%*	*39.9%*	*-27.4%*
	1 year	**3 years**	**5 years**	**Since launch ****	
Fund (Class Y)	-7.0%	108.8%	132.1%	-52.0%	
MSCI World NR Index	16.5%	58.4%	86.3%	154.7%	
Outperformance/Underperformance	*-23.5%*	*50.4%*	*45.8%*	*-206.7%*	

**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%. **The Guinness Sustainable Energy Fund was launched on 19/12/2007.*

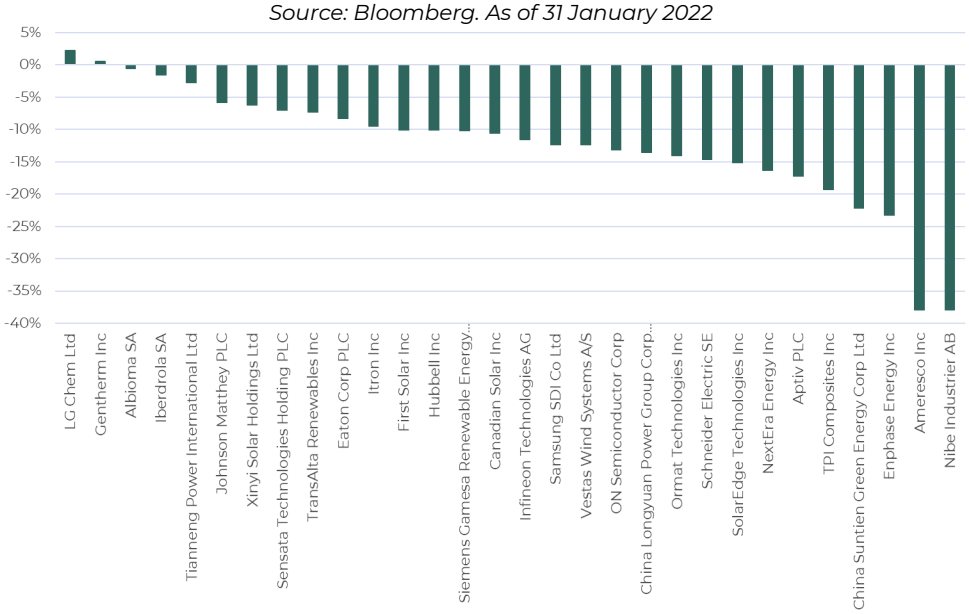
Source: Financial Express, bid to bid, total return. Fund returns are for share classes with a current Ongoing Charges Figure (OCF) of 0.74%; returns for share classes with a different OCF will vary accordingly.

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 OCF. Performance returns do not reflect any initial charge; any such charge will also reduce the return.

Within the Fund, the strongest performers were LG Chem, Gentherm, Albioma, Iberdrola and Tianneng Power while the weakest performers were Nibe, Ameresco, Enphase Energy, China Suntien and TPI Composites.

Stock by Stock performance over the month, in USD

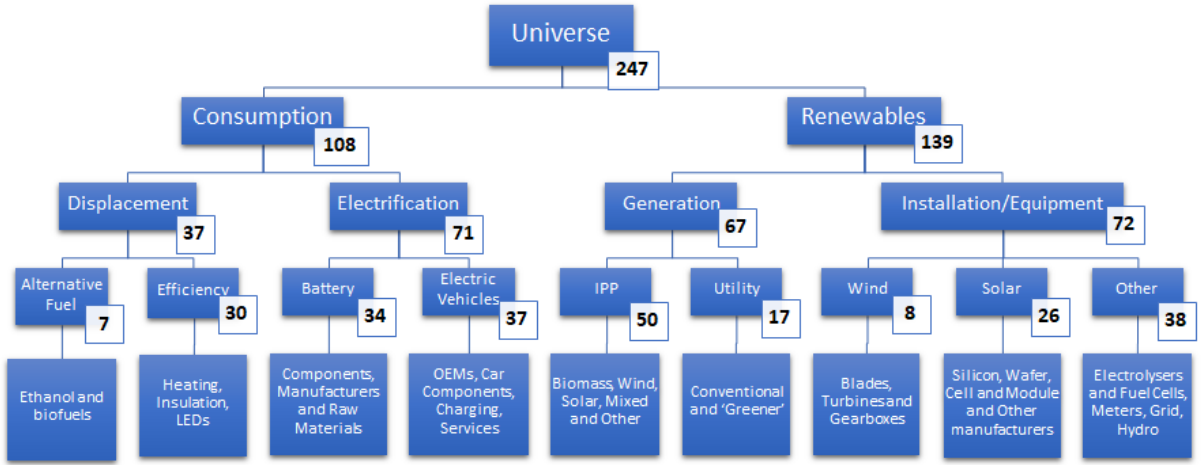
Source: Bloomberg. As of 31 January 2022



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 Asset Management 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:

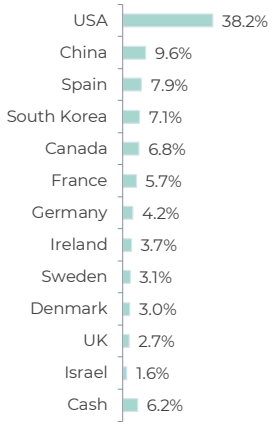
PRI Principles for Responsible Investment

Buys/Sells

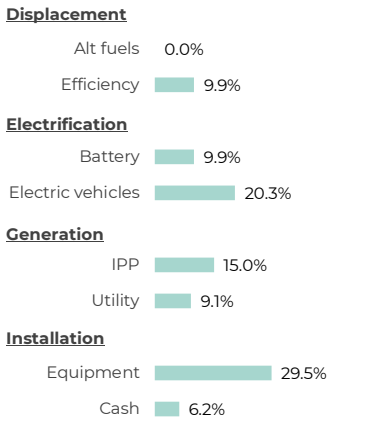
There were no stock switches during the month, but the portfolio was actively rebalanced.

Portfolio structure analysis

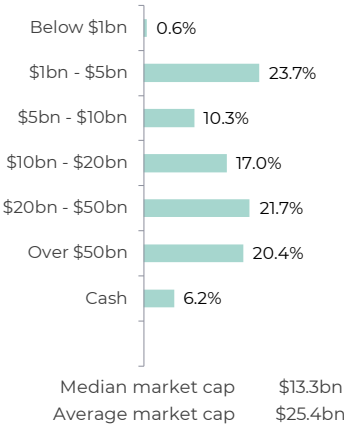
Geographic Analysis



Classification Analysis



Market Cap 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	
	Jan-22		Dec-21	Dec-20	Dec-19	Dec-18
Consumption	**40.1%**	**3.4%**	**43.4%**	**36.7%**	**41.7%**	**26.5%**
Displacement	9.9%	*0.0%*	11.8%	9.9%	13.4%	16.4%
Alternative Fuel	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*3.9%*
Efficiency	*9.9%*	*0.0%*	*11.8%*	*9.9%*	*13.4%*	*12.5%*
Electrification	30.2%	*3.4%*	31.6%	26.8%	28.2%	10.1%
Batteries	*9.9%*	*-0.9%*	*8.9%*	*10.8%*	*12.6%*	*3.9%*
Electric vehicles	*20.3%*	*4.3%*	*22.8%*	*16.0%*	*15.7%*	*6.2%*
Renewables	**53.7%**	**-6.7%**	**51.3%**	**60.4%**	**54.1%**	**69.7%**
Generation	24.2%	*-0.4%*	23.1%	24.6%	22.2%	27.3%
IPP	*15.0%*	*-2.0%*	*14.5%*	*17.0%*	*18.9%*	*26.7%*
Utility	*9.1%*	*1.5%*	*8.6%*	*7.6%*	*3.2%*	*0.6%*
Installation	29.5%	*-6.3%*	28.2%	35.8%	32.0%	42.5%
Equipment	*29.5%*	*-6.3%*	*28.2%*	*35.8%*	*32.0%*	*42.5%*
Cash	6.2%	*3.2%*	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 January 2022	P/E			EV/EBITDA			Dividend Yield		EPS Growth (%pa)		CFROI*	
	2021	2022E	2023E	2021	2022E	2023E	2022E	2023E	2014-21	2021-23	2021E	2022E
Guinness Sustainable Energy Fund	25.1x	21.7x	18.3x	13.8x	12.1x	10.3x	1.4%	1.5%	5.3%	21.2%	7.2%	8.2%
MSCI World Index	21.4x	18.5x	17.0x	13.9x	12.3x	11.6x	1.9%	2.0%	5.9%	12.7%	8.9%	9.2%
Fund Premium/(Discount)	*17%*	*17%*	*8%*	*-1%*	*-2%*	*-11%*						

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

Source: Guinness Global Investors, Bloomberg

Portfolio holdings, as at end December 2021

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

We hold c.43% weight to companies associated with the consumption (or demand) of sustainable energy. Our largest exposure here is to companies involved in the electrification of demand, either via the creation of new batteries (9%) or the electrification of transportation (23% weight) while we have 12% 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 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. ON Semiconductor 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, Hella, 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), 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 23% weight to companies involved in the generation of sustainable energy and 28% 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 biomass (Albioma), geothermal (Ormat) and then broad-based wind/solar renewable energy generation through TransAlta Renewables and NextEra Energy (the largest producer of renewable energy in the world). Iberdrola is our only Utility company.

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 A/C 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 December 2021

	Theme	Example holdings	Weighting (%)
1	Electrification of the energy mix	TransAlta renewables, NextEra Energy	23.3%
2	Rise of the electric vehicle and auto efficiency	Sensata Technologies, Aptiv	23.0%
3	Battery manufacturing	Samsung SDI	7.2%
4	Expansion of the wind industry	Siemens Gamesa Renewable Energy, Vestas	13.0%
5	Expansion of the solar industry	CanadianSolar	12.7%
6	Heating, lighting and power efficiency	NIBE Industrier	9.9%
7	Geothermal and biomass	Ormat, Albioma	4.7%
8	Other (inc cash)		6.2%

Portfolio at end December 2021 (one month in arrears for compliance reasons)

Guinness Sustianable Energy Fund (31 January 2022)			P/E			EV/EBITDA			Price/Book			Dividend Yield		
Stock	**% of NAV**	**Market Cap USD**	**2021**	**2022E**	**2023E**	**2021**	**2022E**	**2023E**	**2021**	**2022E**	**2023E**	**2021**	**2022E**	**2023E**
Displacement/Efficiency														
Hubbell Inc	4.1%	10,191	22.3x	20.5x	18.4x	15.6x	14.2x	13.3x	4.6x	4.5x	4.2x	2.1%	2.2%	2.4%
Nibe Industrier AB	3.1%	18,915	53.3x	48.1x	43.0x	31.1x	28.4x	25.7x	8.7x	7.7x	6.8x	0.5%	0.6%	0.7%
Ameresco Inc	2.7%	2,609	35.5x	26.6x	24.1x	20.3x	15.1x	14.1x	3.9x	3.6x	3.2x	n/a	n/a	n/a
	9.9%													
Electrification/Battery														
LG Chem Ltd	3.4%	37,235	12.3x	15.6x	13.2x	6.6x	6.7x	5.9x	2.2x	2.0x	1.7x	1.7%	1.7%	1.7%
Samsung SDI Co Ltd	3.7%	33,149	33.4x	26.4x	21.1x	17.1x	13.6x	11.0x	2.7x	2.5x	2.2x	0.2%	0.2%	0.2%
Johnson Matthey PLC	2.7%	4,913	10.6x	9.3x	8.7x	6.3x	6.1x	5.9x	1.2x	1.4x	1.3x	3.1%	3.9%	4.1%
Tianneng Power International Ltd	0.1%	1,158	3.6x	3.1x	2.7x	1.1x	0.9x	0.9x	0.7x	0.6x	0.5x	4.1%	4.5%	4.9%
	9.9%													
Electrification/Electric Vehicles														
Aptiv PLC	3.7%	36,947	52.5x	30.3x	21.0x	18.7x	14.3x	11.3x	4.5x	4.0x	3.5x	0.1%	0.3%	0.4%
ON Semiconductor Corp	4.3%	25,419	21.1x	18.1x	17.2x	13.0x	11.0x	9.8x	5.6x	4.5x	3.8x	n/a	n/a	n/a
Infineon Technologies AG	4.2%	53,235	31.4x	22.5x	20.1x	15.4x	12.3x	11.1x	4.1x	3.7x	3.3x	0.7%	0.9%	1.0%
Sensata Technologies Holding PLC	4.3%	9,090	16.4x	14.5x	12.5x	12.1x	11.1x	10.0x	3.0x	2.6x	2.3x	n/a	n/a	n/a
Gentherm Inc	3.7%	2,904	32.8x	25.8x	19.4x	18.2x	15.0x	12.0x	4.2x	n/a	n/a	n/a	n/a	n/a
	20.3%													
Generation/IPP														
China Longyuan Power Group Corp Ltd	3.6%	27,076	16.8x	14.2x	12.2x	8.8x	7.4x	6.2x	1.7x	1.5x	1.4x	1.2%	1.4%	1.8%
Ormat Technologies Inc	3.3%	3,817	53.4x	42.2x	33.2x	14.1x	12.3x	10.6x	1.9x	1.8x	1.8x	0.7%	0.8%	0.8%
TransAlta Renewables Inc	4.1%	3,651	29.4x	23.6x	20.6x	11.8x	10.9x	10.3x	2.2x	2.3x	2.3x	5.5%	5.4%	5.4%
Albioma SA	1.5%	1,243	19.7x	17.5x	16.5x	9.7x	9.1x	8.6x	2.3x	2.1x	2.0x	2.5%	2.7%	2.9%
China Suntien Green Energy Corp Ltd	2.6%	6,328	6.9x	6.4x	5.7x	7.4x	6.2x	5.2x	0.9x	0.8x	0.7x	5.1%	5.6%	6.4%
	15.0%													
Generation/Utility														
Iberdrola SA	4.7%	72,564	17.5x	15.9x	14.7x	10.5x	9.8x	9.1x	1.7x	1.6x	1.5x	4.3%	4.6%	4.9%
NextEra Energy Inc	4.4%	153,282	30.9x	28.2x	26.0x	22.7x	18.0x	16.5x	3.6x	3.5x	3.3x	2.0%	2.2%	2.4%
	9.1%													
Installation/Equipment														
Schneider Electric SE	4.2%	95,351	25.8x	22.9x	20.3x	17.3x	15.7x	14.2x	3.9x	3.7x	3.4x	1.9%	2.0%	2.2%
Eaton Corp PLC	2.8%	63,150	23.9x	21.2x	19.2x	19.2x	17.1x	15.8x	3.9x	3.8x	3.6x	1.9%	2.0%	2.1%
Itron Inc	2.9%	2,807	51.3x	29.3x	19.6x	23.2x	16.9x	11.7x	2.3x	2.2x	2.1x	n/a	n/a	n/a
Xinyi Solar Holdings Ltd	3.4%	14,139	20.1x	18.1x	14.7x	14.6x	12.9x	10.6x	3.6x	3.2x	2.8x	2.3%	2.5%	3.1%
SolarEdge Technologies Inc	1.6%	12,511	47.3x	35.2x	26.8x	35.0x	24.4x	18.6x	10.0x	7.8x	6.0x	n/a	n/a	n/a
Enphase Energy Inc	1.6%	18,951	61.1x	45.8x	35.8x	52.8x	39.3x	28.7x	28.3x	19.0x	13.2x	n/a	n/a	n/a
First Solar Inc	3.4%	8,334	18.7x	38.3x	21.0x	13.5x	16.8x	11.4x	1.4x	1.3x	1.3x	n/a	n/a	n/a
Canadian Solar Inc	2.7%	1,781	19.5x	9.0x	9.2x	7.1x	4.9x	4.3x	0.9x	0.8x	0.7x	n/a	n/a	n/a
Vestas Wind Systems A/S	3.0%	26,943	61.3x	71.7x	32.7x	16.3x	16.5x	11.8x	5.0x	5.0x	4.5x	0.5%	0.5%	0.9%
Siemens Gamesa Renewable Energy SA	3.2%	14,592	n/a	n/a	55.6x	29.0x	49.6x	14.0x	2.8x	3.2x	3.0x	n/a	0.1%	0.2%
TPI Composites Inc	0.6%	447	n/a	n/a	16.6x	9.0x	6.4x	2.4x	1.6x	1.9x	1.9x	n/a	n/a	n/a
	29.5%													
Cash	**6.2%**													

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

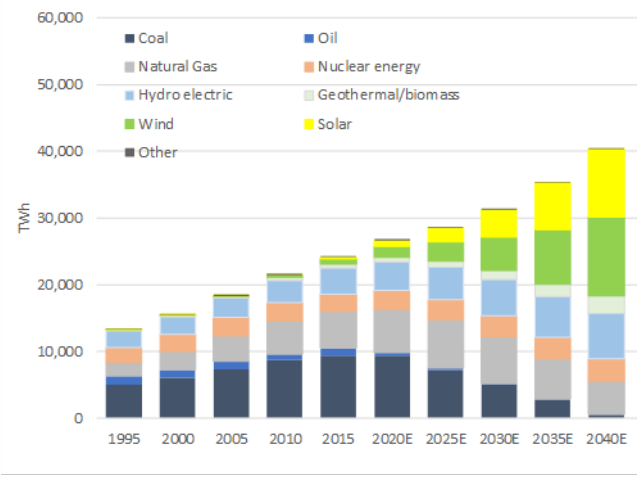
Over the next thirty years, the world will continue its transition to a sustainable energy system. The key factors driving the transition are:

- **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.

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

Policy support for decarbonisation

After very strong policy support in 2020, we witnessed further policy commitment in 2021. The path has not always been smooth, however, with US's return to the Paris Agreement, for example, butting up against resistance to key clean energy spending plans. The most significant policy milestones in 2021 included:

- **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.** Mid-year, the Intergovernmental Panel on Climate Change (IPCC) published their 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, 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.

- **Post COVID stimulus and infrastructure plans.** While policy towards stimulus plans continues to be positive, the passage of actual investment into the energy transition has been slower than expected. The influential US "Build Back Better" (BBB) infrastructure package is the clearest example of the delay between policy announcement and actual investment. After passing the House of Representatives in November, Democratic Senator Joe Manchin announced on December 19th that he would not be supporting the $1.75trn bill (as currently written) thus delaying the passage of the BBB bill through the House of Congress. A compromise bill is likely in our opinion.

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

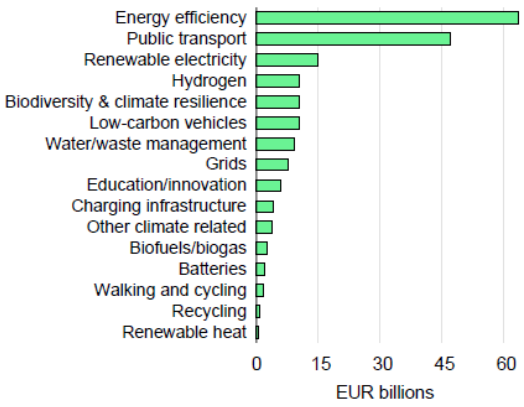
Energy efficiency measures were negatively impacted by COVID in 2020, as projects and investments were disrupted, but it appears that governments are turning their attention to efficiency measures as part of post-COVID stimulus measures. There is urgency to do this as current government policies imply 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



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. 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.

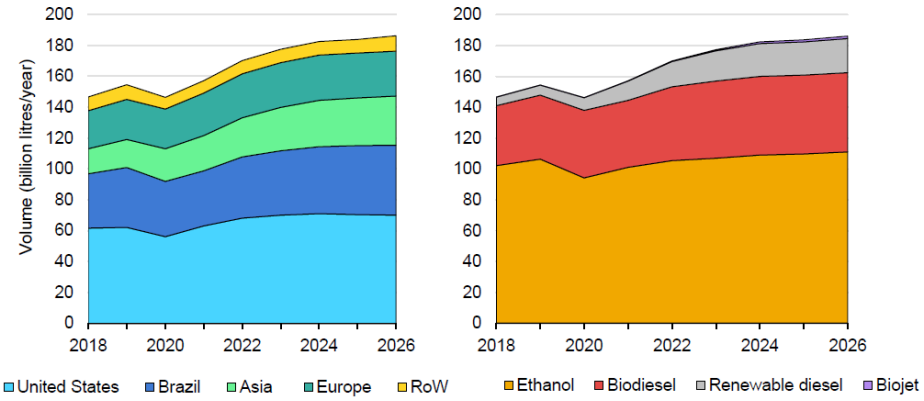
Alternative fuels consumption in 2021 grew by 10% versus 2020 and 3% versus 2019. Demand growth was significantly stronger than the underlying 6% increase in global oil demand, underlining the policy support for increased blending of alternative fuels in the transportation mix. Renewable diesel demand 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



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

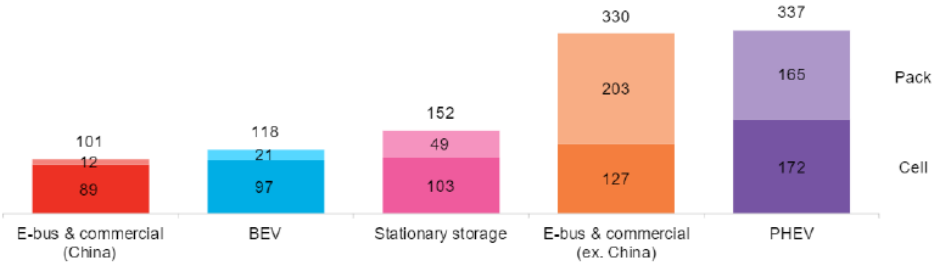
The energy transition is seeing energy demand being 'electrified' as it moves away from predominantly hydrocarbon fuels and gases towards the consumption of electricity. Our 'electrification' sector includes some key enablers of this transition: the lithium-ion battery and the electric vehicle industries. 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

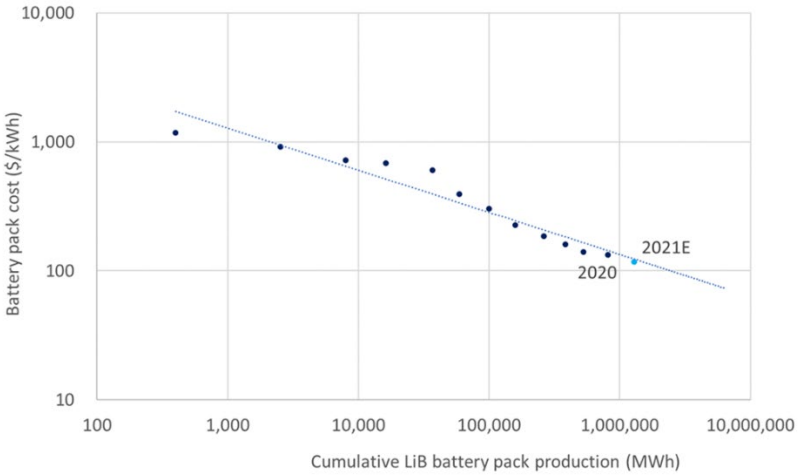


Raw materials make up around 50% of the cost of a lithium-ion battery pack, with cathode materials alone representing around 20% of the total cost. The key catalyst material is lithium carbonate, whose price in China rose by 270% in 2021. While battery manufacturers have long-term contracts and approaches 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, maybe a year or so 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 Asset Management



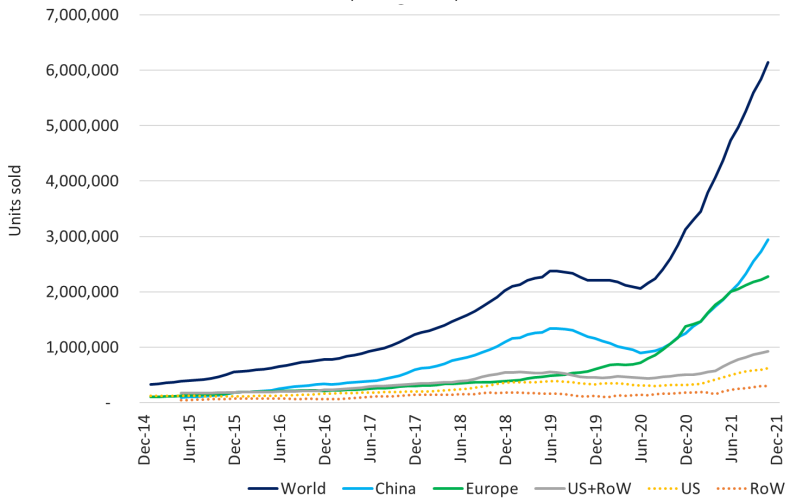
Electric Vehicles

Strong momentum in EV sales growth continued through 2021. On our estimates, nearly 6.1m new EVs were sold in the twelve months to November 2021, a growth of around 116% versus sales in the same period twelve months earlier (affected by COVID) and 178% higher than the same period in 2019. This growth compares very favourably to overall global light vehicle sales growth of 6.8%% and -9.4% for the same periods in 2021 and 2020 respectively. Accordingly, the market share for EVs has increased to around 7.6% for 2021 versus 3.4% and 2.4% in 2020 and 2019 respectively.

Regionally, China has regained its position as the largest EV market with total sales of new EVs of 2.9m in the twelve months to November 2021, up 150% on 2020. Europe, which overtook China to be the largest EV market at the end of 2020, saw total new EV sales of 2.27m units, up 94%. The US still lags Europe and China with new EV sales of 0.6m, up 95% on the same period twelve months earlier.

Global EV sales (rolling 12-month basis up to November 2021)

Source: Guinness, EV-Sales, Cleantechnica

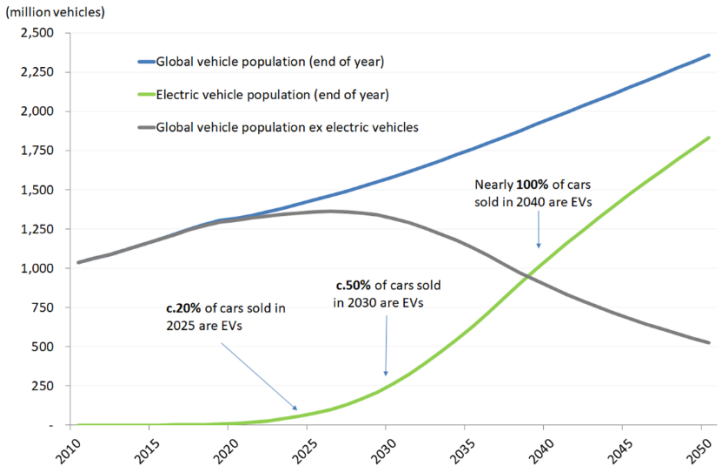


Government support for EVs will reduce in 2022. Europe will continue rolling back its EV "super-credits", and China plans to reduce EV subsidies further. Despite this, we expect global EV sales to exceed 9 million in 2022, representing around 10% of total passenger vehicle sales, taking the global EV stock from 16m vehicles to 25m vehicles.

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 current global population of around 15m EVs. 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 Asset Management



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.

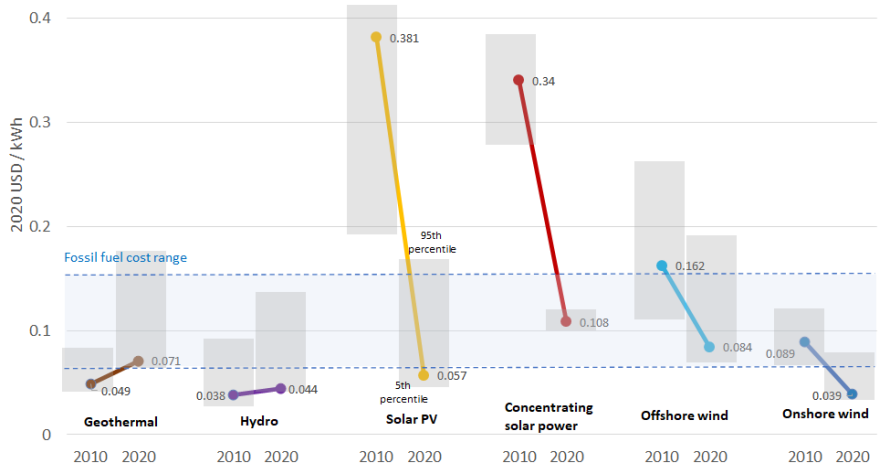
Generation & installation (equipment)

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 (2010–2020)
source: IRENA, Guinness Asset Management estimates



The solar sector

2021 was a year of record installations, but one that also witnessed a tick up in the cost of solar module manufacturing as a result of raw material, power and logistics inflation. These issues slowed installation growth in the fourth quarter and lead us to forecast 173 GW for 2021. Even so, it is level comfortably above our 155 GW forecast for 2021 that we made at the start of the year. In 2020, the IEA described solar power as "now the cheapest electricity in history" and, despite near term headwinds and cyclical cost inflationary factors, large-scale solar remains at the bottom of the cost curve.

We introduce an estimate for 2022 installations of 215 GW (up 42 GW on 2021) and note that the factors creating uncertainty around 2021 installations will also impact 2022 installations. Most projects being installed today utilise projects with modules purchased some months earlier, so full effect of higher costs in 2021 is still to be witnessed in 2022. On the other hand, our checks generally show that affected projects are being delayed rather than cancelled, so projects falling out of 2021 are likely to be delivered in 2022.

Global solar module installations, 2010-2022E (GW)
Source: BP, BNEF, IEA and Guinness Asset Management estimates

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021E	2022E
OECD solar installations (annual)													
North America	1	2	4	6	7	8	14	11	10	11	19	30	25
Germany	7	7	8	3	2	1	2	2	4	4	5	5	6
Spain	0	0	0	0	0	0	0	0	0	5	3	4	5
Rest of Europe	3	4	5	5	5	6	4	3	4	6	8	15	19
Australia	0	1	1	1	1	1	1	2	4	4	4	5	6
South Korea	0	0	0	1	1	1	1	1	2	3	4	4	5
Japan	1	1	2	7	10	11	8	8	7	7	9	7	9
Total OECD	**17**	**23**	**24**	**24**	**25**	**29**	**29**	**26**	**31**	**40**	**51**	**70**	**75**
Change in OECD annual installations	*10*	*7*	*0*	*0*	*2*	*4*	*0*	*-3*	*5*	*9*	*11*	*19*	*5*
Non-OECD solar installations (annual)													
China	0	3	3	14	13	19	30	53	44	33	52	55	75
India	0	0	1	1	1	2	5	10	11	12	4	12	19
Rest of non-OECD	1	3	3	4	6	6	11	9	22	34	37	36	46
Total Non-OECD	**2**	**5**	**8**	**18**	**21**	**27**	**46**	**72**	**77**	**78**	**93**	**103**	**140**
Change in non-OECD annual installations	*1*	*3*	*2*	*11*	*2*	*6*	*19*	*26*	*5*	*1*	*15*	*10*	*37*
Total solar installations (annual)	**19**	**29**	**31**	**42**	**46**	**56**	**75**	**98**	**108**	**118**	**144**	**173**	**215**
Change in world annual installations	*11*	*10*	*2*	*11*	*4*	*10*	*19*	*23*	*10*	*10*	*26*	*29*	*42*

Supply solar supply chain

Most parts of the solar module manufacturing chain were oversupplied in 2021 and will likely remain so in 2022 as new capacity is added across the breadth of the chain, including poly silicon, wafers, cells and modules.

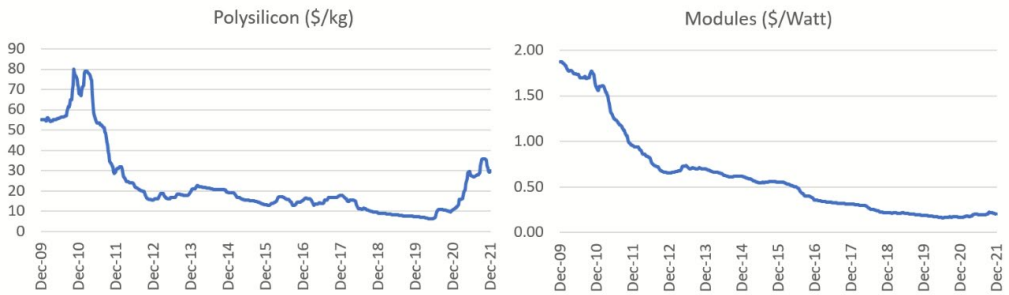
- **Poly-silicon** is a key raw material for a solar wafer. This was the tightest part of the solar market in 2021, evidenced by poly-silicon prices nearly trebling over the year to end the year at around US$30/kg. The price strength allowed poly-silicon manufacturers to realise super normal profits and is incentivising a supply response. Capacity averaged around 460 MT in 2021 but around 190 MT of new Chinese supply

(representing 40% of 2021 capacity) has either recently started or is about to start production.

- **Wafer and solar cell** manufacturing capacity increased by over 60% in 2021 while mono wafer prices have increased by around 75%. The increase in capacity leaves this part of the value chain as oversupplied in 2022 as it was in 2021 although 78% of 2022 wafer capacity is in the hands of the five largest producers.

- **Solar module** prices have increased around 25% during 2021 (to around US$0.28/Watt according to BNEF) – back to where they were in mid-2018. Module manufacturing continues to be significantly oversupplied with around 470 GW of available capacity in 2022, of which around 310 GW is newer 'Tier 1' capacity with lower costs resulting from the scale of manufacturing and new technologies.

Poly-silicon and solar module pricing
source: Bloomberg



Solar installations by region

Installations by country and region are affected by a wide range of factors:

- **China**, which represents around one third of global solar installation demand, is likely to see lower installations in 2021 than initially expected. Cost inflation could therefore cause actual 2021 installations to be biased lower. Any shortfall is expected to be only a short-term delay and to be delivered in 2022, leading to an upside bias here. Recent comments from President Xi at COP15 indicate that annual Chinese solar installations could rise to 130-150 GW (versus around 50 GW in 2020).

- **India** is still small in terms of global solar installations (4GW in 2020 and potentially 12GW in 2021) but installations could grow by around 50% in 2022. The Indian market has good potential and is being driven by the large conglomerates such as Ambani, Tata Power and Adani Green that publicly stated plans to install 100GW, 30 GW and 45GW respectively by 2030, thus forming a large part of India's overall 450 GW installation plan for 2030.

- Solar installations in the **United States** continued in 2021 to surprise to the upside. The estimated 30 GW of installation in 2021 has been supported by the investment tax credit (ITC) and support for local manufacturing of clean power equipment.

- The new coalition government in **Germany** has a target of installing 200 GW of solar by 2030, biased to residential projects.

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 700 GW with annual installations in 2022 expected to be around 84 GW.

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 Asset management estimates

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021E	2022E
Onshore wind installations (annual)															
North America	9	11	6	8	15	2	7	10	9	8	8	10	17	16	8
Latin America	0	0	0	0	0	0	5	3	3	3	4	4	2	5	5
Europe	6	9	9	10	12	11	11	11	12	13	8	9	12	16	18
China	6	14	17	18	14	15	21	29	22	17	19	26	54	29	31
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	9	5
Total onshore	**27**	**38**	**35**	**40**	**46**	**33**	**49**	**61**	**55**	**49**	**46**	**55**	**91**	**78**	**71**
Change in onshore annual installations		*12*	*-3*	*5*	*6*	*-14*	*17*	*11*	*-6*	*-6*	*-3*	*9*	*36*	*-13*	*-7*
World ex China	*21*	*24*	*18*	*22*	*32*	*18*	*29*	*32*	*33*	*32*	*27*	*29*	*37*	*49*	*40*
Offshore wind installations (annual)															
China	0	0	0	0	0	0	0	1	1	1	2	3	4	5	3
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	3	6
Total offshore	**0**	**0**	**1**	**0**	**2**	**2**	**1**	**4**	**1**	**4**	**4**	**8**	**7**	**11**	**13**
Change in onshore annual installations		*0*	*1*	*-1*	*1*	*1*	*-1*	*4*	*-4*	*3*	*0*	*3*	*-1*	*4*	*2*
World ex China	0	0	1	0	1	2	1	3	0	4	3	5	3	5	10
Total wind installations (annual)	**27**	**38**	**36**	**40**	**48**	**35**	**50**	**65**	**56**	**53**	**50**	**63**	**98**	**89**	**84**
Change in world annual installations		*12*	*-2*	*4*	*8*	*-13*	*16*	*15*	*-9*	*-3*	*-2*	*12*	*35*	*-9*	*-5*

Onshore wind

Global onshore wind installations in 2021 were around 78 GW, down 13 GW from the record level seen in 2020 but still up 23 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 3GW 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 30 GW of installations in 2022.

Outside China, onshore installations reached a new high in 2021, averaging 49 GW, up 12 GW on 2020 levels. Onshore installations outside China are expected to be lower in 2022, averaging around 40 GW, as the surge of policy and tax incentive-led demand falls off and post-COVID supply chain issues and cost inflation start to impact the value chain. A level of 40 GW is still higher than any year prior to 2020.

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 14% of the size of onshore (by annual installations in 2021), but one where the growth trajectory is becoming increasingly visible.

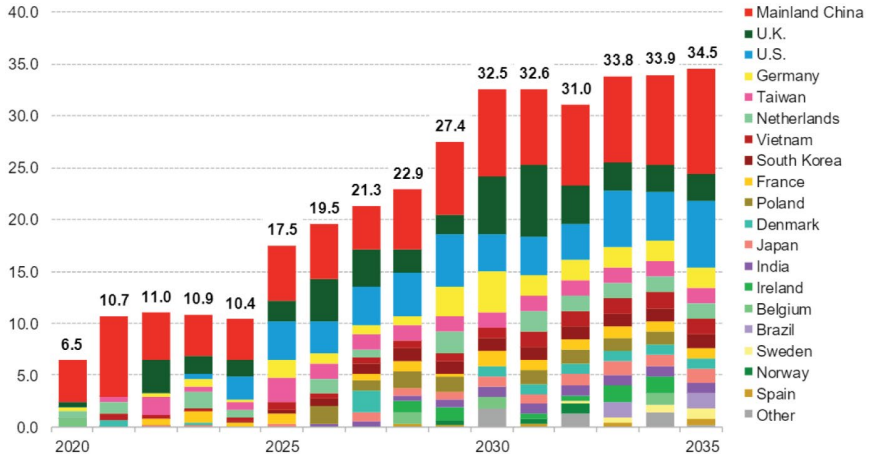
Annual installations of offshore wind capacity have increased from 0.9 GW in 2010 to a new high of 11 GW in 2021. Chinese offshore installations reached 5 GW in 2021 while ex-China installations are likely to grow from 5 GW in 2021 to a new high of 10 GW in 2022.

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 140GW. 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



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