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.

March 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 in the sustainable 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. Historic data may not be a reliable indicator for the future.

HIGHLIGHTS FOR FEBRUARY

ENERGY SECURITY

Global stock markets weakened in February, initially thanks to ongoing concerns about a faster than expected interest rising cycle, then thanks to the Russian invasion of Ukraine. Sustainable energy equities outperformed, and particularly in the final days of the month as concerns over reliance on Russian energy exports focused attention on the role of renewables and energy efficiency in improving global energy security.

EQUITIES

Over the month, the MSCI Alternative Energy Index was up by 12.8% while the MSCI World Net Return Index was down by 2.5%.

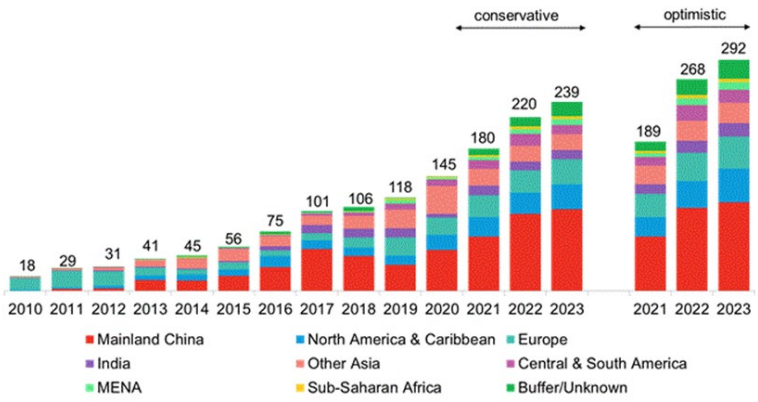
In the portfolio, the strongest performers included Vestas and Siemens Gamesa, benefitting from record offshore wind auctions in the UK and the US, plus Europe's acceleration towards renewables in light of the Russia/Ukraine war. Weaker performers included LG Chem and Itron, both announcing an outlook for 2022 below expectations.

CHART OF THE MONTH

At the start of March Bloomberg New Energy Finance published new forecasts for solar PV shipments. BNEF have increased their forecast for 2022 to 245GW, up 33% year-on-year, versus their previous forecast up 24%.

Annual PV solar shipments

source: BNEF



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1. FEBRUARY 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 February, initially thanks to ongoing concerns about a faster than expected interest rising cycle, then thanks to the Russian invasion of Ukraine. Sustainable energy equities outperformed, and particularly in the final days of the month as concerns over reliance on Russian energy exports focused attention on the role of renewables and energy efficiency in improving global energy security.	Sustainable energy equities	
On February 25, the New York Bight offshore wind seabed auction was concluded, with successful bids totalling $4.4bn. Similar to the Scottish offshore wind auction held earlier in the year, the New York auction ended with the total capacity auctioned being 'upsized', ending at around 10-11GW versus expectations of around 6GW. The administration has set a goal to install some 30 gigawatts (GW) of offshore wind by 2030 along the nation's coastlines and several states, including New York and New Jersey, have set ambition mandates for clean power adoption.	Offshore wind	
February saw a notable landmark in the energy transition with the announcement that Australia's largest coal utility, Eraring Power Station, was to be closed in 2025, seven years earlier than scheduled. Justifying the decision, the CEO of Eraring's owner, Origin Energy, said: "Australia's energy market today is very different to the one when Eraring was brought online in the early 1980s, and the reality is the economics of coal-fired power stations are being put under increasing, unsustainable pressure by cleaner and lower-cost generation, including solar, wind and batteries."	Coal	
In early February, the European carbon price reached a new high of EUR 96/tonne. The carbon price is up by more than 200% since the start of 2021. There is some concern that prices have been driven higher by speculators: Poland has asked the EU to intervene. However, the European Securities and Markets Authority's recent assessment of the carbon pricing mechanism saw no proof of market abuse.	European carbon price	

2. MANAGER'S COMMENTS

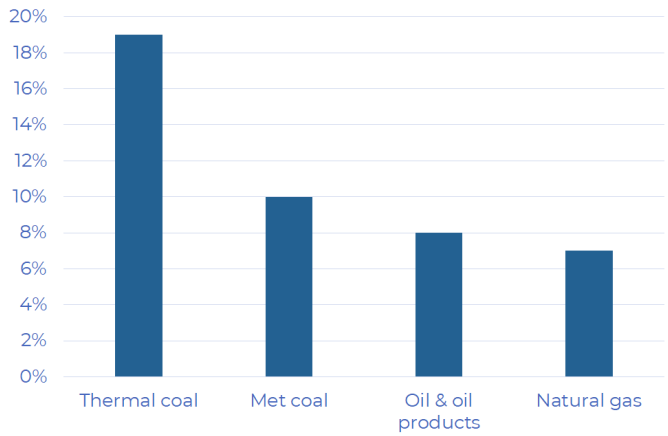
Energy transition: the role of energy security

When thinking about the catalysts for the energy transition, much of the focus for the past couple of years has been around ambitions to control carbon emissions and reduce global temperature increases. In 2020, we saw the proposal of the EU Green Deal; we saw Joe Biden set out a clean energy spending plan as a centrepiece of his manifesto for the US presidency; and China's plans to decarbonise being set out for the first time. Much of the rhetoric around these announcements, particularly in Europe and the US, put climate change at the forefront of the argument: reducing global carbon emissions via the adoption of low carbon energy technologies. This rhetoric was supported in 2021 by the return of the US to the Paris Agreement, the publication of the IPCC report on climate change, then the COP26 climate conference, each event doubling down on the need to achieve net zero by 2050 and limit warming to 1.5 degrees.

Now, with the Russia/Ukraine war at the forefront of governments' minds, there is another key catalyst for the energy transition that has risen up the agenda: energy security.

The concept of energy security has many meanings. On the one hand, those concerned with short-term energy security tends to focus on the ability of the energy system to react promptly to sudden changes in the supply-demand balance. And the Russia/Ukraine war does of course pose questions around the immediate security of world energy supply, should the West choose to restrict Russian exports of oil or natural gas, or if Russia decides to 'weaponise' its energy exports by further restricting its supply to various end markets. In normal times, Russia supplies around 16 Bcf/day of natural gas into Europe (c.35% of European gas demand), and exports around 8m b/day of oil and oil products (c.8% of world oil/liquids demand). Germany looks particularly vulnerable, given it consumes nearly 40% of Russia's gas imports into Europe. The world oil & gas balance was already reasonably tight going into this crisis, so immediate replacement of Russian exports is challenging (we explore this further in our Global Energy Fund update, here).

Russia's hydrocarbon exports as a % of global demand ex-Russia



Source: BP Statistical Review; Morgan Stanley; Guinness Global Investors

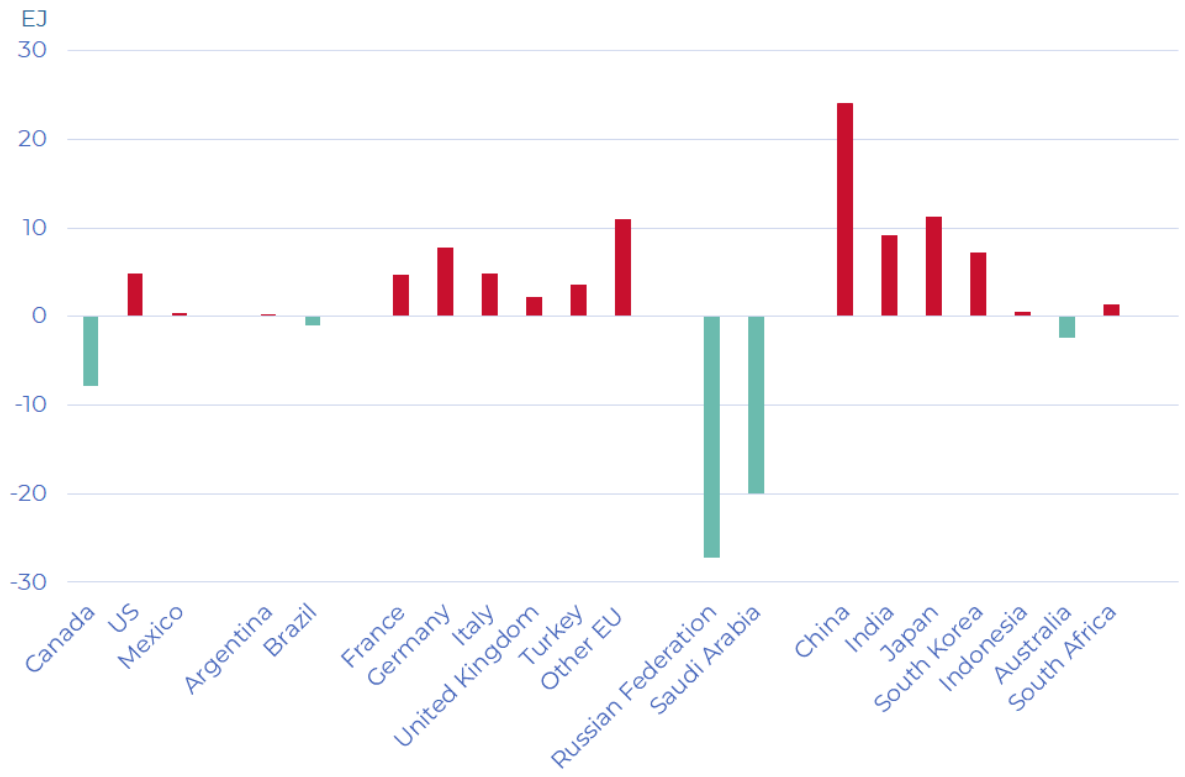
Beyond the immediate crisis, energy security can be thought of in a longer-term context, considering the ongoing availability and affordability of energy for consumers. As Daniel

Yergin summarised, “the objective of energy security is to assure adequate, reliable supplies of energy at reasonable prices and in ways that do not jeopardize major national values and objectives.”

For European countries, it is extremely difficult to remove Russian oil or natural gas from the supply mix in the short-term. However, it is a credible ambition, should they wish, to reduce reliance by the latter part of the decade (and beyond) via a shift to non-hydrocarbon sources of energy. The simple point here is that sustainable energy tends to be localised and distributed, and reduces energy importing nations’ reliance on imports.

G20: Net oil & natural gas imports/exports (Exajoules)

*Imports in **red** and exports in **green***



Source: BP Statistical Review; Guinness Global Investors

In reality, of course, the choice for Europe (or any other nation) between hydrocarbons and low carbon energy is not a binary one. In particular, Europe will look to increase its share of the liquefied gas market, taking more gas over time from key LNG exporters like the US and Qatar. On 27 February, Chancellor Scholz announced that Germany had accelerated plans to build two LNG import terminals (total capacity of 2 Bcf/day) to help reduce dependence on Russian gas imports. Whilst Europe currently has around 23 Bcf/day of LNG import capacity, Germany has none. "The events of the last few days and weeks have shown us that a responsible, forward-looking energy policy is not only crucial for our economy and our climate. But also crucial for our security," Scholz said.

Germany is also accelerating its renewable energy plans, having recently raised the target for renewable generation from 65% to 80% of the power mix by 2030. This is to be achieved by installing 200 GW of solar and at least 30 GW of offshore wind. With recent Russia/Ukraine developments, the outcome for Germany by 2030 has become less predictable, but probably involves more coal, LNG and nuclear to sit alongside the major renewables expansion, compensating for less Russian gas.

Whilst exports of oil and gas from Russia are currently the key debate, energy security across the world has long been a major strategic topic, particularly for the largest net oil & gas importing regions, being Europe and Asia. Indeed, we would say that for China, security of supply (and development of strategic new industries) are the most important catalysts for energy transition, above climate concerns. Today, China is comfortably the largest net energy importer in the world, importing around 14 Bcf/day of gas and 11m b/day of oil, much of which flows from OPEC countries in the Middle East.

The Chinese government are of course well aware of the issues they face, with the implementation of an "energy resource security strategy" featuring as part of the country's latest 5 year plan, published in 2021. The plan talks of improving "the production, supply, storage, and marketing [of energy], enhancing our capacity to sustain the stable supply…". It retains a focus on conventional energy, with China keen to grow the scale of domestic oil and gas reserves, plus keep appropriately sized coal reserves, but President Xi's recent actions leave us in little doubt that the expansion of renewable power capacity remains a key ambition. His announcement at the COP15 Biodiversity conference in October 2021, for example, that China would look double or even triple annual domestic solar installations in short order, gave one such illustration.

As the IEA often point out, energy efficiency is the "first fuel" to achieve clean energy transitions in a secure manner. Efforts to strengthen and expand efficient technologies and practices need to be scaled up significantly, bringing the cleanest and, in most cases, the cheapest way to meet global energy needs. In early 2021, Germany announced steps to improve energy efficiency in buildings, including programmes to modernise existing buildings with better insulation and more efficient heating systems with annual incentives of EUR6bn. We expect schemes such as these to ramp up significantly.

It would be simplistic to think that the shift to a low carbon energy system is not without its own energy security issues. Take electric vehicles, for example. In 2021, China accounted for nearly 75% of the 211 major lithium-ion battery factories planned or under construction worldwide. Swapping a reliance on Russia for a reliance on China is not a palatable outcome for the West, either.

In practice though, we will see an energy transition that prioritises flexibility of supply. Much of that diversity will come via a focus on electrification: moving away from the direct burn of hydrocarbons to the electrification of transportation, buildings, industry and heating. Renewable capacity expansion will combine with increased investment in dispatchable generation, including hydropower, nuclear and natural gas depending on national circumstances. And there will be mechanisms to reward flexibility in electricity systems, and to expand energy storage, demand response and digital solutions as well as regional integration of electricity markets.

As the Russia/Ukraine war shows, the concept of energy security is becoming broader and more dynamic, though in reality it has been a major policy concern for many years, especially in Europe and Asia. Ensuring uninterrupted and reliable fuel supplies and critical energy-related commodities at affordable prices remains a fundamental policy goal, and one which is supported by the outcomes of an accelerated energy transition.

3. PERFORMANCE

Past performance does not predict future returns. 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 in USD to	Feb-22	Feb-21	Feb-20	Feb-19	Feb-18*
Fund (Class Y, 0.67% OCF)	-4.5%	98.7%	7.7%	0.8%	10.2%
MSCI World NR Index	10.7%	29.3%	4.6%	0.4%	17.4%
Outperformance/Underperformance	-15.2%	69.4%	3.1%	0.3%	-7.1%
1 year rolling performance in USD to	**Feb-17***	**Feb-16***	**Feb-15***	**Feb-14***	**Feb-13***
Fund (Class Y, 0.67% OCF)	5.3%	-25.3%	-19.6%	66.4%	-12.2%
MSCI World NR Index	21.2%	-11.0%	7.9%	21.7%	10.7%
Outperformance/Underperformance	*-15.9%*	*-14.3%*	*-27.5%*	*44.7%*	*-22.9%*

Cumulative performance in USD	1 year	3 years	5 years
Fund (Class Y, 0.67% OCF)	-4.5%	104.3%	126.9%
MSCI World NR Index	10.7%	49.9%	76.7%
Outperformance/Underperformance	*-15.2%*	*54.4%*	*50.2%*

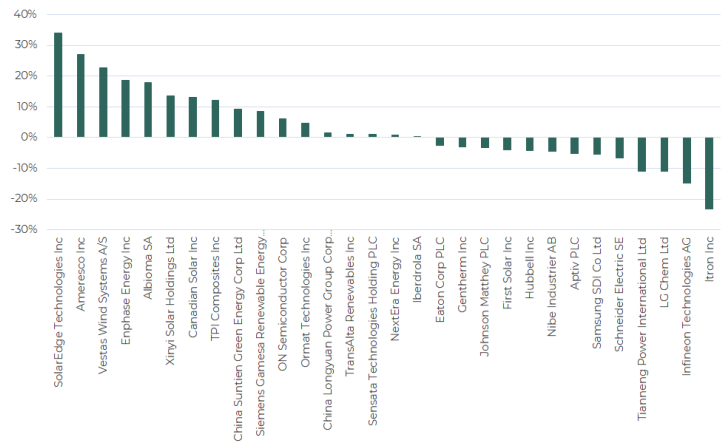
**Simulated Past Performance prior to the launch of the Y class on 16/02/2018. The Performance shown is a composite simulation for Y class performance being based on the actual performance of the Fund's E class, which has an OCF of 1.24%.*

Source: Financial Express, bid to bid, total return. Fund returns are for share classes with a current Ongoing Charges Figure (OCF) of 0.67%; 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 Solaredge, Ameresco, Vestas, Enphase and Albioma, while the weakest performers were Itron, Infineon, LG Chem, Tianneng and Schneider Electric.

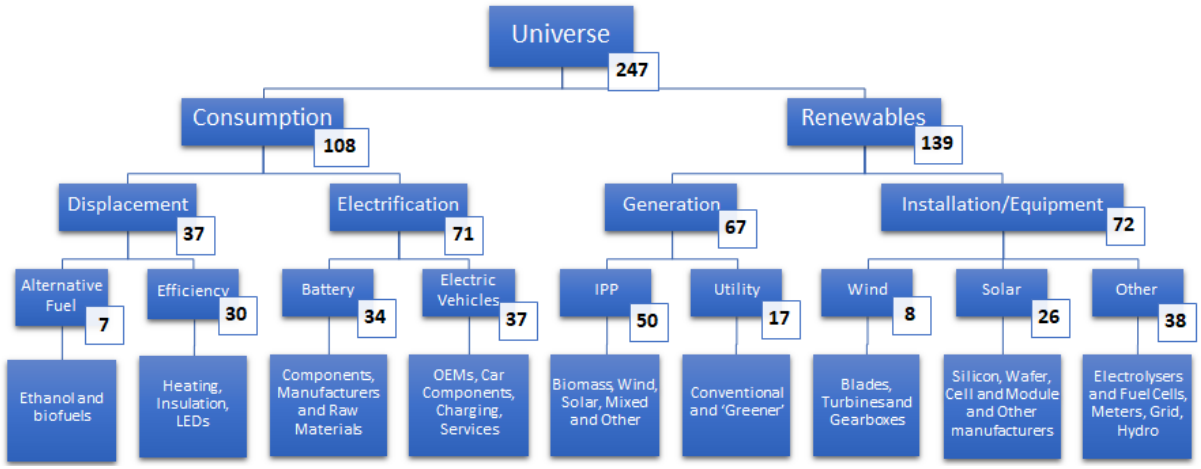
Stock by Stock performance over the month, in USD
Source: Bloomberg. As of 28 February 2022



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:

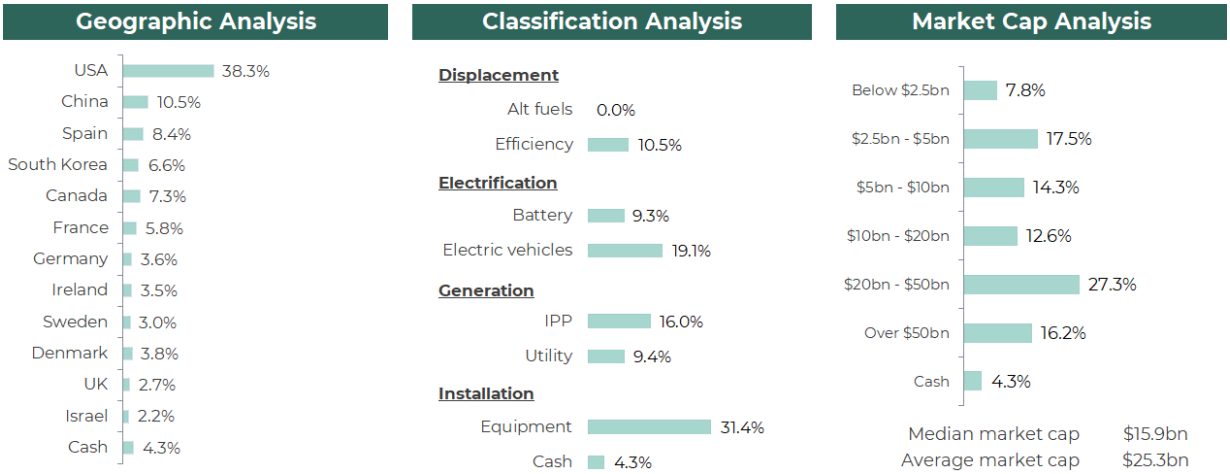
Signatory of:

PRI Principles for Responsible Investment

Buys/Sells

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

Portfolio structure analysis



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	
	Feb-22		Dec-21	Dec-20	Dec-19	Dec-18
Consumption	**38.9%**	**-4.5%**	**43.4%**	**36.7%**	**41.7%**	**26.5%**
Displacement	10.5%	-1.3%	11.8%	9.9%	13.4%	16.4%
Alternative Fuel	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*3.9%*
Efficiency	*10.5%*	*-1.3%*	*11.8%*	*9.9%*	*13.4%*	*12.5%*
Electrification	28.5%	-3.2%	31.6%	26.8%	28.2%	10.1%
Batteries	*9.3%*	*0.5%*	*8.9%*	*10.8%*	*12.6%*	*3.9%*
Electric vehicles	*19.1%*	*-3.7%*	*22.8%*	*16.0%*	*15.7%*	*6.2%*
Renewables	**56.7%**	**5.4%**	**51.3%**	**60.4%**	**54.1%**	**69.7%**
Generation	25.3%	2.2%	23.1%	24.6%	22.2%	27.3%
IPP	*16.0%*	*1.4%*	*14.5%*	*17.0%*	*18.9%*	*26.7%*
Utility	*9.4%*	*0.8%*	*8.6%*	*7.6%*	*3.2%*	*0.6%*
Installation	31.4%	3.2%	28.2%	35.8%	32.0%	42.5%
Equipment	*31.4%*	*3.2%*	*28.2%*	*35.8%*	*32.0%*	*42.5%*
Cash	4.3%	-0.9%	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 28 February 2022	P/E			EV/EBITDA			Dividend Yield		EPS Growth (%pa)		CFROI*	
	2021	2022E	2023E	2021	2022E	2023E	2022E	2023E	2016-20	2021-23	2021E	2022E
Guinness Sustainable Energy Fund	24.9x	21.7x	18.3x	13.9x	12.4x	10.5x	1.4%	1.5%	6.1%	22.5%	7.2%	8.2%
MSCI World Index	19.7x	17.7x	16.3x	13.1x	11.9x	11.3x	2.0%	2.1%	0.5%	10.0%	8.9%	9.2%
Fund Premium/(Discount)	*26%*	*23%*	*12%*	*6%*	*4%*	*-7%*						

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

Source: Guinness Global Investors, Bloomberg

Portfolio holdings, as at end February 2022

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

We hold c.39% 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 (19% weight) while we have 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 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 25% weight to companies involved in the generation of sustainable energy and 31% 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 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 February 2022

	Theme	Example holdings	Weighting (%)
1	Electrification of the energy mix	TransAlta renewables, NextEra Energy	22.7%
2	Rise of the electric vehicle and auto efficiency	Sensata Technologies, APTIV	21.8%
3	Battery manufacturing	Samsung SDI	6.7%
4	Expansion of the wind industry	Siemens Gamesa Renewable Energy, Vestas	14.5%
5	Expansion of the solar industry	CanadianSolar	14.4%
6	Heating, lighting and power efficiency	NIBE Industrier	10.5%
7	Geothermal and biomass	Ormat, Albioma	5.2%
8	Other (inc cash)		4.3%

Portfolio at end January 2022 (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

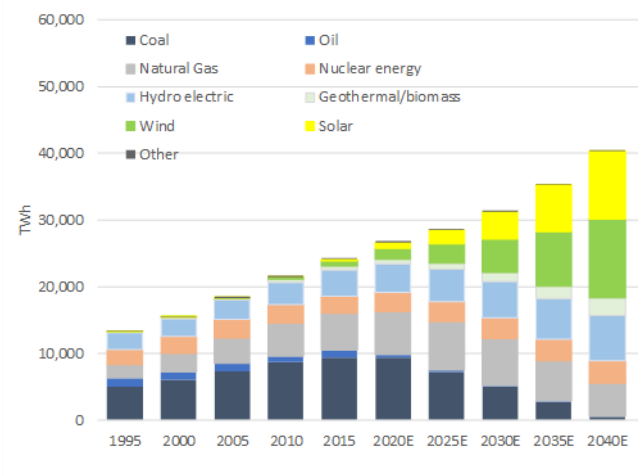
Over the next thirty years, the world will continue its transition to a sustainable energy system. The key factors driving the transition are:

- **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

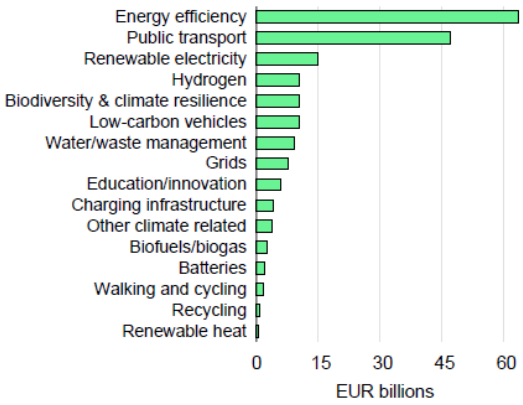
Energy efficiency measures were negatively impacted by COVID in 2020, as projects and investments were disrupted, but it appears that governments are turning their attention to efficiency measures as part of post-COVID stimulus measures. There is urgency to do this as current government policies imply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

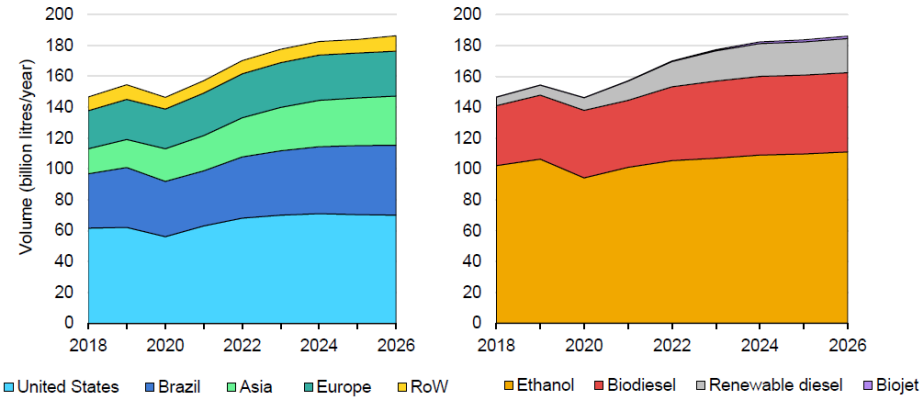
Alternative fuels consumption in 2021 grew by 10% versus 2020 and 3% versus 2019. Demand growth was significantly stronger than the underlying 6% increase in global oil demand, underlining the policy support for increased blending of alternative fuels in the transportation mix. Renewable diesel demand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

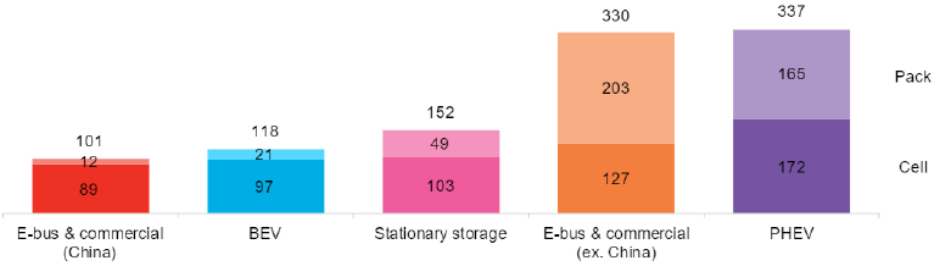
Batteries

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



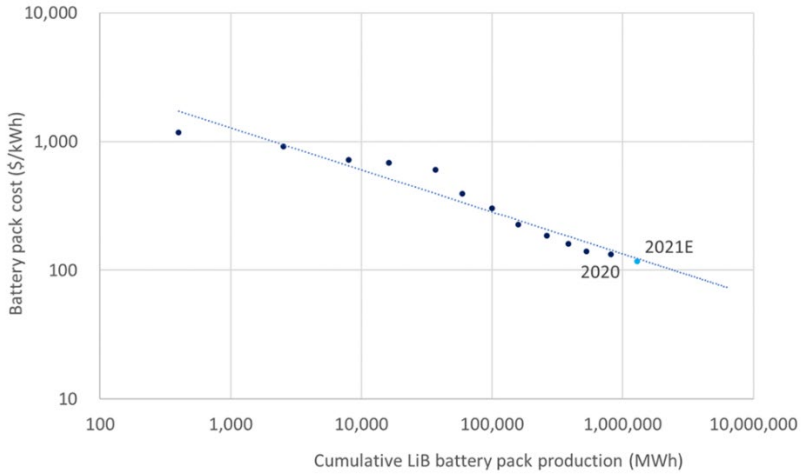
Raw materials make up around 50% of the cost of a lithium-ion battery pack, with cathode materials alone representing around 20% of the total cost. The key catalyst material is lithium carbonate, whose price in China rose by 270% in 2021. While battery manufacturers have long-term contracts and approaches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

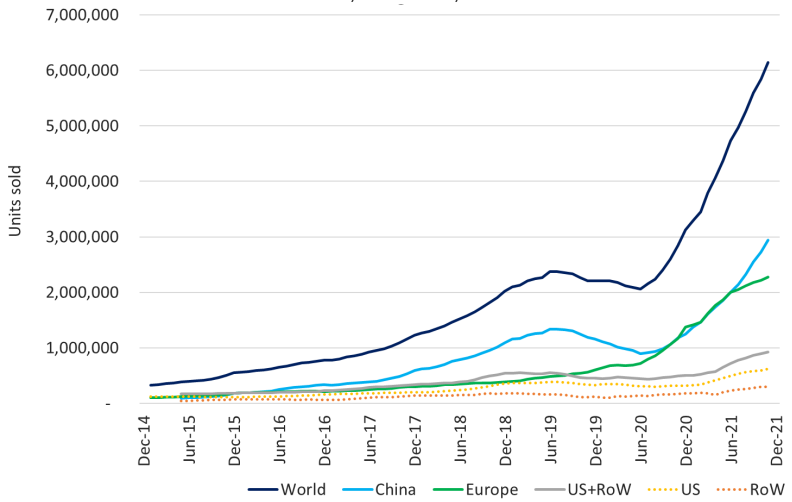
Strong momentum in EV sales growth continued through 2021. On our estimates, nearly 6.1m new EVs were sold in the twelve months to November 2021, a growth of around 116%

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

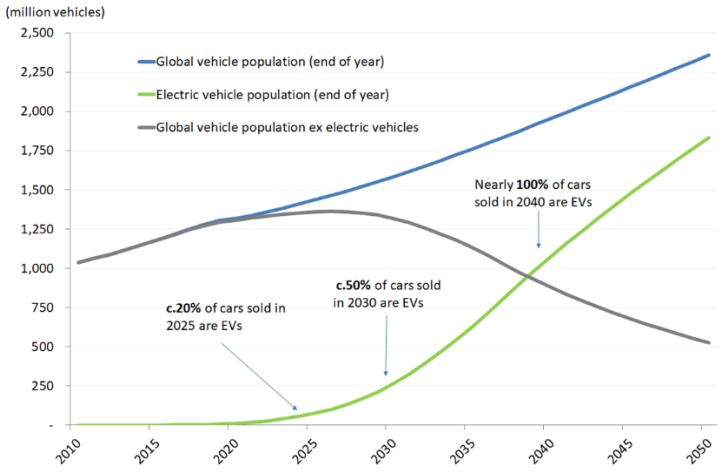


Government support for EVs will reduce in 2022. Europe will continue rolling back its EV "super-credits", and China plans to reduce EV subsidies further. Despite this, we expect global EV sales to exceed 9 million in 2022, representing around 10% of total passenger vehicle sales, taking the global EV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

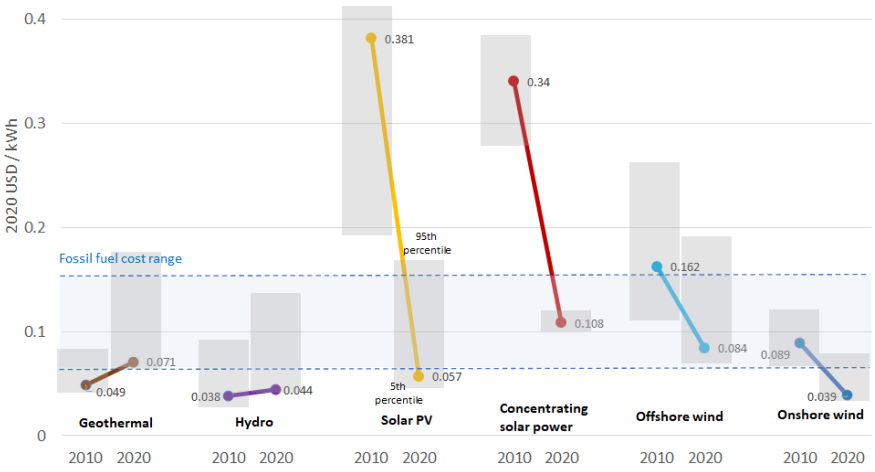
Generation & installation (equipment)

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. LCOE = levelized cost of energy



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.

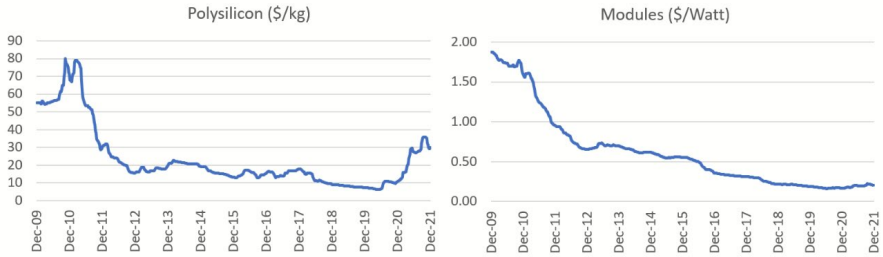
- **Wafer and solar cell** manufacturing capacity increased by over 60% in 2021 while mono wafer prices have increased by around 75%. The increase in capacity leaves this part of the value chain as oversupplied in 2022 as it was in 2021 although 78% of 2022 wafer capacity is in the hands of the five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

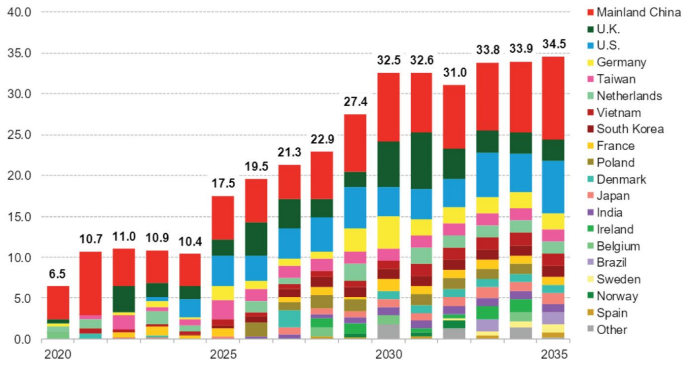
Annual installations of offshore wind capacity have increased from 0.9 GW in 2010 to a new high of 11 GW in 2021. Chinese offshore installations reached 5 GW in 2021 while ex-China installations are likely to grow from 5 GW in 2021 to a new high of 10 GW in 2022.

The economics of offshore wind continue to improve and there was further constructive cost data in 2021 suggesting that the levelized cost of energy (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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