

*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.*

July 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.



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

## REVIEW OF THE FIRST HALF OF 2022

The energy transition is accelerating as a result of the Russian invasion of Ukraine and the increasing importance of energy security. Development in solar, wind, electric vehicles and energy efficiency is well ahead of growth expectations at the start of the year, supporting our view that sustainable energy generation has become relatively even more economic than fossil fuels during 2022 (despite it suffering its own raw material inflation). Within the Guinness portfolio, M&A activity was high in the first half of the year, indicating pockets of value. KKR announced a bid for Albioma, Siemens announced a bid for Siemens Gamesa, and Standard Investments announced a new 5%+ ownership stake in Johnson Matthey. For the remainder of 2022 and beyond, we expect further acceleration of the energy transition driven by improved relative economics, security of supply concerns and supportive policy.

## EQUITIES

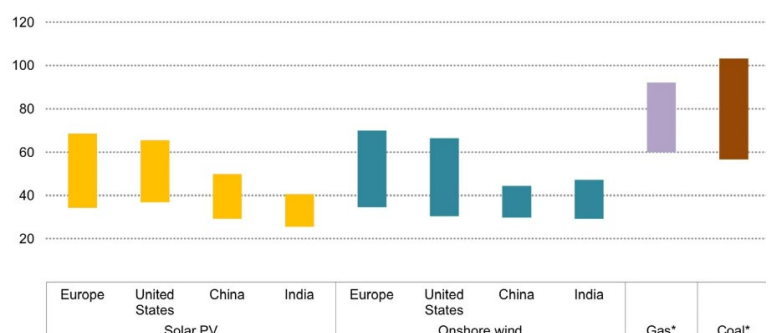
Sustainable energy equities underperformed global stock markets in June. The Guinness Sustainable Energy Fund (Class Y) delivered a return of -9.6% (in USD), behind the MSCI World at -8.7%. Year to date, the Guinness Sustainable Energy Fund (Class Y) has delivered -22.4% (in USD), versus the MSCI World at -20.5%.

The Fund's performance was led by the equipment (+6.5%) and generation (-5.5%) sub sectors while efficiency and EV-oriented names were underperformers.

## CHART OF THE MONTH

Sharp inflation in the cost of natural gas and coal in 2022 means that the levelised cost of electricity (LCOE) from solar PV and onshore wind projects across the world is relatively even more attractive. This is despite renewable energy projects suffering from higher energy prices, their own raw material inflation and supply chain constraints.

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



Signatory of:



# The Guinness Sustainable Energy Report

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## 1. JUNE 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
According to the Global Wind Energy Council (GWEC), the offshore wind industry enjoyed its best-ever year in 2021, with 21.1GW of new capacity connected to the grid. GWEC also revised up its outlook for 2030 by 45.3 GW (c.17%) from last year's report and believes that 260 GW of new offshore wind capacity could be added in 2022-2030.	Offshore wind	
EU environment ministers struck a deal to eliminate carbon emissions from new cars by 2035, effectively heralding the end of the era of petrol and diesel combustion engines in Europe. Along with four other member states, Italy had sought a 90% reduction in carmakers' emissions by 2035, the year that the European Commission has targeted a full phase-out. It won some concessions on derogation for niche manufacturers (e.g. Lamborghini) which will be spared interim targets until the end of 2035, from 2029 proposed by the Commission.	Electric vehicles	
The German government is planning to pass emergency laws to reopen mothballed coal plants for electricity generation amid concerns of a gas shortage in the run up to winter. Russia recently cut capacity on the main gas export pipeline to Europe's largest economy by 60%, raising concerns across the continent that Moscow is weaponising its gas exports in response to EU sanctions following the full-scale invasion of Ukraine.	EU energy transition	
NextEra Energy Inc, the largest producer of electricity in the US and the world's largest generator of renewable energy from the wind and sun, announced the launch of Real Zero, a new goal to eliminate carbon emissions from its operations without the use of offsets by 2045. The company plans to reduce its rate of emissions by 70% by 2025, 82% by 2030, 87% by 2035, 94% by 2040, before hitting Real Zero by no later than 2045.	US energy transition	
"Bloomberg Intelligence thinks that Volkswagen could sell more electric vehicles (EVs) than Tesla by 2024, with the two most important markets being China and Europe. Volkswagen currently lags behind Tesla in China in terms of EV sales. Tesla and BYD held around 13% market share in China last year, behind Wuling, manufacturer of the hugely popular Hongguang mini EV, at 16% market share.	Electric vehicles	

## 2. MANAGER'S COMMENTS

### Review of 1H22

#### Summary

- The energy transition has accelerated as a result of the Russian invasion of Ukraine and the increasing importance of energy security.
- Despite raw material inflation, the relative economics of sustainable energy generation versus fossil fuels have improved during 2022.
- The run rates of activity in solar, wind, electric vehicles and energy efficiency are well ahead of growth expectations at the start of the year.
- Solar and wind installation companies as well as generation companies outperformed in the first half of the year. Displacement and electrification underperformed.
- M&A activity was high across the portfolio, indicating pockets of value. KKR announced an acquisition of Albioma, Siemens announced a deal for Siemens Gamesa and Standard Investments announced a new 5%+ ownership stake in Johnson Matthey.
- For the remainder of 2022 and beyond, we expect further acceleration of the energy transition driven by improved relative economics and security of supply concerns.

#### The macro backdrop in the first half of 2022

The Russian invasion of Ukraine brought the 'weaponisation' of energy flows to the forefront of attention for investors in the first half of 2022. Prior to this, the focus for energy investors has been around government and societal ambitions to control carbon emissions and global temperature increases (COP26 in November 2021) but this has been eclipsed by the topic of energy security. We believe that the invasion of Ukraine will accelerate the energy transition, especially in Europe, and we consider key impacts and issues towards the end of this report.

Shortly after the invasion, the EU responded to the threat of supply disruption with the 'REPowerEU' deal, designed to increase the resilience of the EU energy system. The deal includes increasing domestic renewable energy capacity and improving energy efficiency while taking higher non-Russian LNG and pipeline gas imports together with larger volumes of biomethane and renewable hydrogen. The plan builds on the EU's 'Fit for 55' proposals which are designed to deliver a 55% reduction in GHG emissions by 2030 (vs 1990) and is expected to reduce Europe's reliance on natural gas by a further 12 bcf/d (30% of current European gas demand).

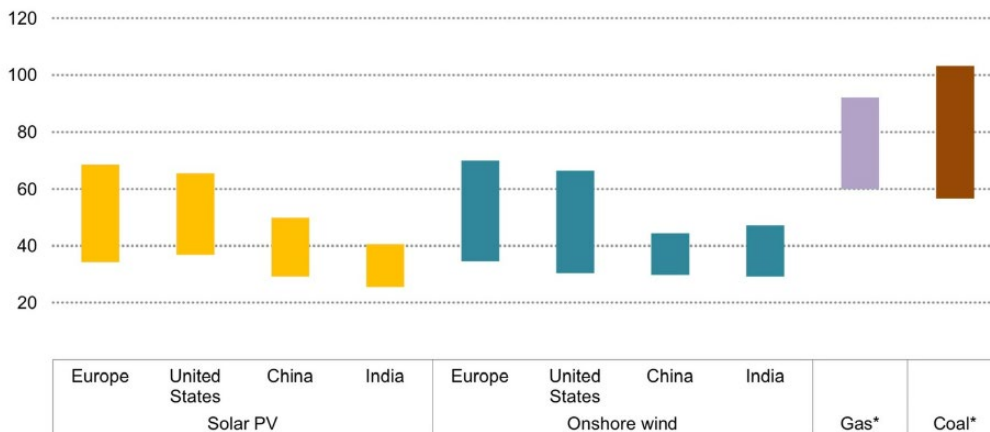
Sustainable energy companies will be beneficiaries of the energy transition that is likely to accelerate as a result of these issues but, in the first half of this year, they were not immune to some continued business headwinds:

- Record natural gas and electricity prices impact the cost of manufacturing clean energy products and are difficult to pass on quickly.
- Raw material inflationary conditions have led to solar module and battery price increases of around 30%, as an example. However, while these were inflationary in the first half of 2022, we are seeing signs that prices are now starting to roll over.
- Supply chain pressures remain for most companies though, like raw material costs, they are starting to show signs of levelling off.

## The Guinness Sustainable Energy Report

These inflationary and supply chain issues will increase the cost of installing and generating renewable power (and increasing energy efficiency) in the near term. However, with sharp rises in oil, gas and coal prices, the **relative economics of sustainable energy generation have improved**. We believe that improved relative economics as well as security of supply considerations will help to sustain strong demand for sustainable energy activities during any potential recession. In the first half of this year, demand growth has been very robust with expectations for solar, wind, EVs and energy efficiency improving further during the first half of the year.

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

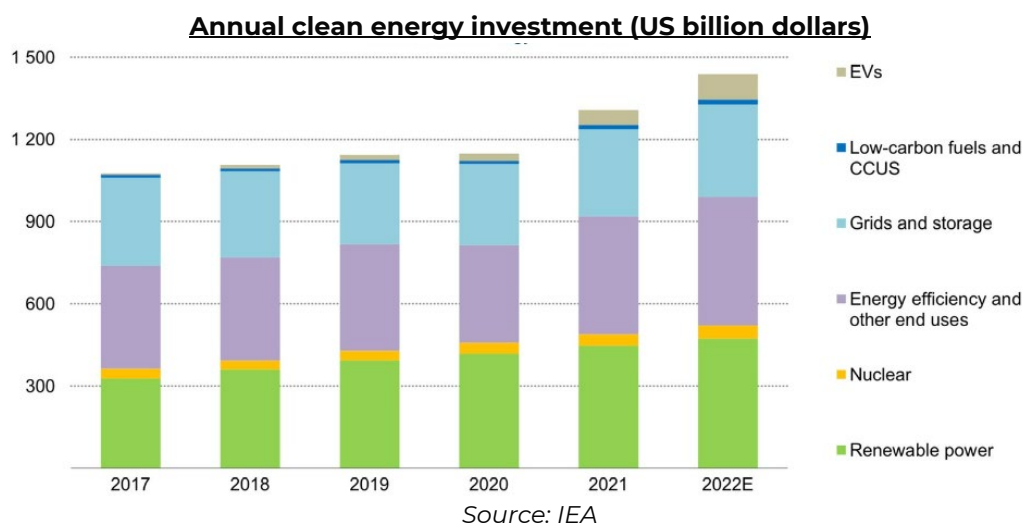


Source: IEA

- In terms of **solar**, at the start of 2022, market estimates for global solar installations were around 215GW in 2022 (up from 173GW in 2021) but a strong end to 2021 and start to 2022 leads us to expect installations will now be more like 250GW (up 66GW or 36% vs revised 2021 installations of 184GW). 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).
- The **wind** industry is now also likely to see installation growth in 2022, a shift from initial estimates of a 5GW decline. A recent forecast from BNEF indicates record installations of around 105GW this year with over half of the installations, and most of the new growth, being in China. We see the continued growth as a confirmation of the economic rationale for wind-based power generation.
- The take up of **electric vehicles** continues to surprise to the upside and 2022 EV sales estimates are likely to do the same. Overall demand for EVs is strong despite inflation in the cost of the lithium-ion battery (the most expensive component of an EV) and reflects policy support, consumer preference for EVs and total cost of ownership savings as a result of higher gasoline and diesel prices. According to BNEF, a California EV owner could save \$1,700 per year (\$1,400 national average) on fuel alone versus an ICE vehicle if they charged their EV during off-peak times.
- The topic of **energy efficiency** has been thrust into the forefront of consumers' and policy makers' minds as a result of supply disruptions and energy price inflation so far this year. As the IEA often points out, energy efficiency is the 'first fuel' to achieve clean energy transitions in a secure manner and, as such, it is garnering solid policy support. 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. The increased investment and activity as of mid-2022 remains well behind levels needed to satisfy broader policy goals.

## The Guinness Sustainable Energy Report

These areas remain the most attractive and, while overall investment in energy is lagging, investment in the clean energy activities mentioned above are starting to see increased absolute investment and relative share.



### The Guinness Sustainable Energy Fund

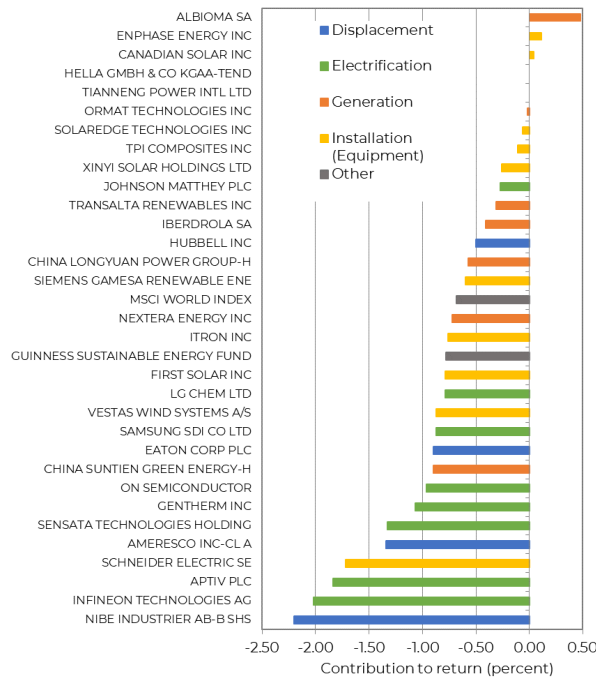
The backdrop of inflation and recessionary fears trumped strong underlying sustainable energy demand growth, leaving the **Guinness Sustainable Energy Fund** to deliver a total return (USD) of -22.4% vs the MSCI World Index (net return) of -20.5% in the first half of the year. Within the portfolio, outperforming sectors included solar and (to a lesser extent) wind installation companies as well as our generation companies. Underperforming sectors included our displacement and electrification sectors.

Solar equipment was the strongest individual sector, with Enphase and Canadian Solar delivering positive contribution and SolarEdge and Xinyi Solar outperforming the Fund on average. The improving solar demand outlook described earlier was a key factor behind the outperformance combined with a re-rating after a year of weak performance in 2021. Within wind, we saw Siemens Energy announce a bid for the remaining shares in Siemens Gamesa that it did not already own, an action that confirms long-term value in the wind industry once near-term pressures are overcome. Our generation companies were a safe haven in the period as a result of their lower volatility earnings profile, with all but one outperforming relatively. Albioma's was the best individual performance as it was subject to a bid from private equity firm KKR and, as with the Siemens bid, we see this as highlighting some of the pockets of long-term value in the portfolio.

All but one of our electrification holdings were relative underperformers as the global auto cycle weakened amid China's Covid-related slowdowns and growing recessionary fears. As noted earlier, EV sales continue to increase, but our EV-related portfolio holdings still have exposure to the ICE vehicle market. The one outperformer in the group was Johnson Matthey, which performed well after Standard Investments (the investment arm of Standard Industries) announced a new 5%+ ownership stake in the company, thus creating speculation over a full acquisition. Our displacement holdings were underperformers, with Nibe and Ameresco particularly weak on the weaker economic outlook and the broader unwinding of premium valuation for quality/growth companies that we have seen across the broader market.

# The Guinness Sustainable Energy Report

## First half 2022 contribution for Guinness Sustainable Energy Fund



Source: Bloomberg, Guinness Global Investors estimates; 30 June 2022

### Outlook

Looking at the remainder of 2022 and beyond, we expect further acceleration of the energy transition driven by improved relative economics and security of supply concerns, albeit slowed near term by continued inflationary and supply chain headwinds. Importantly, new policy schemes like REPowerEU are not yet contributing to the strong demand outlook; their impact is still to be felt over a number of years ahead and will be supportive of multi-year and decade growth outlooks.

The IEA has described **solar power** as “the cheapest electricity in history” and, despite near-term headwinds and cyclical cost inflationary factors, large-scale solar remains at the bottom end of the cost curve and is likely to get economically more attractive in the year ahead. Chinese solar manufacturers are investing for further growth across polysilicon (+150% increase in capacity in 2023 vs 2Q 2022) as well as 10-30% increases in capacity in 2022 vs 4Q2021 across the remainder of the solar value chain. Rapid growth in solar installations is likely in the years ahead. European growth will accelerate sharply and sustain through to 2030 (partly thanks to 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 executive order, 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 US appears to be robust and supported by policy.

While global **wind** installations are expected to return to growth in 2022, the outlook for developed world wind companies continues to be blighted by flat global ex-China demand, supply chain issues and raw material cost inflation. Development of wind power is a key component in solving Europe’s security of supply issues but the longer-term development cycle means that onshore wind installations will not pick up meaningfully until the middle of the decade, and growth in offshore wind installations will only be small in absolute terms for a few more years yet. Importantly, policy support remains robust and economics are supportive, but the market remains tough for manufacturers.



## The Guinness Sustainable Energy Report

**Energy efficiency** will continue to receive a good proportion of post-Covid stimulus spending, with a continued focus on buildings. We expect an acceleration in the penetration of LED lighting, insulation and heat pumps, as well as a focus on grid and transmission upgrades. The IEA estimates that to meet current government policies, energy efficiency spending needs to increase from a recent average level of around \$250bn pa to around \$375bn this decade and nearly \$550bn in the 2030s. As an illustration of new policy commitments, the EU's RePower Europe plan includes the ambition to install 10 million new heat pumps over 2021-25 and 30 million new pumps in total by 2030 (1.5x the number of currently installed heat pumps in the EU).

**EV sales** should exceed 10mn this year although ultimate EV sales could be weaker if economic conditions weaken sharply. The market remains very strong with Chinese sales data (May 2022) suggesting over 400,000 xEV sales in the month (up >100% on May 2021) and representing a 31% market share. Whatever the near-term demand, we believe that the rush to build lithium battery plants will continue unabated with 2022 investment in new manufacturing plant being double the level seen in 2021.

Despite long-term attractive growth, the near term is still likely to be held back somewhat as a result of energy and raw material inflation compounded by continuing supply chain pressures. These pressures will affect portfolio holdings in different ways with our **displacement** and **installation** subsectors seeing higher energy, raw material and finished product prices while our **electrification** subsector suffers similar issues (especially in battery metals and semiconductors) combined with the greatest exposure to recessionary factors. Our **generation** subsector remains relatively immune on existing power generation assets but higher material costs will require higher power prices for new installations. We would expect investment in new capacity to continue somewhat undeterred by economic conditions (utility-scale renewable investments were at record levels in 2021) since their new supply will likely be cheaper than existing sources and will represent a source of potential savings for consumers.

At 30 June 2022, the **Guinness Sustainable Energy Fund** traded on a 2022/23 P/E ratio of 20.8x/16.9x and 2022/23 EV/EBITDA multiple of 12.6x/10.3x. The Fund trades at about a 30% premium to the MSCI World Index, which we see as justified given the attractive growth rates available to invest in across the sector. As a sense check, consensus EPS growth (2021-2023E) of the portfolio (at c.20%pa) is well ahead of the MSCI World (at c.10%pa), and looking over the next five years, we believe that the portfolio is likely to deliver average earnings growth of around 13-14%pa, comfortably ahead of growth in the MSCI World. Our current portfolio is summarised below by investment theme.

### Key themes in the Guinness Sustainable Energy Fund

Theme	Example holdings	Weighting (%)
1 Electrification of the energy mix		21.4%
2 Rise of the electric vehicle and auto efficiency		20.8%
3 Battery manufacturing		8.0%
4 Expansion of the wind industry		12.8%
5 Expansion of the solar industry		15.2%
6 Heating, lighting and power efficiency		10.0%
7 Geothermal and biomass		5.1%
8 Other (inc cash)		6.6%

source: Guinness Global Investors (30 June 2022)

**Overview of macro factors post the Russian invasion of Ukraine**

Russian energy is critical to the European economy. The EU imports 57% of its energy needs and relies on Russia for 41% of its natural gas, 27% of its crude oil/oil product and 47% of its coal imports. Within the EU, Germany imports nearly 64% of its energy consumption (up from 59% in 2000) with Russia representing one third of both its crude oil/oil product and natural gas demand in 2021.

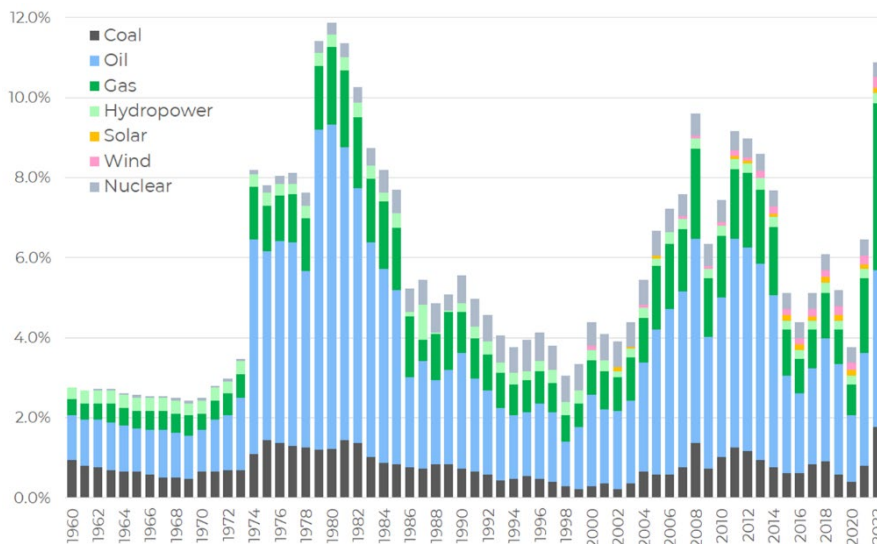
Reflecting its untenable energy position, Germany announced the boldest moves including the building of six new LNG import terminals and creating the Renewable Energy Sources Act which brings the 100% renewable power target forward to 2035 from 2040. Facing the threat of gas shortages this year, Germany is planning to restart some mothballed coal-fired power generation capacity and has enacted Stage 2 of the ‘Gas Act’ which allows gas suppliers to quickly pass on higher prices to consumers in order to ration demand. In the face of limited natural gas supplies, these actions are necessary for consumers but are clearly negative for the country’s economic growth.

Supply disruptions have brought substantially higher global coal, crude oil and European/Asian natural gas prices (up between 50% and 300% versus prior year levels). In order to rebuild natural gas inventories, Europe has little choice but to bid LNG tankers away from Asian markets (and therefore keep gas prices high in the near term), leaving Asian power producers to rely on coal to replace their lost LNG. Negative implications from the invasion are that coal demand will increase again in 2022 (after a 6% increase in 2021), investment in new coal plant will rise around 10% and global carbon emissions will reach a new peak and higher levels than previously anticipated, a near-term retrograde step for the energy transition.

Energy prices were already rising prior to the invasion, reflecting the fact that there has been lagging investment in energy capacity in recent years. Post-invasion, there appears to be greater acceptance that we need greater investment across both hydrocarbons and renewables to help close a widening long-term energy supply/demand imbalance. A combination of all the measures mentioned above (demand destruction, efficiency measures, increasing renewables and some easing of the conventional energy wind-down) will be needed to achieve a balance to the energy market in both the short and long term.

Higher energy costs have negative economic implications and we estimate that the combined cost of energy (oil, gas and coal) on average in 2022 is now 11% of global GDP, up from around 6% in 2021 and back to peak levels that were last seen in the early 1980s. This level of economic burden is likely to be recessionary for the global economy as demand and economic growth are destroyed in the near term in order to achieve balanced markets.

**The world primary energy ‘bill’ as a percentage of world GDP**



Source: Bloomberg LP; Thunder Said; Guinness Global Investors



## The Guinness Sustainable Energy Report

### 3. PERFORMANCE

Past performance does not predict future returns.

The Guinness Sustainable Energy Fund (Class Y, 0.68% OCF) delivered a return of -9.6% in the month, while the MSCI World Index (net return) delivered -8.7% (all in USD terms).

	Ytd	1 Yr	3 Yrs	5 Yrs*	10 Yrs*
Fund (Class Y)	-22.4	-19.9	73.1	92.7	140.7
MSCI World NR Index	-20.5	-14.3	22.5	44.7	148.1
Out/Underperformance	-1.9%	-5.6%	50.6%	48.0%	-7.4

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%

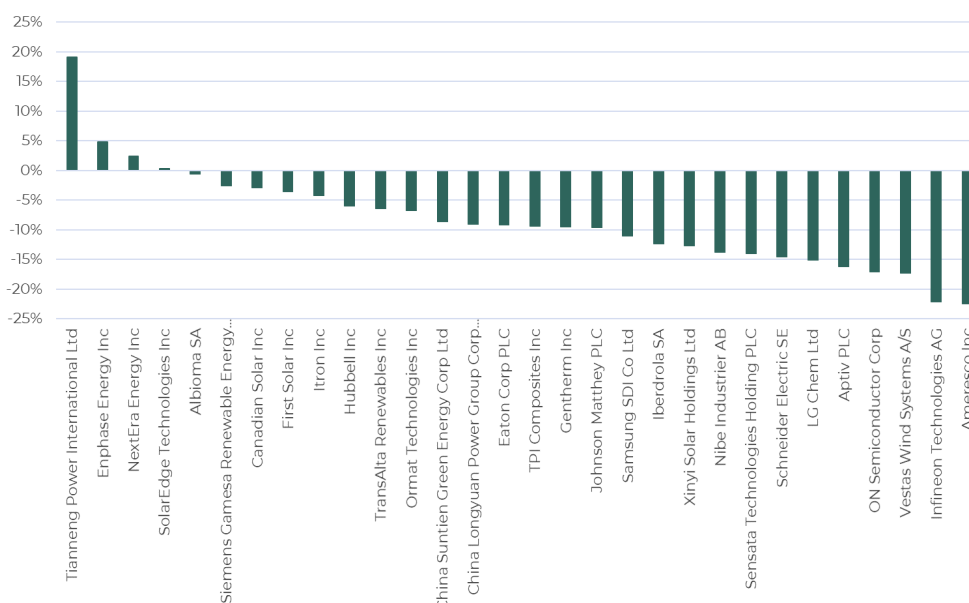
Annual performance	2016*	2015*	2014*	2013*	2012*
Fund (Class Y)	-15.4%	-12.0%	-12.1%	70.8%	-13.2%
MSCI World NR Index	7.5%	-0.9%	4.9%	26.7%	15.8%
Out/Underperformance	-23.0%	-11.2%	-17.0%	44.1%	-29.1%

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 Tianneng Power, Enphase, NextEra Energy, SolarEdge and Albioma. The weakest performers were Ameresco, Infineon Technologies, Vestas Wind Systems, ON Semiconductor and Aptiv.

#### Stock by Stock performance over the month, in USD

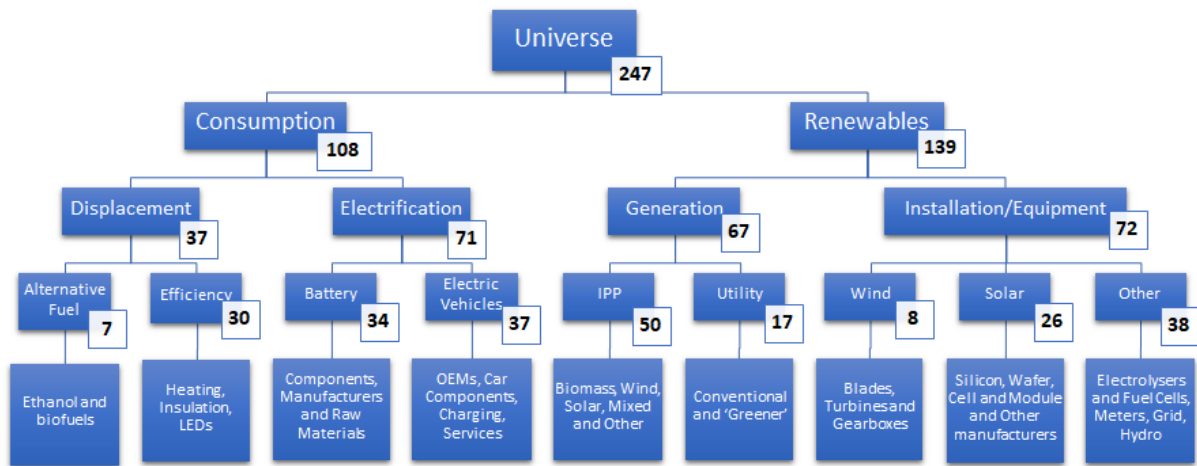


Source: Bloomberg. As of 30 June 2022

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:

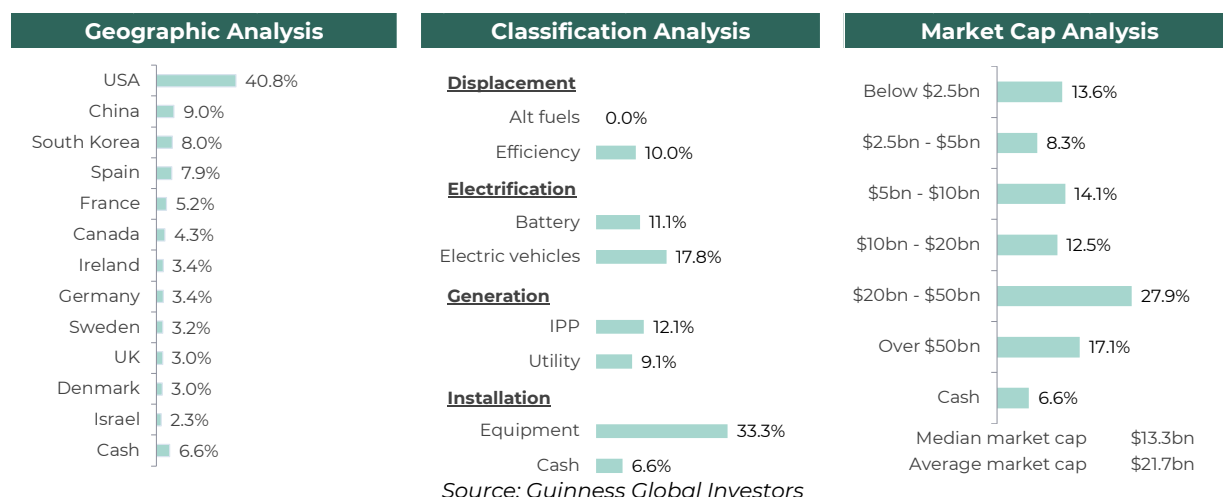


# The Guinness Sustainable Energy Report

## Buys/Sells

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

## Portfolio structure analysis



## 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	
	Jun-22		Dec-21	Dec-20	Dec-19	Dec-18
<b>Consumption</b>	<b>38.9%</b>	<b>-4.5%</b>	<b>43.4%</b>	<b>36.7%</b>	<b>41.7%</b>	<b>26.5%</b>
Displacement	10.0%	-1.7%	11.8%	9.9%	13.4%	16.4%
Alternative Fuel	0.0%	0.0%	0.0%	0.0%	0.0%	3.9%
Efficiency	10.0%	-1.7%	11.8%	9.9%	13.4%	12.5%
Electrification	28.8%	-2.8%	31.6%	26.8%	28.2%	10.1%
Batteries	11.1%	2.2%	8.9%	10.8%	12.6%	3.9%
Electric vehicles	17.8%	-5.0%	22.8%	16.0%	15.7%	6.2%
<b>Renewables</b>	<b>54.5%</b>	<b>3.2%</b>	<b>51.3%</b>	<b>60.4%</b>	<b>54.1%</b>	<b>69.7%</b>
Generation	21.2%	-2.0%	23.1%	24.6%	22.2%	27.3%
IPP	12.1%	-2.5%	14.5%	17.0%	18.9%	26.7%
Utility	9.1%	0.5%	8.6%	7.6%	3.2%	0.6%
Installation	33.3%	5.1%	28.2%	35.8%	32.0%	42.5%
Equipment	33.3%	5.1%	28.2%	35.8%	32.0%	42.5%
Cash	6.6%	1.4%	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 30 June 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	22.0x	20.8x	16.9x	13.0x	12.6x	10.3x	1.3%	1.5%	5.1%	19.7%	6.2%	7.3%
MSCI World Index	16.9x	14.9x	13.9x	11.5x	10.1x	9.9x	2.3%	2.4%	6.7%	10.3%	8.6%	9.0%
Fund Premium/(Discount)	30%	40%	22%	13%	25%	4%						

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

*Source: Guinness Global Investors, Bloomberg*

## The Guinness Sustainable Energy Report

### Portfolio holdings, as at end June 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 (11%) or the electrification of transportation (18% weight) while we have 10% 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 21% weight to companies involved in the generation of sustainable energy and 33% weight to those exposed to the installation of or equipment used in the process of sustainable energy generation.








China Suntien and China Longyuan are our two pure play Chinese wind power producers and they represent 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.

# The Guinness Sustainable Energy Report

## Portfolio themes as at end June 2022

Theme	Example holdings	Weighting (%)
1	Electrification of the energy mix 	21.4%
2	Rise of the electric vehicle and auto efficiency 	20.8%
3	Battery manufacturing 	8.0%
4	Expansion of the wind industry 	12.8%
5	Expansion of the solar industry 	15.2%
6	Heating, lighting and power efficiency 	10.0%
7	Geothermal and biomass 	5.1%
8	Other (inc cash)	6.6%

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

Guinness Sustainable Energy Fund (31 May 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
<b>Displacement/Efficiency</b>														
Hubbell Inc	4.3%	10,188	22.6x	20.6x	18.7x	15.4x	14.3x	13.0x	4.7x	4.4x	4.1x	2.1%	2.3%	2.4%
Nibe Industrier AB	3.2%	17,562	49.2x	45.8x	39.8x	28.8x	27.3x	23.7x	7.8x	7.3x	6.4x	0.6%	0.6%	0.7%
Ameresco Inc	2.7%	3,042	41.3x	31.4x	28.4x	25.4x	18.5x	17.0x	4.5x	3.9x	3.4x	n/a	n/a	n/a
	<b>10.3%</b>													
<b>Electrification/Battery</b>														
LG Chem Ltd	3.8%	33,316	11.0x	17.4x	13.7x	6.9x	7.8x	6.4x	2.0x	1.6x	1.5x	2.0%	1.7%	2.0%
Samsung SDI Co Ltd	4.2%	31,898	32.1x	24.8x	20.4x	17.0x	14.1x	11.5x	2.6x	2.4x	2.1x	0.2%	0.2%	0.2%
Johnson Matthey PLC	3.0%	4,890	10.8x	10.2x	9.9x	6.1x	6.3x	6.3x	1.2x	1.5x	1.5x	3.0%	3.6%	3.7%
Tianneng Power International Ltd	0.1%	1,078	4.0x	3.1x	2.7x	0.9x	0.7x	0.7x	0.5x	0.5x	0.4x	5.3%	6.6%	7.2%
	<b>11.0%</b>													
<b>Electrification/Electric Vehicles</b>														
Aptiv PLC	3.5%	28,784	40.6x	26.9x	17.5x	14.9x	12.3x	9.4x	3.5x	3.2x	2.8x	0.1%	0.1%	0.3%
ON Semiconductor Corp	4.3%	26,366	21.5x	12.4x	12.3x	13.0x	7.8x	7.7x	5.8x	4.0x	3.2x	n/a	n/a	n/a
Infineon Technologies AG	3.7%	40,560	23.9x	16.4x	15.5x	12.0x	9.5x	8.9x	3.2x	2.9x	2.6x	1.0%	1.1%	1.3%
Sensata Technologies Holding PLC	3.8%	7,537	13.8x	12.4x	10.6x	11.0x	10.3x	9.2x	2.5x	2.3x	2.0x	n/a	0.6%	0.9%
Gentherm Inc	3.1%	2,284	25.9x	25.7x	17.0x	14.3x	13.8x	9.8x	3.3x	n/a	n/a	n/a	n/a	n/a
	<b>18.5%</b>													
<b>Generation/IPP</b>														
China Longyuan Power Group Corp Ltd	3.4%	24,444	18.1x	15.8x	13.4x	12.7x	11.7x	10.2x	1.8x	1.7x	1.6x	1.1%	1.3%	1.4%
Ormat Technologies Inc	3.6%	4,708	68.1x	63.5x	42.7x	16.7x	15.3x	12.6x	2.3x	2.3x	2.2x	0.6%	0.6%	0.6%
TransAlta Renewables Inc	2.2%	3,663	28.7x	25.0x	20.7x	12.0x	10.7x	10.4x	2.2x	2.5x	2.5x	5.4%	5.4%	5.4%
Albioma SA	1.3%	1,728	27.3x	27.5x	24.2x	11.6x	11.9x	10.8x	3.2x	3.0x	2.8x	1.8%	1.7%	1.9%
NextEra Energy Inc	4.5%	148,693	30.0x	26.9x	24.9x	21.6x	18.4x	15.9x	3.5x	3.4x	3.2x	2.0%	2.2%	2.5%
China Suntien Green Energy Corp Ltd	2.1%	5,371	6.6x	6.9x	5.8x	12.7x	12.3x	10.9x	0.9x	0.8x	0.7x	5.5%	4.8%	5.5%
	<b>17.1%</b>													
<b>Generation/Utility</b>														
Iberdrola SA	5.4%	76,239	17.8x	16.9x	15.6x	10.5x	10.2x	9.4x	1.7x	1.6x	1.5x	4.2%	4.2%	4.5%
	<b>5.4%</b>													
<b>Installation/Equipment</b>														
Schneider Electric SE	4.0%	78,803	20.7x	18.7x	16.8x	14.6x	13.5x	12.3x	3.1x	2.8x	2.6x	2.3%	2.4%	2.6%
Eaton Corp PLC	3.8%	55,301	20.9x	18.4x	16.6x	17.7x	15.0x	13.7x	3.4x	3.2x	3.0x	2.2%	2.3%	2.5%
Itron Inc	2.7%	2,326	42.7x	40.3x	18.6x	18.7x	20.1x	11.3x	1.9x	1.9x	1.8x	n/a	n/a	n/a
Xinyi Solar Holdings Ltd	3.3%	15,846	22.6x	22.8x	17.8x	17.0x	15.7x	12.1x	4.1x	3.6x	3.2x	2.0%	2.1%	2.6%
SolarEdge Technologies Inc	2.0%	15,109	54.3x	41.0x	28.3x	40.2x	30.2x	19.9x	11.5x	6.8x	5.6x	n/a	n/a	n/a
Enphase Energy Inc	2.3%	25,141	80.6x	53.5x	43.2x	71.4x	44.0x	33.6x	37.5x	36.3x	19.8x	n/a	n/a	n/a
First Solar Inc	3.5%	7,526	17.0x	255.8x	34.8x	12.3x	47.9x	15.7x	1.3x	1.3x	1.2x	n/a	n/a	n/a
Canadian Solar Inc	2.6%	2,057	22.3x	11.1x	7.1x	7.1x	5.5x	3.9x	1.0x	0.9x	0.8x	n/a	n/a	n/a
Vestas Wind Systems A/S	3.1%	25,792	59.5x	n/a	47.3x	16.2x	41.4x	14.2x	4.7x	6.0x	4.9x	0.5%	0.1%	0.6%
Siemens Gamesa Renewable Energy SA	3.2%	13,129	n/a	n/a	166.2x	28.4x	390.0x	18.7x	2.5x	3.2x	3.2x	n/a	n/a	0.0%
TPI Composites Inc	0.6%	514	n/a	n/a	n/a	20.9x	16.2x	7.4x	1.8x	2.2x	2.2x	n/a	n/a	n/a
	<b>31.1%</b>													

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:

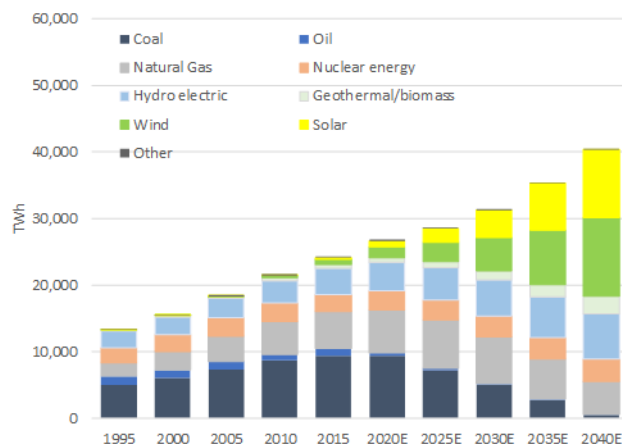
- **Population and GDP growth** putting a significant strain on today's energy supply
- **Economics** as sustainable sources of energy will be cheaper than the incumbents
- **Climate change** leading the world to reduce carbon emissions via cleaner energy
- **Pollution** forcing governments to drive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



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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<sub>2</sub>e) 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

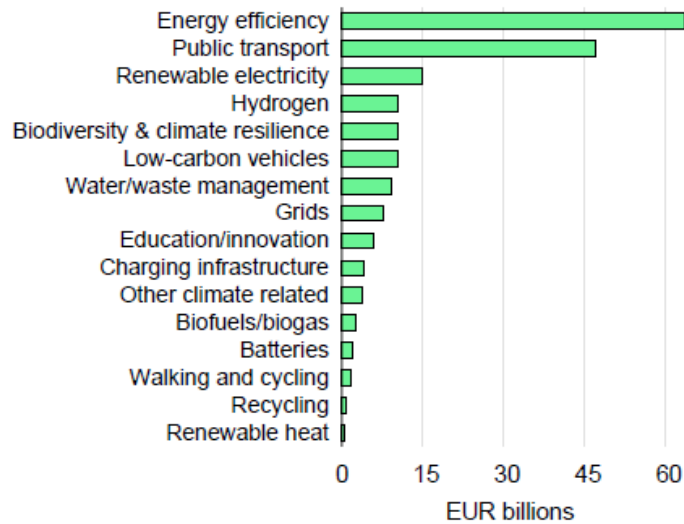
Energy efficiency measures were negatively impacted by Covid in 2020, as projects and investments were disrupted, but it appears that governments are turning their attention to efficiency measures as part of post-Covid stimulus measures. There is urgency to do this as current government policies imply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

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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 (RRF) 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.

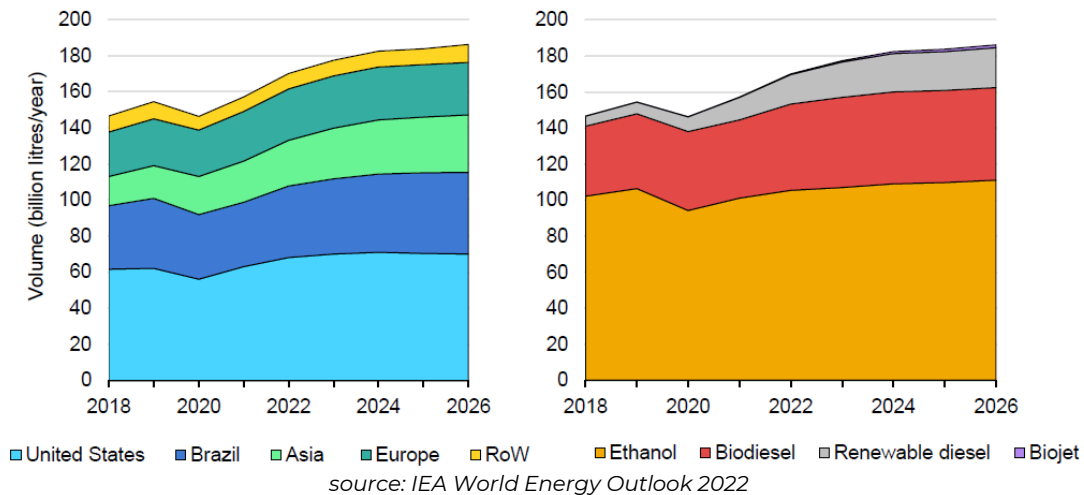
Alternative fuels consumption in 2021 grew by 10% versus 2020 and 3% versus 2019. Demand growth was significantly stronger than the underlying 6% increase in global oil demand, underlining the policy support for increased blending of alternative fuels in the transportation mix. Renewable diesel demand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

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



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

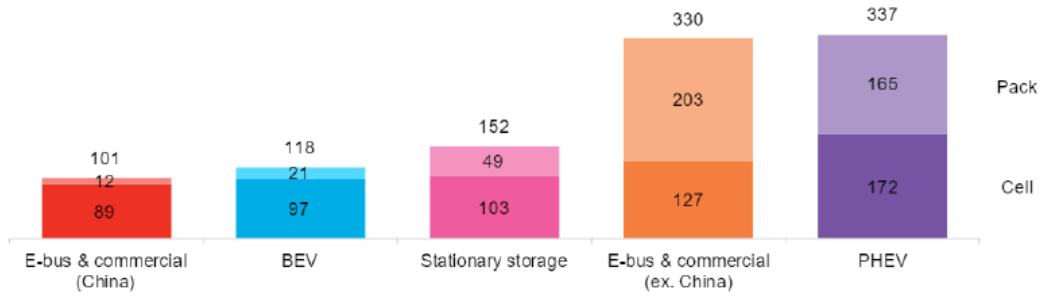
The catalyst for greater **lithium-ion battery** use has been sharp falls in the cost of manufacturing. According to BNEF, battery pack costs are down 89% over the period 2010 to 2021 (an implied 'learning rate' of around 18%) with the average cost being \$132/kWh in 2021 (split \$101/kWh for the cell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

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

source: BNEF



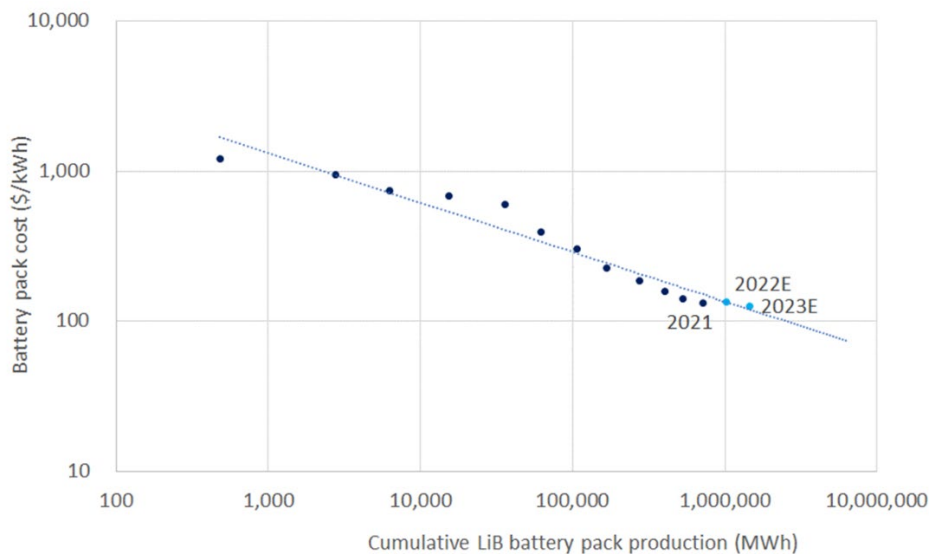
Raw materials make up around 50% of the cost of a lithium-ion battery pack, with cathode materials alone representing around 30% of the total cost. The key catalyst material is lithium carbonate, whose price in China rose by 270% in 2021. While battery manufacturers have long-term contracts and approaches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

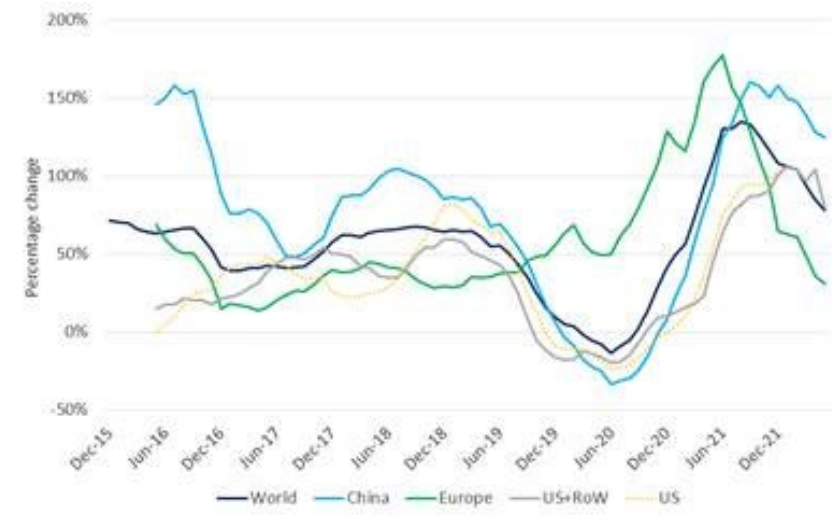
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on the same period last year. This growth continues to compare favourably against broader passenger vehicle sales (down 4% over the same period). We estimate that the 12-month rolling EV sales penetration rate at the end of May 2022 stood at 9.2% versus 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

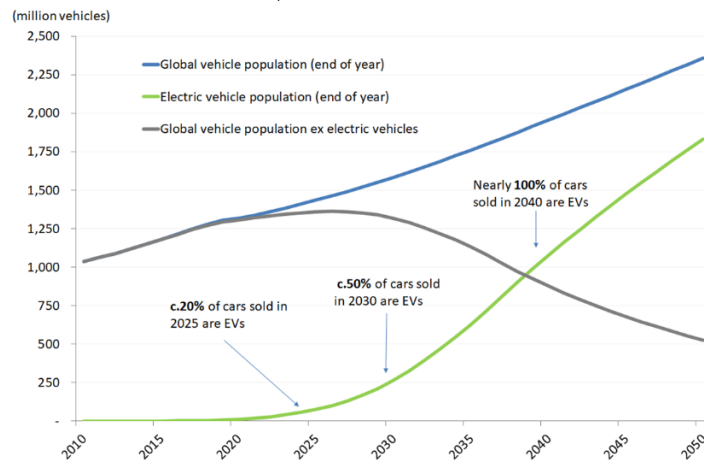


Government support for EVs is reducing in 2022. Europe will continue rolling back its EV ‘super-credits’, and China plans to reduce EV subsidies further. Despite this, we expect global EV sales to exceed 10 million in 2022, representing around 10% of total passenger vehicle sales, taking the global EV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



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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.

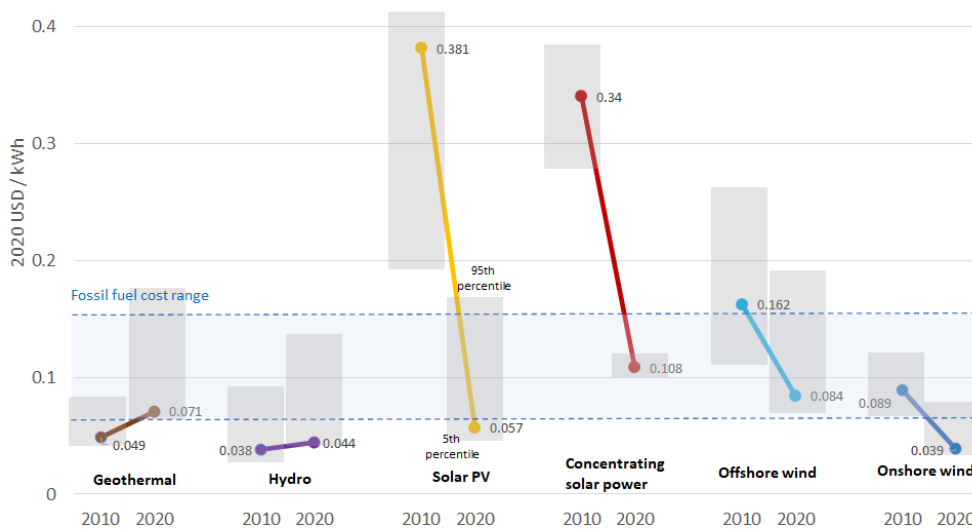
### Generation & installation (equipment)

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).



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## 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
<b>OECD solar installations (annual)</b>													
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
<b>Total OECD</b>	<b>17</b>	<b>23</b>	<b>24</b>	<b>24</b>	<b>25</b>	<b>29</b>	<b>29</b>	<b>26</b>	<b>31</b>	<b>40</b>	<b>51</b>	<b>70</b>	<b>80</b>
<i>Change in OECD annual installations</i>	<i>10</i>	<i>7</i>	<i>0</i>	<i>0</i>	<i>2</i>	<i>4</i>	<i>0</i>	<i>-3</i>	<i>5</i>	<i>9</i>	<i>11</i>	<i>19</i>	<i>10</i>
<b>Non-OECD solar installations (annual)</b>													
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
<b>Total Non-OECD</b>	<b>2</b>	<b>5</b>	<b>8</b>	<b>18</b>	<b>21</b>	<b>27</b>	<b>46</b>	<b>72</b>	<b>77</b>	<b>78</b>	<b>93</b>	<b>114</b>	<b>170</b>
<i>Change in non-OECD annual installations</i>	<i>1</i>	<i>3</i>	<i>2</i>	<i>11</i>	<i>2</i>	<i>6</i>	<i>19</i>	<i>26</i>	<i>5</i>	<i>1</i>	<i>15</i>	<i>21</i>	<i>56</i>
<b>Total solar installations (annual)</b>	<b>19</b>	<b>29</b>	<b>31</b>	<b>42</b>	<b>46</b>	<b>56</b>	<b>75</b>	<b>98</b>	<b>108</b>	<b>118</b>	<b>144</b>	<b>184</b>	<b>250</b>
<i>Change in world annual installations</i>	<i>11</i>	<i>10</i>	<i>2</i>	<i>11</i>	<i>4</i>	<i>10</i>	<i>19</i>	<i>23</i>	<i>10</i>	<i>10</i>	<i>26</i>	<i>40</i>	<i>66</i>

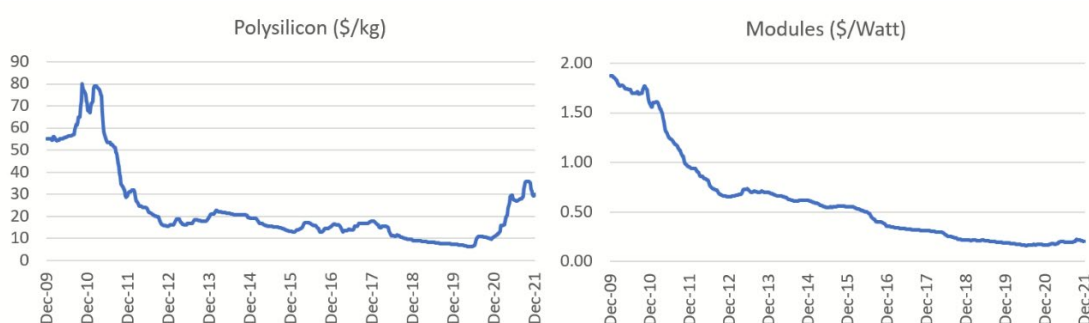
### Supply solar supply chain

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

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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
<b>Onshore wind installations (annual)</b>															
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
<b>Total onshore</b>	<b>27</b>	<b>38</b>	<b>35</b>	<b>40</b>	<b>46</b>	<b>33</b>	<b>49</b>	<b>61</b>	<b>55</b>	<b>49</b>	<b>46</b>	<b>55</b>	<b>91</b>	<b>83</b>	<b>92</b>
<i>Change in onshore annual installations</i>		12	-3	5	6	-14	17	11	-6	-6	-3	9	36	-8	9
<i>World ex China</i>	21	24	18	22	32	18	29	32	33	32	27	29	37	42	44
<b>Offshore wind installations (annual)</b>															
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
<b>Total offshore</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>4</b>	<b>1</b>	<b>4</b>	<b>4</b>	<b>8</b>	<b>7</b>	<b>17</b>	<b>13</b>
<i>Change in onshore annual installations</i>		0	1	-1	1	1	-1	4	-4	3	0	3	-1	11	-4
<i>World ex China</i>	0	0	1	0	1	2	1	3	0	4	3	5	3	3	7
<b>Total wind installations (annual)</b>	<b>27</b>	<b>38</b>	<b>36</b>	<b>40</b>	<b>48</b>	<b>35</b>	<b>50</b>	<b>65</b>	<b>56</b>	<b>53</b>	<b>50</b>	<b>63</b>	<b>98</b>	<b>100</b>	<b>105</b>
<i>Change in world annual installations</i>		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 2020 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.

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## 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.

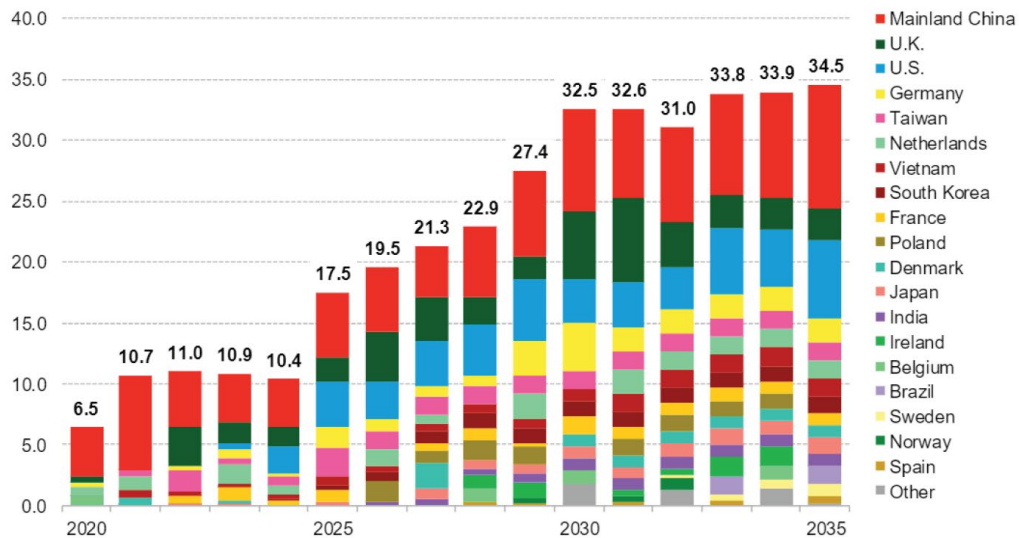
Annual installations of offshore wind capacity have increased from 0.9GW in 2010 to a new high of 17 GW in 2021. Chinese offshore installations reached 14 GW in 2021 while ex-China installations are likely to grow from 3 GW in 2021 to a new high of 7 GW in 2022.

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 electrolyzers, 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



# The Guinness Sustainable Energy Report

## IMPORTANT INFORMATION

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The documentation needed to make an investment, including the Prospectus, the Key Investor Information Document (KIID) and the Application Form, is available in English from [www.guinnessgi.com](http://www.guinnessgi.com) or free of charge from:-

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

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### Investor Rights

A summary of investor rights in English is available here:

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**Telephone calls** will be recorded and monitored.