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.

August 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.

HOPE REMAINS FOR A US CLIMATE STIMULUS PACKAGE

After months of Joe Manchin blocking the Build Back Better bill from passing, the West Virginia Senator and Senate majority leader, Chuck Schumer, announced a reconciliation deal in July. The rebranded and revamped "Inflation Reduction Act of 2022" reserves $369bn in support for energy security and climate change.

We explore how this support will be primarily delivered via Production and Investment Tax Credits which have helped to drive the US wind and solar industries to date. If passed, we would view this package as broadly positive for the US clean energy sector, benefitting many names held in the Guinness Sustainable Energy Fund.

EQUITIES

Sustainable energy equities outperformed global stock markets in July. The Guinness Sustainable Energy Fund (Class Y) delivered a return of +14.4% (in USD), ahead of the MSCI World at +7.9%. Year to date, the Guinness Sustainable Energy Fund (Class Y) has delivered -11.2% (in USD), versus the MSCI World at -14.2%.

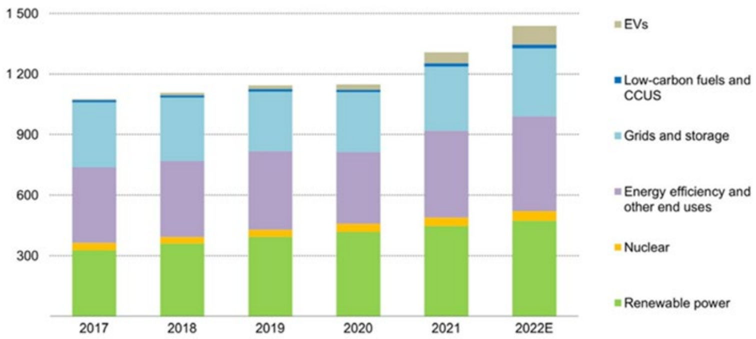
The Fund's performance in the month was led by the efficiency (+27.1%) and equipment (+23.2%) sub sectors while generation and battery names were underperformers.

CHART OF THE MONTH

Global clean energy investment in 2022 is expected to be around $1.4tn and growing. Clean energy represents around 55% of total annual energy investment and 75% of the total growth in 2022. According to the IEA, this needs to increase to an estimated $4.5tn per annum in order to limit global warming to 1.5 degrees.

Annual clean energy investment (USD bn)

(Source: IEA; Guinness Global Investors estimates)



Signatory of:

PRI Principles for Responsible Investment

Contents

1. JULY 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
Cleantechnica reported that June saw record electric vehicle sales around the global, reaching 913,000 units, increasing 54% from June 2021. In the month, plug-in vehicles represented a 16% share of the overall automotive market with battery electric vehicles (BEVs) themselves reaching 12% share.	Electric vehicles	↗
The EU called on members to significantly cut gas demand, warning that without increased efficiency the continent risks running short this winter as Russia restricts supplies. The European Commission will provide member states with voluntary gas reduction targets which may be made mandatory in the event of severe disruptions to supplies. Efforts to restrict gas consumption could involve limiting central heating and cooling in buildings, exempting coal-fired power stations from emissions reduction targets, and auctioning gas to industry.	European gas consumption	↘
The Greater London Authority (GLA) announced that the grid has run out of capacity to power new home in west London. This could mean that developers may be prevented from starting projects in Hillingdon, Ealing and Hounslow until grid capacity can be increased which may take until 2035. The GLA blamed pressure on the grid being exacerbated by a number of energy intensive data centres being built in recent years.	Future grid investment	↗
Chinese solar installations nearly doubled in the first half of 2022, according to the China Photovoltaic Industry Association. Around 31GW of new solar power capacity was built between January and June 2022, up 137% from 2021. This brought the country's total solar capacity to 340GW. Installations are expected to break records again in 2022 at 75-90GW, up from a peak of 54.9GW in 2021.	Solar	↗
The French government is planning to fully nationalise EDF, buying out the 16% stake it does not currently own. The state is offering to pay €9.7bn for the nuclear specialist (€12 per share) in order to shore up the company's finances amid the current energy crisis. EDF has struggled with outages in recent months, which have forced France to pay up for expensive energy imports as Europe attempts to move away from Russian gas.	Nuclear	→

2. MANAGER'S COMMENTS

Hope remains for a US climate stimulus package

This month, we discuss Senator Joe Manchin and Chuck Schumer's proposed Inflation Reduction Act of 2022, its potential $369bn in support for energy security and climate change in the US, and the sectors that are set to benefit if it can be passed in the Senate.

In the US, the big will-they-won't-they question over whether the Build Back Better (BBB) bill will be passed has seen a fresh injection of excitement. After initially being a key Democratic hold-out, Senator Joe Manchin surprised Senate Republicans (and his own party) by striking a deal with Senate majority leader, Chuck Schumer, to advance a package of clean energy incentives. Up to this point, Manchin had opposed the bill on the grounds that it would fuel soaring inflation. The centrist Democratic Senator from West Virginia, a top US state for coal and gas production, also wanted to ensure the bill did not negatively impact the fossil fuel industry. Manchin announced that the bill has been rebranded from the Build Back Better bill to the Inflation Reduction Act of 2022.

The stated aims of the Inflation Reduction Act of 2022 (the Act) are to:

- Reduce the deficit to fight inflation;
- Lower energy costs while incentivising clean energy production and promoting a 40% reduction in carbon emissions by 2030;
- Allow Medicare to negotiate drug prices and caps out-of-pocket costs to $2,000;
- Lower healthcare premiums;
- Make the biggest corporations and ultra-wealthy pay their fair share of tax; and
- Close tax loopholes and improve enforcement of the tax code.

Top-line estimates for the Inflation Reduction Act of 2022

TOTAL REVENUE RAISED	**$**	**739 bn**
15% Corporate Minimum Tax	$	313 bn
Prescription Drug Pricing Reform	$	288 bn
IRS Tax Enforcement	$	124 bn
Carried Interest Loophole	$	14 bn
TOTAL INVESTMENTS	**$**	**433 bn**
Energy Security and Climate Char	$	369 bn
Affordable Care Act Extension	$	64 bn
TOTAL DEFICIT REDUCTION	**$**	**306 bn**

Source: Guinness estimates

The $369bn package targeting climate and energy security focuses on reducing emissions from electricity generation, transport, industrial manufacturing, buildings, and agriculture by providing:

- Financial support for clean sources of electricity and energy storage;
- Tax credits and grants for clean fuels and clean commercial vehicles;
- Grants and tax credits to reduce emissions from industrial manufacturing processes;
- Funding for US-made clean products; and

- Funding to reduce emissions in disadvantaged communities and from leaks from natural gas production and distribution.

It appears that many of the measures discussed in the BBB bill have been carried over into the Inflation Reduction Act. At a high level, support for the US renewable energy industry will be facilitated by the Investment Tax Credit (ITC), the Production Tax Credit (PTC), and a support package for clean transportation which are discussed in more detail below.

Investment Tax Credit (ITC)

The ITC was first implemented in 2006 and has helped to spur the nation's solar industry, allowing companies and consumers to reduce their tax bill by a percentage of the cost of the installed solar system. From an initial level of 30%, the ITC stands at 26% through 2022 and is set to fall to 22% in 2023 and to 10% in 2024 and beyond (only for commercial customers). The proposed Act would provide a 10-year extension of the ITC, restoring the credit to 30% through 2032, before stepping it down to 26%/22%/0% in 2033/34/35. It provides additional 10% 'bonus' credits for systems installed in low-income communities or systems where over 40% of the iron, steel, or manufactured components are sourced domestically. This implies that certain projects could qualify for up to a 50% ITC. For the first time, the ITC will also be made eligible for stand-alone energy storage, heat pumps, and water heaters.

Recent history of the Investment Tax Credit

Source: U.S. Internal Revenue Service

Production Tax Credit (PTC)

The PTC was first enacted in the Energy Policy Act of 1992 and has helped drive significant growth in the US onshore wind industry. It was initially set to lapse in 1999 but has since been extended 12 times. The tax credit amount is based on 1.5c/kWh in 1993 dollars, and is inflation adjusted annually. The new Act could see a 10-year extension of the PTC (previously set to be phased out by 2023) set at an amount of around 2.6c/kWh, which would continue to be adjusted with inflation. The Act also extends the PTC to include both nuclear and hydrogen production (3c/kWh and up to 60c/kg respectively) alongside incentives to develop a domestic clean energy supply chain including $3/kg for polysilicon, 4c/watt for solar cells, 7c/watt for solar modules, $35/kWh for batteries, 2c/watt for wind blades, 87c/watt for tracker torque tubes and a range of 2.5-11c/watt for inverters. The same 10% bonuses for installations in lower income communities and local content would also apply to the PTC.

Support for Clean Transportation

The Act includes provisions for the purchase of battery electric vehicles (BEVs) and fuel-cell electric vehicles (FCEVs). Consumers that earn less than $150,000 per year could receive a $4,000 tax credit to buy a second-hand BEV/FCEV, increasing to $7,500 for a new BEV/FCEV. The Act would remove the 200,000 electric vehicle tax credit limit, making Tesla and GM eligible again. There are provisions for $3bn in funding for zero-emission equipment and technology at ports; $1bn for clean heavy-duty vehicles (e.g. buses); $2bn in grants to help transition auto manufacturing facilities into electric vehicle factories; and $20bn of loans for new clean vehicle manufacturing facilities. The Act also encompasses continued support for alternative fuels, including the extension of the $1/gallon Biodiesel Blenders Tax Credit (BTC) through to 2024. Beyond 2024, a new Clean Fuel Producers Credit (CFPC) would be introduced (initially for 2025-27), providing up to $1/gallon credit for domestically produced biofuels. Both the BTC and CFPC have specific carve outs for sustainable aviation fuel, resulting in a credit of $1.25-1.75/gallon.

Getting Manchin onboard is a hugely positive step, but the Act's future is still precarious. Schumer cannot afford to lose a single vote among Senate Democrats and the House speaker, Nancy Pelosi, can only afford to lose a few Democratic votes in the House. On top of this, Covid continues to add to the drama, keeping some Senators out, and the Act needs to be passed at pace or risk being picked apart by lobbyists. If all goes smoothly, House Democrats may hold a vote on the package in mid-August. If passed, the Act would be a material positive for most subsectors owned within the fund e.g. energy efficiency products, electric vehicle component suppliers, solar module manufacturers, wind blade manufacturers and renewable energy generators.

3. PERFORMANCE

Past performance does not predict future returns.

The Guinness Sustainable Energy Fund (Class Y, 0.68% OCF) delivered a return of +14.4% in the month, while the MSCI World Index (net return) delivered +7.9% (all in USD terms).

	Ytd	1 Yr	3 Yrs	5 Yrs*	10 Yrs*
Fund (Class Y)	-11.2%	-9.3%	101.1%	111.2%	207.7%
MSCI World NR Index	-14.2%	-9.2%	31.6%	52.5%	164.4%
Out/Underperformance	*-3.0%*	*-0.2%*	*69.5%*	*58.7%*	*43.3%*

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%*

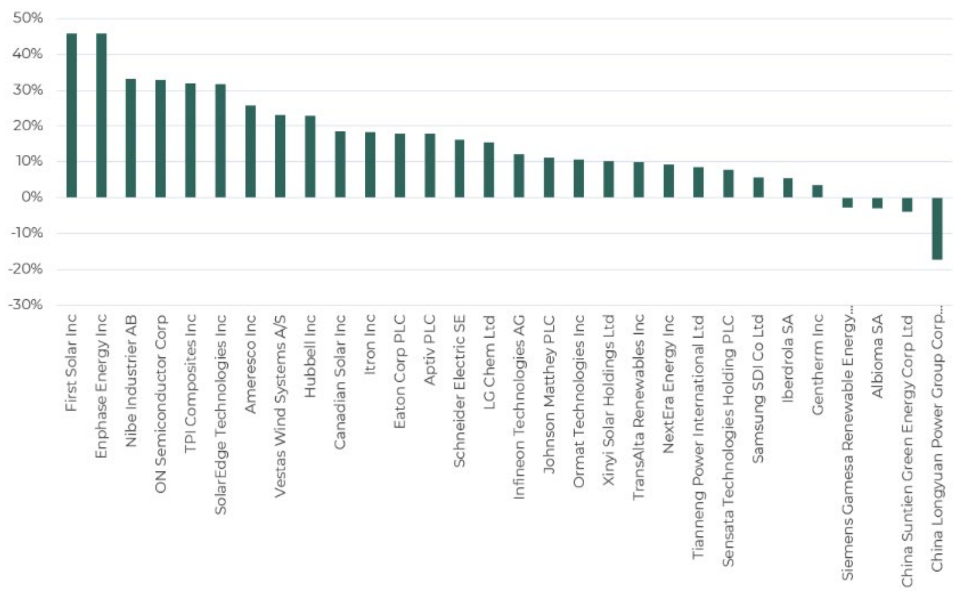
Annual performance	2016*	2015*	2014*	2013*	2012*
Fund (Class Y)	-15.4%	-12.0%	-12.1%	70.8%	-13.2%
MSCI World NR Index	7.5%	-0.9%	4.9%	26.7%	15.8%
Out/Underperformance	*-23.0%*	*-11.2%*	*-17.0%*	*44.1%*	*-29.1%*

*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 First Solar, Enphase, Nibe, onsemi, and TPI Composites. The weakest performers were China Longyuan, China Suntien, Albioma, Siemens Gamesa, and Gentherm.

Stock by Stock performance over the month, in USD

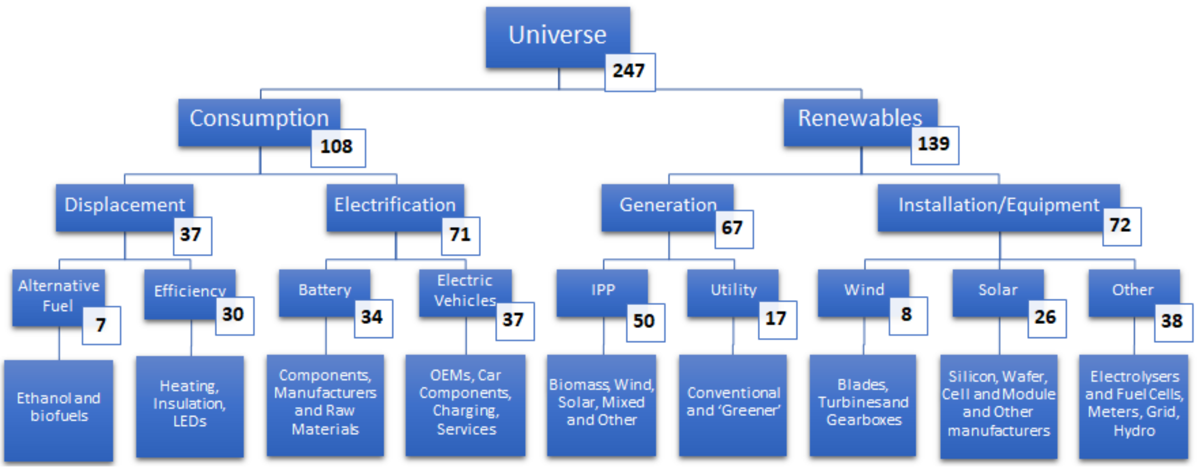


Source: Bloomberg. As of 31 July 2022

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

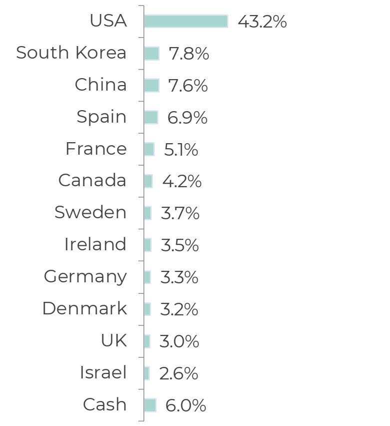
7 AFFORDABLE AND CLEAN ENERGY | 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE | 11 SUSTAINABLE CITIES AND COMMUNITIES | 13 CLIMATE ACTION

Buys/Sells

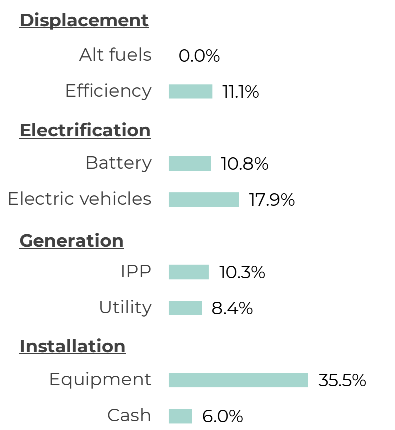
There were no stock switches during the month, but the portfolio was actively rebalanced.

Portfolio structure analysis

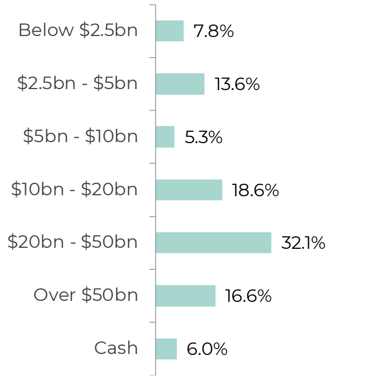
Geographic Analysis



Classification Analysis



Market Cap Analysis



Median market cap $13.8bn
Average market cap $24.7bn

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	
	Jul-22		Dec-21	Dec-20	Dec-19	Dec-18
Consumption	**39.8%**	***-3.6%***	**43.4%**	**36.7%**	**41.7%**	**26.5%**
Displacement	11.1%	*-0.6%*	11.8%	9.9%	13.4%	16.4%
Alternative Fuel	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*3.9%*
Efficiency	*11.1%*	*-0.6%*	*11.8%*	*9.9%*	*13.4%*	*12.5%*
Electrification	28.7%	*-3.0%*	31.6%	26.8%	28.2%	10.1%
Batteries	*10.8%*	*1.9%*	*8.9%*	*10.8%*	*12.6%*	*3.9%*
Electric vehicles	*17.9%*	*-4.9%*	*22.8%*	*16.0%*	*15.7%*	*6.2%*
Renewables	**54.2%**	***2.9%***	**51.3%**	**60.4%**	**54.1%**	**69.7%**
Generation	18.7%	*-4.4%*	23.1%	24.6%	22.2%	27.3%
IPP	*10.3%*	*-4.3%*	*14.5%*	*17.0%*	*18.9%*	*26.7%*
Utility	*8.4%*	*-0.1%*	*8.6%*	*7.6%*	*3.2%*	*0.6%*
Installation	35.5%	*7.3%*	28.2%	35.8%	32.0%	42.5%
Equipment	*35.5%*	*7.3%*	*28.2%*	*35.8%*	*32.0%*	*42.5%*
Cash	6.0%	*0.7%*	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 July 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	25.0x	23.8x	19.6x	14.3x	14.0x	11.6x	1.1%	1.3%	5.1%	18.2%	6.2%	7.2%
MSCI World Index	18.3x	16.2x	15.2x	12.3x	10.9x	10.7x	2.1%	2.2%	6.7%	9.6%	8.7%	9.0%
Fund Premium/(Discount)	*37%*	*47%*	*29%*	*16%*	*28%*	*8%*						

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

Source: Guinness Global Investors, Bloomberg

Portfolio holdings as at end July 2022

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

We hold c.40% 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 (11%) or the electrification of transportation (18% weight) while we have an 11% 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 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), 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 19% weight to companies involved in the generation of sustainable energy and 36% 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 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 July 2022

	Theme	Example holdings	Weighting (%)
1	Electrification of the energy mix	TransAlta renewables, NextEra Energy	20.8%
2	Rise of the electric vehicle and auto efficiency	Sensata Technologies, APTIV	20.8%
3	Battery manufacturing	Samsung SDI	7.8%
4	Expansion of the wind industry	Siemens Gamesa Renewable Energy, Vestas	11.3%
5	Expansion of the solar industry	CanadianSolar	17.3%
6	Heating, lighting and power efficiency	NIBE Industrier	11.1%
7	Geothermal and biomass	ORMAT, ALBIOMA	4.8%
8	Other (inc cash)		6.0%

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

Guinness Sustainable Energy Fund (30 June 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	4.4%	9,583	21.2x	19.1x	17.4x	14.6x	13.5x	12.3x	4.4x	4.2x	3.9x	2.2%	2.4%	2.5%
Nibe Industrier AB	3.2%	15,153	42.5x	40.8x	35.5x	24.9x	24.3x	21.2x	6.8x	6.3x	5.6x	0.7%	0.7%	0.8%
Ameresco Inc	2.5%	2,360	32.0x	24.4x	22.2x	20.8x	15.2x	13.9x	3.5x	3.0x	2.6x	n/a	n/a	n/a
	10.0%													
Electrification/Battery														
LG Chem Ltd	3.7%	28,274	9.4x	15.2x	12.0x	5.5x	6.4x	5.3x	1.7x	1.4x	1.3x	2.3%	2.0%	2.3%
Samsung SDI Co Ltd	4.3%	28,396	28.6x	23.0x	18.8x	15.3x	13.0x	10.5x	2.3x	2.2x	2.0x	0.2%	0.2%	0.2%
Johnson Matthey PLC	3.0%	4,294	9.5x	9.0x	9.3x	5.4x	5.6x	6.1x	1.1x	1.3x	1.3x	3.4%	4.1%	4.2%
Tianneng Power International Ltd	0.1%	1,218	4.5x	3.5x	3.0x	1.2x	1.0x	0.9x	0.6x	0.5x	0.5x	4.7%	5.8%	6.4%
	11.1%													
Electrification/Electric Vehicles														
Aptiv PLC	3.4%	24,132	34.0x	22.8x	14.8x	12.6x	10.5x	8.0x	2.9x	2.7x	2.3x	0.1%	0.0%	0.3%
ON Semiconductor Corp	3.9%	21,860	17.8x	10.3x	10.3x	10.7x	6.4x	6.5x	4.8x	3.3x	2.7x	n/a	n/a	n/a
Infineon Technologies AG	3.4%	31,610	18.7x	13.1x	12.5x	9.5x	7.7x	7.2x	2.5x	2.3x	2.0x	1.2%	1.4%	1.6%
Sensata Technologies Holding PLC	3.8%	6,482	11.8x	10.7x	9.2x	9.8x	9.2x	8.3x	2.1x	2.0x	1.7x	n/a	0.7%	1.0%
Gentherm Inc	3.3%	2,068	23.4x	23.3x	15.4x	12.9x	12.5x	8.8x	3.0x	n/a	n/a	n/a	n/a	n/a
	17.8%													
Generation/IPP														
China Longyuan Power Group Corp Ltd	3.5%	22,829	16.2x	14.2x	12.0x	12.3x	11.3x	9.8x	1.7x	1.6x	1.4x	1.2%	1.4%	1.6%
Ormat Technologies Inc	3.9%	4,393	63.5x	61.0x	42.2x	15.9x	14.6x	12.1x	2.2x	2.1x	2.1x	0.6%	0.6%	0.6%
TransAlta Renewables Inc	1.3%	3,410	26.7x	23.6x	19.6x	11.4x	10.4x	10.0x	2.1x	2.3x	2.3x	5.8%	5.7%	5.7%
Albioma SA	1.2%	1,693	26.7x	27.6x	23.5x	11.4x	12.0x	10.9x	3.1x	3.0x	2.7x	1.8%	1.8%	2.0%
NextEra Energy Inc	4.9%	152,170	30.7x	27.2x	26.0x	22.0x	19.1x	16.1x	3.6x	3.6x	3.3x	2.0%	2.2%	2.4%
China Suntien Green Energy Corp Ltd	2.1%	5,256	5.7x	6.0x	5.1x	12.6x	12.2x	10.8x	0.8x	0.7x	0.6x	6.3%	5.5%	6.3%
	16.9%													
Generation/Utility														
Iberdrola SA	4.2%	66,783	15.6x	15.2x	14.0x	9.7x	9.6x	8.9x	1.5x	1.5x	1.4x	4.8%	4.7%	5.0%
	4.2%													
Installation/Equipment														
Schneider Electric SE	4.0%	67,381	17.7x	16.4x	14.8x	12.8x	12.1x	11.1x	2.7x	2.5x	2.3x	2.7%	2.7%	3.0%
Eaton Corp PLC	4.0%	50,270	19.0x	16.8x	15.1x	16.3x	13.9x	12.7x	3.1x	2.9x	2.8x	2.4%	2.6%	2.7%
Itron Inc	3.0%	2,227	40.9x	38.6x	17.8x	18.0x	19.4x	10.8x	1.9x	1.9x	1.7x	n/a	n/a	n/a
Xinyi Solar Holdings Ltd	3.3%	13,737	19.6x	20.1x	15.3x	15.0x	14.0x	10.8x	3.5x	3.2x	2.8x	2.3%	2.3%	3.0%
SolarEdge Technologies Inc	2.3%	15,158	54.5x	40.6x	28.2x	41.7x	30.5x	20.3x	11.5x	6.8x	5.6x	n/a	n/a	n/a
Enphase Energy Inc	2.7%	26,363	84.5x	55.8x	43.7x	74.9x	45.3x	34.7x	39.3x	38.1x	20.7x	n/a	n/a	n/a
First Solar Inc	3.9%	7,262	16.4x	n/a	31.1x	12.0x	40.7x	14.8x	1.2x	1.2x	1.2x	n/a	n/a	n/a
Canadian Solar Inc	3.0%	1,998	21.7x	10.8x	7.3x	6.9x	5.6x	4.0x	1.0x	0.9x	0.8x	n/a	n/a	n/a
Vestas Wind Systems A/S	3.0%	21,336	49.2x	n/a	40.6x	13.4x	31.5x	12.0x	3.9x	5.0x	4.6x	0.6%	0.2%	0.7%
Siemens Gamesa Renewable Energy SA	3.6%	12,789	n/a	n/a	220.9x	27.8x	1074.1x	19.3x	2.4x	3.2x	3.2x	n/a	n/a	0.0%
TPI Composites Inc	0.6%	466	n/a	n/a	n/a	19.6x	14.8x	6.8x	1.6x	2.2x	2.1x	n/a	n/a	n/a
	33.3%													
		23.14%												
Cash	**6.6%**													
Portfolio	**100.0%**		**22.0x**	**20.8x**	**16.9x**	**13.0x**	**12.6x**	**10.3x**	**2.4x**	**2.4x**	**2.2x**	**1.3%**	**1.3%**	**1.5%**

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:

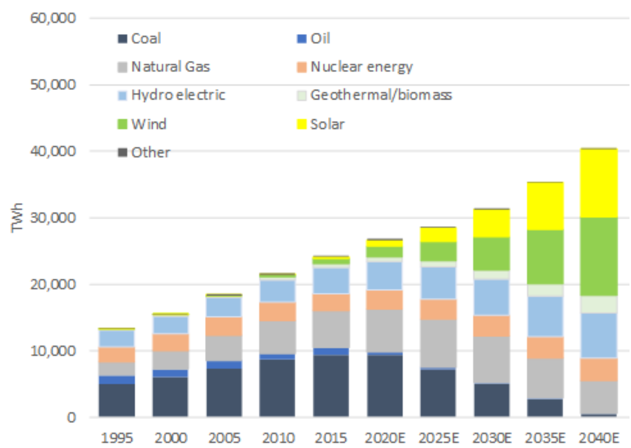
- **Population and GDP growth** putting a significant strain on today's energy supply
- **Economics** as sustainable sources of energy will be cheaper than the incumbents
- **Climate change** leading the world to reduce carbon emissions via cleaner energy
- **Pollution** forcing governments to drive 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 31.12.2020

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 $MtCO_2e$) 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 is likely, in our opinion, but probably not until the end of 2022. In addition, the REPowerEU deal that was announced in March 2022 is unlikely to yield new investments until 2023/2024 and well into the second half of this decade.

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**.

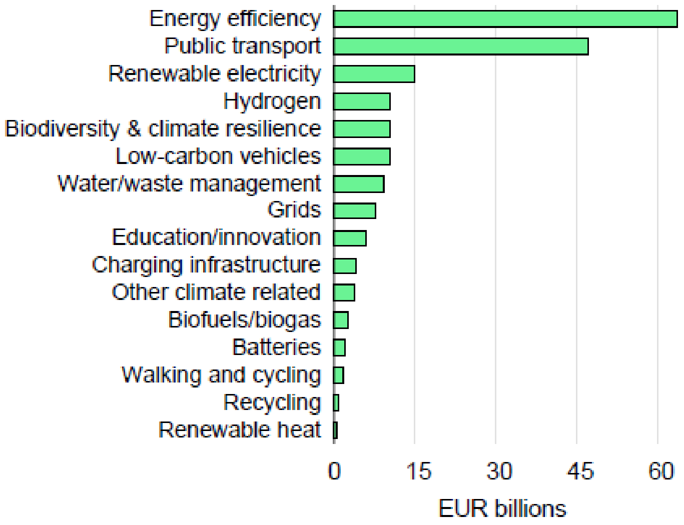
Energy efficiency

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

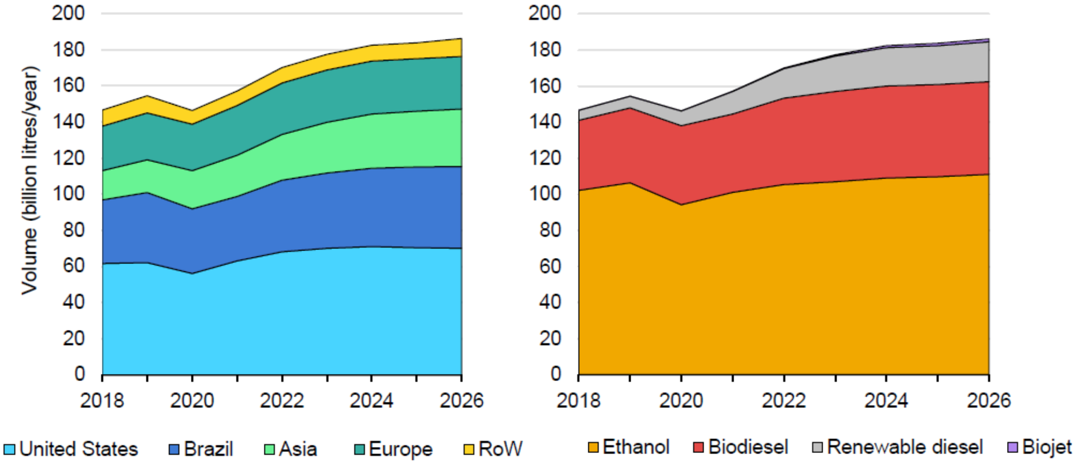
Alternative fuels such as ethanol (which displaces gasoline), biodiesel and renewable diesel (which displace conventional diesel) and Sustainable Aviation Fuels (SAF, which displace conventional jet fuel) serve a role in displacing existing fossil fuel demand, predominantly in transportation. In 2021, 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.

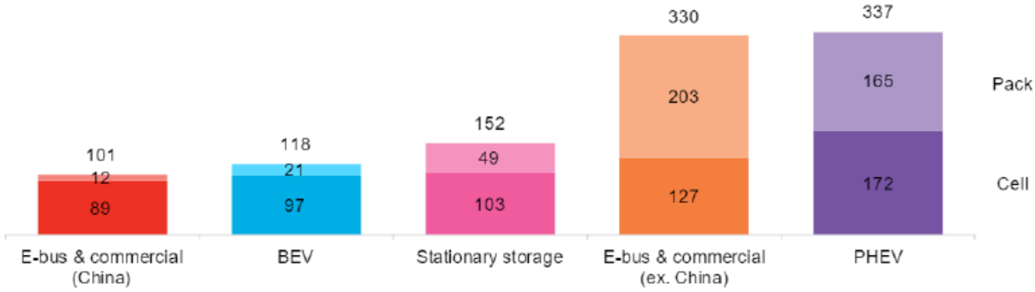
Batteries

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



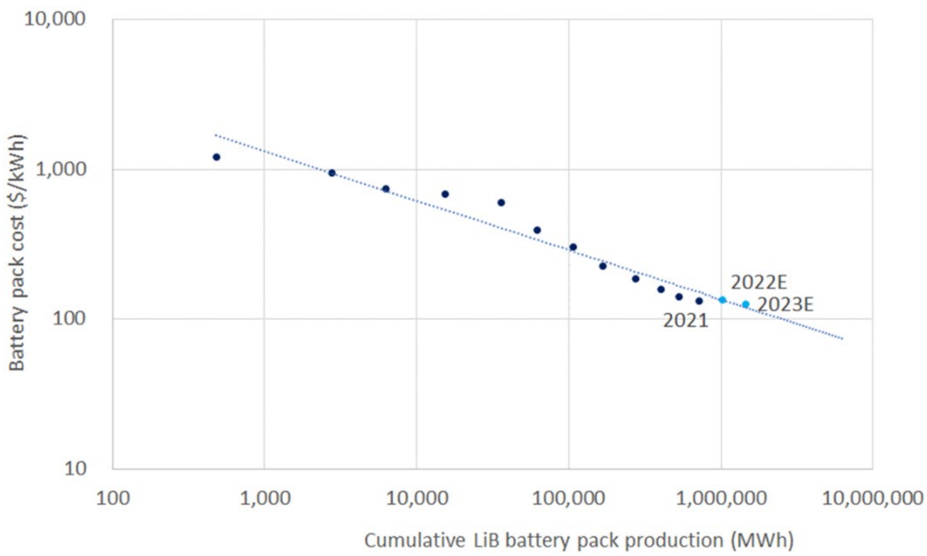
Raw materials make up around 50% of the cost of a lithium-ion battery pack, with cathode materials alone representing around 30% of the total cost. The key catalyst material is lithium carbonate, whose price in China rose by 270% in 2021. While battery manufacturers have long-term contracts and approaches 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

Strong momentum in EV sales growth continued through 2021 and so far in 2022. On our estimates, nearly 6.5m new EVs were sold in 2021, more than double the sales in the same period 12 months earlier (affected by Covid) and 178% higher than the same period in 2019. Electric vehicle (EV) sales have seen a strong start to 2022 with 3.2m units sold to the end of May, up 65%

on the same period last year. This growth continues to compare favourably against broader passenger vehicle sales (down 4% over the same period). We estimate that the 12-month rolling EV sales penetration rate at the end of May 2022 stood at 9.2% versus 5.0% and 2.4% at the end of May 2021 and May 2020. We forecast 20% of global passenger vehicle sales will be electric by 2025 and 50% by 2030.

To the end of May 2022, China has extended its dominance as the largest plug-in vehicle market in the world, selling 1.8m units (more than the 965k for Europe and 480k for the rest of the world combined). China's turbocharged rate of adoption drove monthly penetration rates to 31% in May 2022 compared to 12% in May 2021 and 4% in May 2020.

Global EV sales growth (rolling 12-month basis up to May 2022)

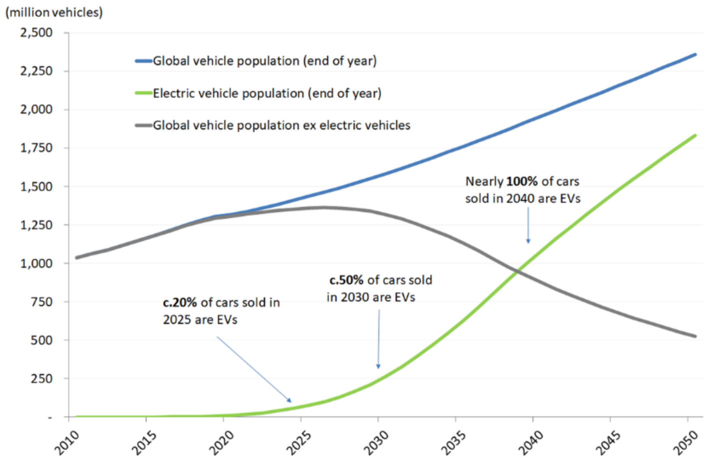
Source: Guinness Global Investors, EV-Sales, Cleantechnica

Government support for EVs is reducing 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 10 million in 2022, representing around 10% of total passenger vehicle sales, taking the global EV stock from 16m vehicles to over 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 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.

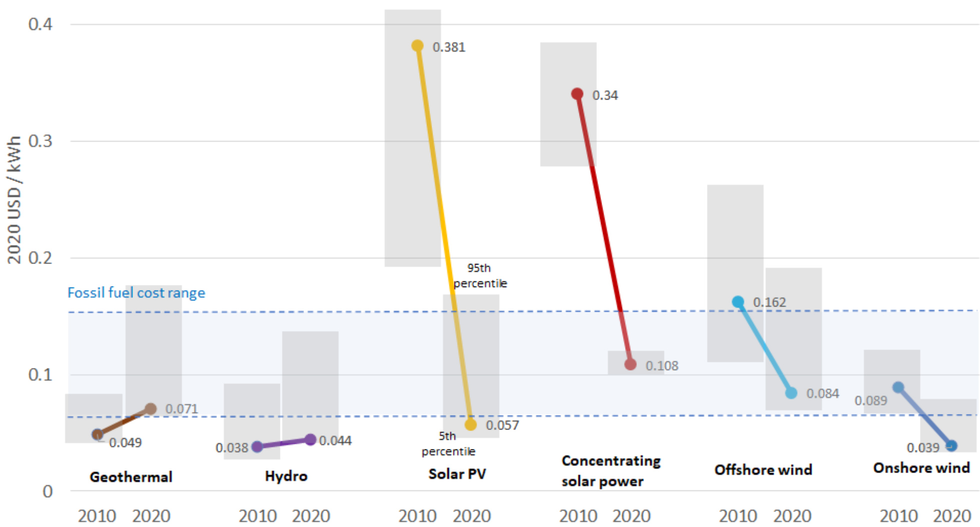
Generation & installation (equipment)

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 (2010–2020)

source: IRENA, Guinness Global Investors 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 to installations of 184 GW for 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.

Market estimates for global solar installations were for around 215 GW in 2022 but a strong start end to 2021 and start to 2022 leads us to expect installations will now be more like 250 GW (up 66 GW vs 2021). The growth has come from Asia and Europe and is likely to be achieved despite regulatory issues (for example the withhold release order (WRO) as well as anti-dumping/ countervailing duty (AD/CVD) investigations) that almost made US utility solar installations grind to a halt in the first half of the year).

Global solar module installations, 2010-2022E (GW)

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

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022E
OECD solar installations (annual)													
North America	1	2	4	6	7	8	14	11	10	11	19	30	20
Germany	7	7	8	3	2	1	2	2	4	4	5	5	8
Spain	0	0	0	0	0	0	0	0	0	5	3	4	6
Rest of Europe	3	4	5	5	5	6	4	3	4	6	8	15	26
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**	**80**
Change in OECD annual installations	*10*	*7*	*0*	*0*	*2*	*4*	*0*	*-3*	*5*	*9*	*11*	*19*	*10*
Non-OECD solar installations (annual)													
China	0	3	3	14	13	19	30	53	44	33	52	65	95
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	37	56
Total Non-OECD	**2**	**5**	**8**	**18**	**21**	**27**	**46**	**72**	**77**	**78**	**93**	**114**	**170**
Change in non-OECD annual installations	*1*	*3*	*2*	*11*	*2*	*6*	*19*	*26*	*5*	*1*	*15*	*21*	*56*
Total solar installations (annual)	**19**	**29**	**31**	**42**	**46**	**56**	**75**	**98**	**108**	**118**	**144**	**184**	**250**
Change in world annual installations	*11*	*10*	*2*	*11*	*4*	*10*	*19*	*23*	*10*	*10*	*26*	*40*	*66*

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 polysilicon, wafers, cells and modules.

- **Polysilicon** is a key raw material for a solar wafer. This was the tightest part of the solar market in 2021, evidenced by polysilicon prices nearly trebling over the year to end the year at around US$30/kg. The price strength allowed polysilicon manufacturers to realise super normal profits and is incentivising a supply response. Capacity averaged around 460 MT in 2021 and while it has grown further in the first half of 2022, a further 150% increase in capacity is planned for 2023 vs 2Q 2022.

- **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 increased around 25% during 2021 (to around US$0.28/Watt according to BNEF) – back to where they were in mid-2018 – and have maintained these levels so far in 2022. 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.

Polysilicon and solar module pricing

source: Bloomberg

Rapid growth in solar installations is likely in the years ahead. European growth will accelerate sharply and sustain through to 2030 (partly as a result of RePowerEU) while the US solar industry is likely to return to growth in the second half of the year. We note a new optimism in the US following President Biden's Executive Order to overrule import tariffs for 24 months. Legal challenges to the EO, implementation of the new Uyghur human rights rules and the result of net metering discussions (at the end of 2022) could provide bumps in the road but demand for solar in the United States appears to be robust and supported by policy.

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 98GW 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.

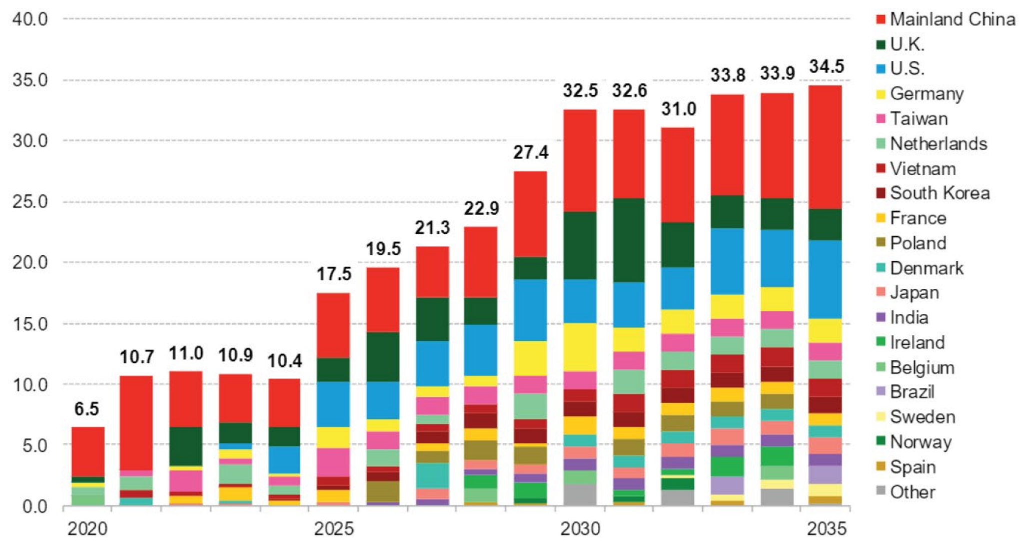
Annual installations of offshore wind capacity have increased from 0.9GW in 2010 to a new high of 17 GW in 2021. Chinese offshore installations reached 14 GW in 2021 while ex-China installations are likely to grow from 3 GW in 2021 to a new high of 7 GW in 2022.

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



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