EDISON

European renewables

An increasingly attractive environment

Edison themes

30 May 2022

Unprecedentedly high wholesale gas and electricity prices across Europe, combined with Russia's invasion of Ukraine, have accelerated energy security proposals in the EU and UK, which build on existing plans to reduce exposure to fossil fuels. We analyse the impact of the new proposals on renewables' contribution to power generation. We estimate they could account for nearly 70% of the EU and UK's combined electricity production in 2030, up from c 40% in 2021. This provides an attractive environment for many companies with activities linked to renewables. We highlight ways to play the theme at the end of this report.

Accelerated energy security measures

Following Russia's invasion of Ukraine, both the EU and UK have accelerated energy security measures to ensure less reliance on fossil fuels from volatile parts of the world such as Russia. The REpowerEU package and British Energy Security Strategy (BESS) paper set out ambitious plans where renewables will play an integral role. In this report, we model what the regulatory packages mean for growth in the wind and solar markets in Europe, and ascertain who will be the beneficiaries of value accretion.

Value coming into the sector

We expect strong long-term growth in European renewables (mostly wind and solar) driven by an increasingly favourable regulatory environment. We estimate the wind and solar markets could grow at CAGRs of 23% and 12% respectively for the rest of this decade. In addition, we expect structurally higher wholesale electricity prices, driven by higher long-term gas prices and an increasing EU carbon price. Furthermore, there is a long-term trend of a decreasing levelised cost of renewables and increasing appetite for corporate power purchase agreements (PPAs) outside of the highly competitive auction systems where winning projects are typically lowest-cost bidders. These factors combined should drive value into the sector.

Developers the primary beneficiaries

Renewables developers should generate enhanced returns on capital (double-digit project internal rates of return, IRRs), although we expect some value to ripple into the renewable equipment manufacturers and to a lesser extent into the component and services providers. We expect grid and energy storage companies to also benefit due to the massive investment (hundreds of billions of euros) required to ensure electricity systems can cope with a significantly higher proportion of renewables. In addition, companies with activities in stationary battery storage, hydrogen electrolysers and grid infrastructure should benefit.

From the street

Executives with whom we met [in our recent California trip] in both the solar and hydrogen industries suggested that their time was now. More utilities had recently accelerated discussions regarding energy transition. One solar CFO said that 'we have not yet scratched the surface' regarding electric vehicle adoption – and such cars will clearly need to be powered by renewable energy if they are to be truly carbon neutral. Energy storage will comprise part of the critical future infrastructure.

Alex Gunz, Heptagon Future Trends Fund

Edison themes

As one of the largest issuer-sponsored research firms, we are known for our bottom-up work on individual stocks. However, our thinking does not stop at the company level. Through our regular dialogue with management teams and investors, we consider the broad themes related to the companies we follow. Edison themes aims to identify the big issues likely to shape company strategy and portfolios in the years ahead.

Edison clients mentioned in this report*

BayWa
Foresight Solar Fund
Gresham House Energy Storage
Hellenic Petroleum
Jersey Electricity
Loop Energy
Mytilineos
Premier Miton Global Renewables Trust
Provaris Energy
visaVento

*For full list of companies mentioned in the report see Exhibit 13

Analyst

James Magness +44 (020) 3077 5700

cleanenergy@edisongroup.com

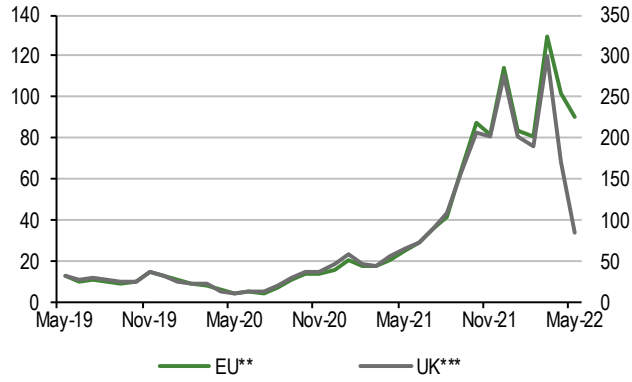
Europe's energy crisis

Europe's energy crisis has intensified following Russia's invasion of Ukraine, but energy price shocks were already underway in 2021 due to several factors:

- oil & gas demand rising as COVID-19 restrictions eased;
- low gas storage levels following a cold winter in 2021;
- increased competition for LNG from Asia and South America; and
- lower gas imports to the EU from Russia.

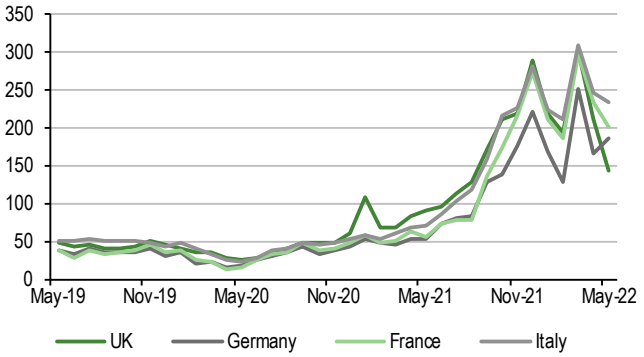
These ongoing supply and geopolitical issues should result in gas prices remaining high for the foreseeable future, and we expect that a structural shift in supply means that in the long term they will remain notably above recent averages.

Exhibit 1: EU wholesale gas price (€/MWh, left-hand side) and UK wholesale gas price (p/therm, right-hand side)*



Source: Bloomberg. Note: *Monthly average prices, other than May 22 (which is average of 1–26 May). **Dutch Title Transfer Facility (TTF) virtual trading point. ***UK National Balancing Point Natural Gas.

Exhibit 2: Select EU countries and UK wholesale electricity price (€/MWh)



Source: Refinitiv. Note: Monthly average prices, other than May 22 (which is average of 1–26 May).

The EU currently imports 90% of its gas consumption, with over 40% of this provided by Russia, according to the European Commission. In addition, c 50% of imported hard coal is from Russia (although import volumes are in decline) and c 30% of imported crude oil. The UK's reliance on Russian gas is significantly less at c 10%, importing instead mostly from Norway and through LNG from Qatar and the United States. The war has led to the recognition that the EU must become independent of Russian gas in order to ensure security of gas supply. Similarly, the UK wants to accelerate energy security and reduce reliance on foreign energy suppliers, such as Russia.

The EU's new REPowerEU plan

In March, the European Commission proposed its REPowerEU plan to increase the resilience of the EU wide energy system. The plan will be implemented by the summer of 2022. The plan builds on the Fit for 55 proposals, adopted in July 2021, that set targets to reduce net emissions by at least 55% by 2030, compared to 1990 levels. The Fit for 55 package is the first step of the EU Green Deal, which targets climate neutrality across the continent by 2050, although some commentators (trade associations and NGOs) have argued that Fit for 55 does not go far enough and therefore is not the most efficient pathway to net zero emissions. REPowerEU proposes that two-thirds of the EU's Russian gas imports of 155 billion cubic meters (bcm) in 2021 (ie c 100bcm) can be replaced by the end of 2022, and the remainder by 2030.

REPowerEU aims to achieve this through two key pillars:

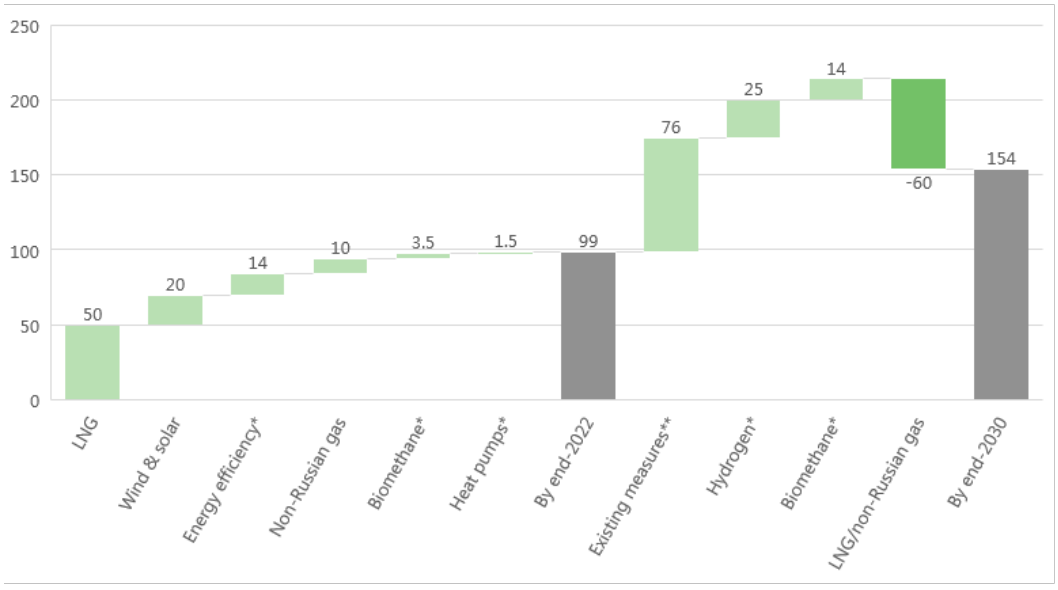
- diversifying gas supplies, and
- reducing dependence on fossil fuels.

Renewable energy will contribute to reducing the dependence on fossil fuels, with an estimated saving of 20bcm in 2022, which includes 17bcm from already expected projects and 3bcm from the front-loading of projects. In our view, front loading 3bcm could be challenging. We note that even with accelerated permitting, utility-scale wind farms and solar plants rarely have construction periods of less than six months and can take up to 18 months in some cases. There is more potential, however, for accelerating rooftop solar installation. We discuss the implications for wind and solar in more detail in the next section. The largest reduction for 2022, of 60bcm, is expected to come from increasing imports of LNG and non-Russian gas. Germany, which currently has no domestic LNG regasification facilities, has already announced that it will build two LNG import terminals, though these are not expected to be operational before 2026.

The plan also builds on legislative proposals, presented by the European Commission in December, aimed at facilitating the uptake of renewable and low carbon gases. It proposes a 'Hydrogen Accelerator' programme to stimulate an additional 15 million tons (mt) of renewable hydrogen by 2030, including developing integrated infrastructure, storage facilities and port capacities. This can replace 25–50bcm of Russian gas. It suggests that 10mt of renewable hydrogen would be imported from diverse sources and 5mt would be produced in Europe, in addition to the 5mt already planned. In addition, the EU will boost its production of biomethane, aiming for 35bcm by 2030, doubling the current EU ambition, using sustainable biomass sources. The EU Commission is targeting 80GW of additional wind and solar installations by 2030, which will be needed due to increased electricity requirements due to the extra renewable hydrogen production and to a lesser extent a planned acceleration in the roll out of heat pumps (an energy efficient method of replacing gas used in heating).

It is also worth noting that full implementation of Fit for 55 would already reduce gas consumption by 30%, equivalent to 100bcm, by 2030, replacing it with wind, solar, heat pumps and renewable gases, along with energy efficiency measures. Thus, the near-term increase in non-Russian gas imports can be reduced over time.

Exhibit 3: Plans to replace Russia gas supply by 2030 (bcm)



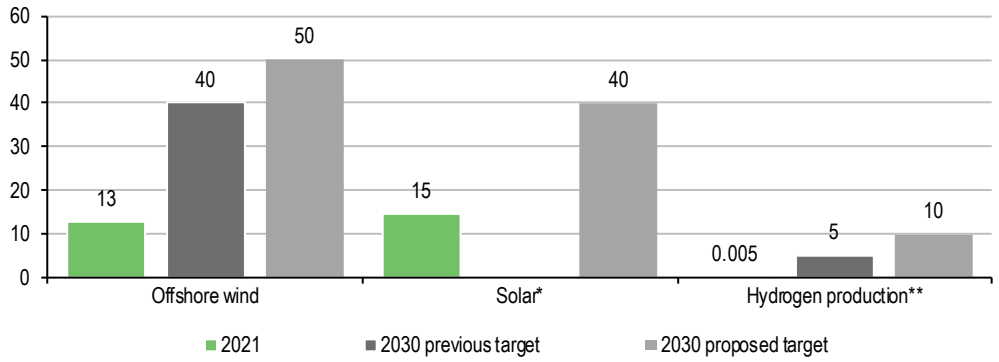
Source: Edison Investment Research, European Commission. Note: *Incremental to REPowerEU (includes 10bcm of energy efficiency; hydrogen of 25-50bcm). **Fit for 55 reduced gas consumption by c 100bcm, with 24bcm front-loaded in 2022 (20bcm wind & solar and net 4bcm of energy efficiency).

The UK also has accelerated its plans

On 7 April, the UK government published its British Energy Security Strategy (BESS) paper. It aims to improve energy security and reduce energy bills for consumers. The proposal increases the previous offshore wind target from 40GW to 50GW, including a higher portion of floating offshore wind (from 1GW to 5GW). This is underpinned by planning reforms that are set to cut approval times for offshore wind from four years to one year. We note that the construction period for a 1GW offshore wind farm is about three years. The government's Build Back Greener package, released in October 2020, already included investment of £160m for upgrades to ports and infrastructure to increase offshore wind capacity and keep the UK as the world's largest offshore wind market.

The paper states that solar capacity 'could be' up to 70GW by 2035. This is the first time any form of ambition has been published for solar. It falls short of providing an onshore wind target, however suggests it is open to developing partnerships with support communities for the benefit of the local population. A week prior to publication of the paper, the UK's business secretary, Kwasi Kwarteng, suggested ambitious 2030 targets of 30GW for onshore wind, 50GW for solar and 50GW for offshore wind. Only the latter made it into the strategy paper. The paper also increases the UK's low-carbon hydrogen capacity target for 2030 from 5GW to 10GW, which will be supported by a £240m Net Zero Hydrogen Fund. The BESS paper also echoed previous energy efficiency plans to improve the efficiency of homes by encouraging insulation and low-carbon heating. It is targeting 600,000 heat pumps per year by 2028, which effectively electrifies heating.

Exhibit 4: UK – Proposed capacity targets, compared with previous targets and end-2021 capacity (GW)



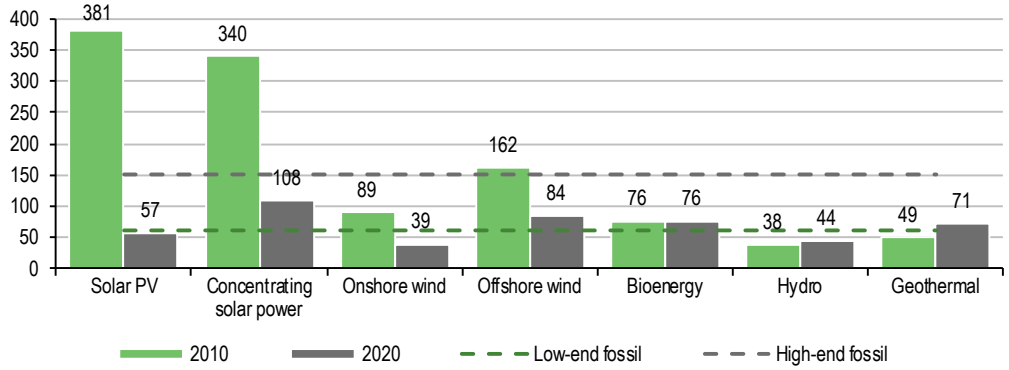
Source: Edison Investment Research, UK government documents. Note: *We estimate that 70GW by 2035, equates approximately to a pathway with 40GW in 2030. **At end-2021, hydrogen production capacity in the UK was under 5MW.

Wind and solar markets are particularly attractive

Wind and solar power generation technologies have developed significantly over the last 20 years and costs have reduced substantially. Even before the recent energy price surges, the economics for solar photovoltaic (PV) and onshore wind compared favourably against other power generation technologies, without government support, on average, globally. Exhibit 5 shows that between 2010 and 2020, the global weighted-average levelised cost of energy (LCOE) for onshore wind reduced by 56% to $39/MWh, which is considerably below the low-end range for fossil fuels of c $60/MWh and corresponding to combined cycle gas thermal (CCGT). The 2020 LCOEs for solar PV and hydro are also below the low-end fossil range. The LCOE for solar PV has decreased by 85% over the period, the largest amount of any technology, to $57/MWh. In contrast, the LCOEs for both hydro and geothermal have increased over the period, by 16% and 45% respectively, although are still only $44/MWh and $71MWh respectively. They are both mature, niche technologies and the economics are typically highly dependent on the project site. The relative attractiveness of

renewables is even more favourable in the current high fossil fuel price environment, with wholesale electricity prices still above €150/MWh ($160/MWh) in many European countries.

Exhibit 5: Global weighted-average utility-scale levelised cost of energy ($/MWh)

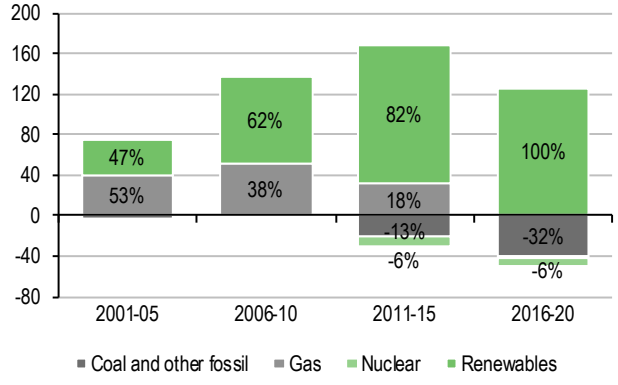


Source: Edison Investment Research, IRENA Renewable Cost Database

The rise of renewables

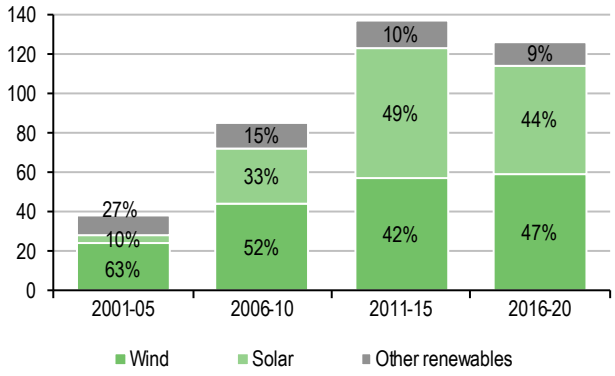
In fact, over the last 20 years, renewables have accounted for more than 75% of net capacity additions in the EU-27 and UK. Note that we have netted additions and closures by technology and both coal and nuclear have net closures. Exhibit 6 shows that even back in 2006–10, renewables installed considerably more net capacity than any other power generation technology with 62% of net additions compared to gas with 38%. By the latest five-year period (2016–20), renewables accounted for 100% of net additions, and wind and solar accounted for more than 90% of these. Other renewables include hydro, geothermal and bioenergy.

Exhibit 6: EU-27 and UK – net capacity additions by technology in five-year buckets (GW)



Source: Edison Investment Research, Ember

Exhibit 7: EU-27 and UK – net capacity additions by renewable technology in five-year buckets (GW)



Source: Edison Investment Research, Ember

On a country-level, Poland is the only country that has increased its coal-thermal capacity over the last five years (2016–20). A significant number of other countries have been closing coal-thermal plants and have more recently started to close down gas-thermal plants. This is resulting in a significant shift in the power production mix in Europe (EU-27 and UK), with 39% of electricity generated from renewables in 2020, up from 20% in 2010 and 14% in 2000 (which was mostly hydro).

Projecting future growth

We have analysed the electricity generation elements of existing National Energy and Climate Plans (NECPs) for EU-27 countries, which were mostly formulated pre-2020, and compared them to the current EU-level climate law (Fit for 55), published in July 2021, and the new proposal under REPowerEU. In addition, we have analysed the UK government's new proposals. The EU-level

legislation typically gives a high-level target for renewables as a percentage of overall energy mix (40% for Fit for 55, up from 32% previously) and allocates countries their own corresponding targets. It is then down to the individual countries to determine the required contribution for electricity generation (and transportation, heating and cooling), and the level of new capacity additions for wind, solar and other renewables, as well as the rate of closures of fossil fuel plants, depending on their own resources and circumstances. It is worth noting that the increased share of renewables, from an electricity generation perspective, is against the backdrop of the electrification of transport and heating (partially offset by energy efficiency). Thus, decarbonisation of supply is required at a time when electricity demand is set to increase significantly.

We have aggregated the existing NECPs, which gives our NECP scenario (in Exhibits 8 and 9). EU members are currently in the process of updating these for the Fit for 55 legislation and the REPowerEU proposal. In the recently published REPowerEU paper, the European Commission indicates its capacity ambitions for wind and solar capacity implicit in the high-level targets of Fit for 55 and REPowerEU. This was not available at the EU-level for the earlier EU-level regulation, which the NECPs are based on. We have modelled what the capacity ambitions mean for wind and solar market growth, in terms of annual capacity additions, across all scenarios.

Wind market

Based on the 2030 ambitions within the UK BESS and REPowerEU, we estimate the European (EU-27 and UK) wind market (annual capacity additions) could grow at a CAGR of 23% over the period 2021–30, from 14GW in 2021, adding 368GW, and reaching total capacity of 583GW. This follows 36% market growth in 2021 and just 2% pa growth over 2016–21. We do not show the estimated market size in 2030, as in reality the growth profile will be front-end loaded, particularly as the EU is looking to accelerate renewables build out in 2022. This very attractive potential growth need will require a progression in country-level policy support, which currently only caters for 9% pa growth (based on the NECPs). In particular, project approval processes will need to be speeded up, especially for offshore, and land made available for onshore.

Exhibit 8: Wind market growth estimates for 2021–30, and related data and metrics (GW)

	Capacity 2021	Capacity target 2030	Market size* 2021	% market growth in 2021	% market growth pa 2016–21	% market growth pa** 2021–30
Combined UK and REPowerEU EU	**215**	**583**	**14**	**36%**	**2%**	**23%**
UK – BESS***	27	73	3	596%	8%	14%
EU scenarios:						
REPowerEU EU	**188**	**510**	**11**	**14%**	**0%**	**24%**
Fit for 55	188	480	11	14%	0%	22%
NECPs****	188	320	11	14%	0%	9%

Source: Edison Investment Research, WindEurope, UK Government, European Council, National Energy & Climate Plans, including various country-level agencies, Ember (for historic capacity data). Note: *New capacity additions. **CAGR 2021–30 for new capacity additions. ***Target comprises 50GW offshore wind plus an estimated 22.5GW of onshore wind, which assumes 50% of the new additions of c 15GW proposed by UK's department for Business, Energy & Industrial Strategy, prior to the publication of the British Energy Security Strategy (BESS) paper. ****The NECP capacity target is based on the aggregate of country-level NECPs along with estimates when not explicitly available.

Solar market

Similarly, based on the 2030 ambitions within the UK BESS and REPowerEU, we estimate the European solar market could grow at a CAGR of 12% over 2021–30, from a higher base of 27GW in 2021, adding 436GW, and reaching total capacity of 615GW. This follows 43% market growth in 2021 and 34% pa growth over 2016–21. Based on momentum in recent years, on first impression, our projected market growth seems achievable. However, enhanced national-level policy support will be required particularly with respect to investment in grid and energy storage. Existing current country-level policies imply negative market growth of 6% from the record base year of 2021. European solar industry association SolarPower Europe believes that the proposed EU-level targets lack ambition. In its base case, it believes 672GW is achievable for 2030, which we estimate

implies 15% pa growth. In its accelerated high case, with the right policy support, it believes 1,000GW is possible for 2030, which we estimate implies 25% pa growth.

Exhibit 9: Solar PV market growth estimates for 2021–30, and related data and metrics (GW)

	Capacity 2021	Capacity target 2030	Market size* 2021	% market growth in 2021	% market growth pa 2016–21	% market growth pa** 2021–30
Combined UK and REPowerEU	**179**	**615**	**27**	**43%**	**34%**	**12%**
UK – BESS***	14	40	1	564%	-21%	27%
EU scenarios:						
REPowerEU	**165**	**575**	**26**	**40%**	**47%**	**11%**
Fit for 55	165	525	26	40%	47%	9%
NECPs****	165	335	26	40%	47%	-6%
SPE – accelerated high	165	1,000	26	40%	47%	25%
SPE – business as usual	165	672	26	40%	47%	15%

Source: Edison Investment Research, SolarPower Europe (SPE), UK government, European Council, National Energy & Climate Plans, including various country-level agencies, Ember (for historic capacity data). Note: *New capacity additions. **CAGR 2021–30 for new capacity additions. ***British Energy Security Strategy (BESS). ****The NECP capacity target is based on the aggregate of country-level NECPs along with estimates when not explicitly available.

Supporting future growth

The Fit for 55 package and REPowerEU include numerous support measures across over 10 pieces of legislation including the Renewable Energy Directive, the Energy Tax Directive, the Alternative Fuels Infrastructure Directive and the EU Emissions Trading System. We highlight a couple of important areas in this section.

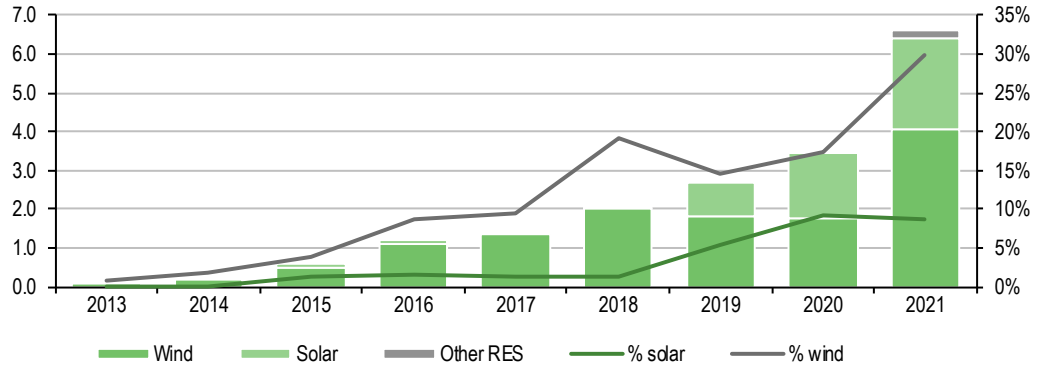
Investment in grid and energy storage required

Based on our analysis above, we estimate the EU could produce more than 65% of its electricity from renewables in 2030, and this assumes a c 30% increase in electricity demand, due to the electrification of transport and heating partially offset by increased energy efficiency measures. Similarly, we estimate that the UK could produce c 80% of electricity from renewables in 2030. This requires major upgrades to electricity grids, including significant energy storage capacity to mitigate against the intermittency of renewables. As part of the Green Deal plan, the EU is allocating €1bn to energy infrastructure projects. However, much more needs to be invested at the country level and urgently.

Corporate PPAs are important for rapid growth

The revision of the EU Renewable Energy Directive, under Fit for 55, crucially improves the legal framework for corporate PPAs. Member states have to issue guarantees of origin for all renewable electricity, regardless of whether the producer was awarded support in government auctions. This will improve the traceability of renewable electricity. The European Commission and the European Investment Bank Group are discussing financing mechanisms on how to promote PPAs, including how to offer better access for new off-takers such as small and medium-sized entities. In our view, this is an important route to accelerating market growth. There is increasing interest in long-term PPAs among industrial and other companies, due to pressure on them to reduce greenhouse gas emissions and in order to mitigate against high and volatile energy prices. The corporate PPA market nearly doubled to c 7GW in 2021 (from 3.5GW in 2020). For wind, corporate PPAs accounted for 30% of annual installations, while only 9% for solar.

Exhibit 10: European corporate PPAs (GW, left-hand side) versus PPAs as a percentage of annual market for each of wind and solar (right-hand side)

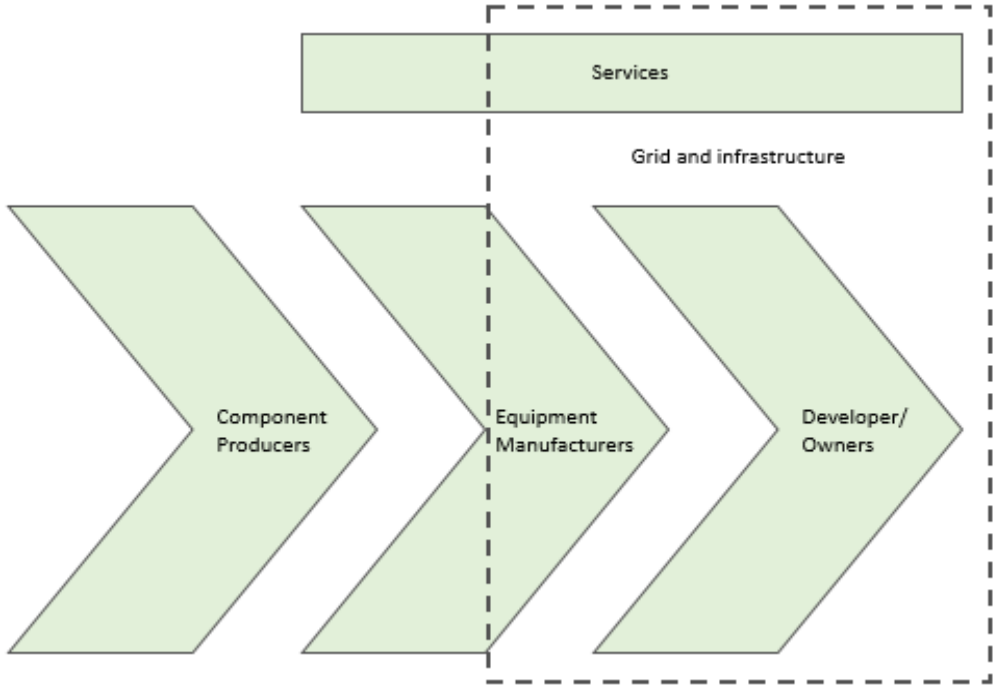


Source: Edison Investment Research, RE-Source

Ways to play renewables

As outlined in this report, we expect strong long-term growth in European renewables (mostly wind and solar) driven by a favourable regulatory environment. In addition, we expect structurally higher wholesale electricity prices, driven by structurally higher gas prices and an increasing EU carbon price. This, combined with a long-term trend of decreasing levelised cost of renewables and increasing appetite for corporate PPAs (outside of the highly competitive auction systems where winning projects are typically the lowest cost bidders), should drive value into the sector, with renewables developers being the primary beneficiaries. We expect some of this value to ripple into the renewable equipment manufacturers and to a lesser extent the component and services providers. We expect grid and energy storage companies to also benefit due to the massive investment required to ensure electricity systems can cope with a significantly higher proportion of renewables. We address each part of the value chain and other related areas below and include companies that we expect will be the likely beneficiaries.

Exhibit 11: Renewable electricity generation schematic



Source: Edison Investment Research

Renewable developer/owners

As mentioned above, renewable developers should be the primary beneficiaries of structurally higher wholesale prices and favourable economics for renewables. This should generate enhanced returns on capital (double-digit project IRRs), although eroded to some extent by increasing interest rates. The level of benefit can vary depending on a number of factors, including business model and geography (resource mix and regulation).

Business model: a developer that develops from greenfield and keeps the operating assets captures the most value; however, this is the most capital-intensive model. Some developers keep some operating assets and sell others, such as large independent power producer Oersted. This helps release capital for reinvestment. Many of the developers listed below under the resource mix and country-level regulation subheadings operate under these models. Sometimes, keeping an operating asset does not make sense for smaller developers with a higher cost of capital; more value can be realised by selling to a utility (with a lower cost of capital). Bluefield Solar Income Fund typically acquires completed renewable projects (mostly solar) and pays its investors a dividend. A less capital-intensive model, which captures a significant portion of the value, is selling pre-construction, fully approved, development assets. Private company Eco Energy World operates purely on this basis. In addition, Premier Miton Global Renewables Trust invests in renewable companies with attractive but varying business models. BayWa is present in a number of areas across the renewable value chain, including project development, component production, and providing energy solutions and services. It recently announced that it is issuing Europe's first ever corporate PPA tender initiated by a developer. The tender, which will take place in autumn 2022, is for 10TWh over a 10-year contract and will see the project's output shared with several off-takers.

Resource mix: the economics of projects vary depending on wind or solar resources, which vary considerably according to geography (and even within a country). For example, Greece has highly favourable conditions for solar power. In the most recent (May 2021) renewables auction in Greece, wind and solar projects competed against each other for an allotted quota of capacity. Winning bids were all solar projects, due to their favourable economics, with tariffs ranging from c €33/MWh to

€51/MWh. This compares to an average monthly wholesale electricity price (in Greece) of greater than €200/MWh since October 2021. The winning tariff prices would likely be based on project IRRs of 6–8%; so, assuming corporate PPAs at €60–80/MWh would imply projects IRRs well into double figures. Similarly, Portugal and Spain have highly favourable solar resources. Developers in these regions include Iberdrola, EDP Renováveis (EDPR), Terna Energy, Mytilineos and Hellenic Petroleum. On the other hand, Northern Europe has some of the most favourable wind resources. The UK is one of the windiest countries in Europe. Similarly, Ireland, France, Belgium, Germany, Netherlands and the Nordics also have favourable wind resources. These countries also have good offshore wind resources, with the UK leading the offshore wind market globally. UK-based developers include renewable energy infrastructure funds (REIFs) Greencoat UK Wind, Renewables Infrastructure Group and Foresight Solar Fund, and utilities SSE and Centrica. French-based developers include independent power producer (IPPs) Voltalia and Neoen, as well as utilities EDF, Engie and Veolia. German-based developers include utilities RWE and E.ON.

Country-level regulation: regulatory support differs depending on country. Although renewable projects are nowadays often economic without government subsidies, other forms of support such as expediting project approval processes, encouraging the corporate PPA market (which is an important factor in our value thesis), ensuring the grid is well-invested and speed of closure of fossil fuel plants can enhance project economics. Poland is an interesting example as it has seen strong growth in rooftop solar over the last couple of years due to a household subsidy of up to PLN5,000 per unit installed. In contrast, its wind industry has ground to a halt due to the 10H rule, which forbids the construction of turbines at a distance smaller than 10 times the wind turbine's tip height from residential housing making it difficult for any onshore wind projects to be approved. On top of this, Poland has the most carbon-intensive power generation in Europe due its high exposure to hard coal and lignite thermal plants, and the Polish government's current plans to decarbonise are lacklustre. Planned closures of coal plants are slow (while other countries are accelerating closures) and it is largely seeking to replace them with new gas thermal capacity rather than renewables. This should keep wholesale electricity prices structurally high well into the 2030s, potentially creating a significant opportunity for renewable developers (in the case of wind, once 10H rules are relaxed), particularly those that can access spot wholesale prices. Polish developers include Polenergia, Tauron Polska, PKN Orlen and private company visaVento. Also, national utility PGE has some wind development assets; however, it also has significant fossil fuel exposure. International developers with renewable energy activities in Poland include EDPR and RWE.

Balance sheet strength: developers/owners that can finance assets using their own balance sheet rather than through project finance will be able to benefit from the current exceptionally high wholesale prices (notwithstanding their hedging strategies). Project financiers typically require developers to secure PPAs of c 10 years in order to mitigate market risk, thus developers with operating assets that are greater than 10 years old would also benefit from current high market prices. Utilities, REIFs and large IPPs typically have the strongest balance sheets. Mytilineos is also able to finance renewable projects using its own balance sheet.

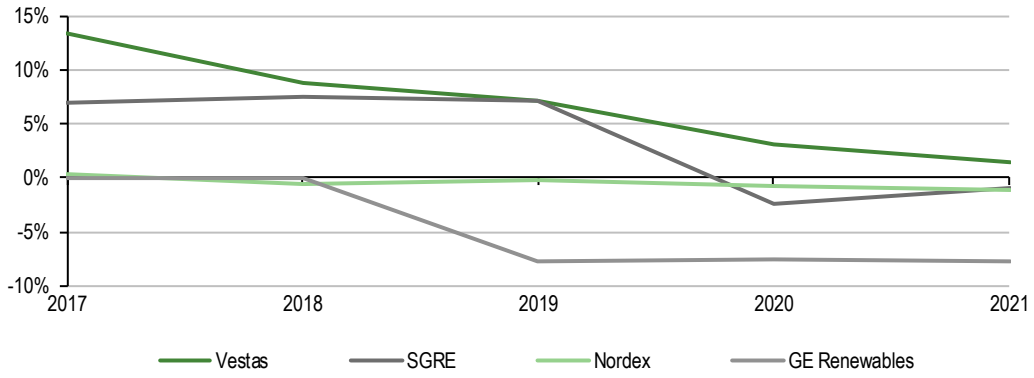
Renewable equipment manufacturers and component producers

In order to get a sense of the potential value flowing into the renewable equipment manufacturers, a distinction should be made between wind turbines and solar panels. Wind turbines are specialist pieces of equipment, with differentiation between products, whereas solar panels are a more commoditised product with low-cost Chinese manufacturers accounting for c 80% of the European market.

For wind, Western banks only tend to provide finance to more reliable Western turbines. Strong long-term growth rates in Europe (10-year CAGR of 23%) should create a sellers' market, following on-off growth over the last five years (a CAGR of just 1.5%). This should lead to some value flowing through to the equipment manufacturers and to a lesser extent component producers. Developers

could potentially pay a larger premium to secure the best-quality turbines that optimise wind conditions. This should be a welcome boost as margins have been squeezed over the last few years due to rising raw materials, components, energy and logistics costs, as well as over-capacity and cost pressures due to competitive auctions.

Exhibit 12: Western wind turbines manufacturers – adjusted EBIT margins



Source: Edison Investment Research, company data

The European wind turbine market is supplied mostly by European wind turbine manufacturers, such as Vestas, Siemens Gamesa Renewable Energy (SGRE), Nordex and Enercon (a private company), along with US manufacturer GE Renewables. Europe has the world's largest offshore wind market, and SGRE is the market leader. Vestas is the onshore market leader.

Component providers for wind and solar face strong competition from China. Surviving Western component providers are typically those that have evolved from parts supplier to system-solution provider, and/or have the ability to help reduce the cost of energy through smart technologies. These premium offering companies could potentially find value flowing to them. Large industrial companies such as ABB and Siemens provide a suite of solutions. Private companies include high-tech wind gearbox manufacturer ZF Wind Power (which has partnered with Vestas). For solar, inverters are a key specialist power electronics component with differentiation between offerings particularly for the rooftop market. There are three main types: string, power optimisers and microinverters, and depending on choice these can potentially increase utilisation rates for the solar system. Leading inverter producers with activities in Europe include German companies BayWa and SMA Solar, French company Schneider Electric, Swiss company ABB and US companies Enphase and SolarEdge.

Services

Services are generally a highly competitive segment of the market, particularly within operations and maintenance (O&M) and construction. We expect some value to flow to those services providers that differentiate themselves by offering a suite of services, from development to construction through to O&M, such as Acciona and Abengoa. Specialist O&M service providers focused on a certain major component (ie gearboxes, generators or blades) should also benefit, such as private companies Moventas, Stork and Windtex. These specialist O&M service providers can help inhouse teams reduce costs by providing services when required. In addition, Windar Photonics is dedicated to making measuring equipment for improving the efficiency of wind turbines. Most wind turbine manufacturers offer a suite of O&M services and have historically benefited from higher margins than for turbine manufacturing (and with lower capital intensity). In recent years, however, there has been margin pressure due to increasing inhouse capabilities among developers/owners and cost economies enjoyed by large third-party O&M players, such as RES Group, which also provide services across and solar, storage and transmission and distribution.

There are also companies, particularly software or power electronics companies, that are broadening their offerings to become home energy services companies, offering solar plus storage solutions along with software connecting electric vehicles and fuel cells to the home system, and also distributed energy management services. Enphase (mentioned above under components) is pursuing a growth strategy into these areas. Large software companies, such as Microsoft, IBM and Oracle, are increasingly involved in these areas along with many other software and electronics companies. These companies should benefit from growth in rooftop solar (and electric vehicles), as well as investment in grid and infrastructure. We include other smart grid-related companies in the grid and infrastructure subsection below.

Other renewables

We focused on the wind and solar industries above, due to the high growth rates and potential value coming into the sector. In addition, there are niche opportunities within geothermal, biomass, hydro, wave and tidal power. Ormat Technologies operates across the geothermal value chain and also offers energy storage and grid management solutions. Companies with activities in biomass include Drax and Active Energy. Simec Atlantis Energy has operations spanning tidal power, hydro power and biomass. There are numerous wave energy technologies and projects globally, some listed examples of which are Eco Wave Power, Ocean Power Technologies and Carnegie Clean Energy. Many of the utilities mentioned elsewhere in this section have activities in hydro power and some of these other niche renewable areas. In addition, Brookfield Renewable Partners has a large portfolio of operating hydro assets, as well as activities in wind, solar, distributed generation and pumped storage.

Grid and infrastructure

In order to enable the targeted renewables penetration in Europe over this decade, hundreds of billions of euros of investment is required to support an increasingly intermittent, decentralised and digitalised power system, exacerbated by closing down coal and gas plants. A study by Deloitte Consulting for two European electricity industry associations, published in January 2021, estimates that distribution grids will need investments of €375–425bn out to 2030. The study also suggests that 90% of this investment (c €30–35bn of annual revenue) can be captured by European manufacturers and service providers. In addition, UK regulator Ofgem has already approved £40bn in grid investment for 2021–26. Deloitte's estimate and the UK's approved investment pre-date the most recent energy security packages in the EU and UK, so will likely need to be revised upwards. Beneficiaries of this massive investment and increasingly favourable regulatory environment include businesses with activities in the following areas:

Short duration storage solutions are required for grid resilience due to the intermittency of renewables. Batteries are increasingly affordable for short duration applications, with prices for stationary applications (ie grid management) having declined by two-thirds over the last decade. The largest battery storage developer in the UK is renewable energy infrastructure fund Gresham House Energy Storage, followed by Gore Street Energy Storage (another REIF). The global leader is Fluence, which is a Nasdaq-listed company majority owned by Siemens and AES Corporation. Other companies involved with battery energy storage solutions include Tesla, Varta, Leclanché, Invinity Energy Systems, Vattenfall and Aggreko, following the acquisition of Younicos. Vattenfall is a utility active across many areas of renewables. In addition, Bloom Energy produces a fuel cell-based grid management system, which is currently being used as a short-duration storage solution (but could be adapted for long duration).

Medium duration storage solutions are typically used to store energy for four hours (the upper limit of short duration storage) to several days. Gravity batteries are an example that can be used for both medium and short durations. They use excess energy from the grid to lift masses (creating

potential energy), which can later be converted back to electrical energy. Swiss company Energy Vault is developing and manufacturing the equipment.

Long duration storage solutions are also required. Green hydrogen is a particularly suitable medium, created by electrolysis of surplus renewable electricity. It can be stored indefinitely and dispatched to different end-use sectors that are otherwise difficult to decarbonise, such as chemicals, steel production, aviation and maritime shipping and other forms of long-haul transportation. The green hydrogen can also be used for grid management by feeding it into a fuel cell. In addition, it can be transported from source to areas of demand by specialist ships. Provaris Energy (formerly Global Energy Ventures) is developing these ships, as well as developing projects to create hydrogen. Before transporting the hydrogen to areas of demand, it can be stored on a large scale in places such as old gas fields. Pressure Technologies and dCarbonX are developing solutions for hydrogen storage. Pure-play hydrogen electrolyser producers include ITM Power, McPhy Energy and Nel. In addition, German industrial group Thyssenkrupp is planning an IPO for its electrolysis unit, Thyssenkrupp Nucera. Pure-play fuel cell companies, with grid management solutions, include Proton Motor Power Systems, Ballard Energy and Loop Energy (although Loop's primary target segment is the return to base fleet market). Companies that offer both electrolysers and fuel cells include Ceres Power, Plug Power and FuelCell Energy. In addition, 2G Energy produces decentralised combined heat and power systems, which can be run on hydrogen and used for grid balancing. Also, Everfuel is an asset owner and operator across the green hydrogen value chain.

Grid infrastructure and cross-border interconnection along with a smart grid is required for a dramatic scale-up of renewables. The wind is always blowing or the sun shining in some parts of Europe. Industrials, such as Siemens, Alstom and ABB have activities in smart grid infrastructure. There are many other companies focused on smart grid activities, including Aclara Technologies, Itron, Smart Metering Systems and private company eleXsys. Also see distributed energy management services companies under Services above. Many of the utilities mentioned elsewhere in this section are also investing in smart grid and energy storage. Grid operators that are investing in future grids include National Grid, Terna Group, SNAM, Red Electrica and Jersey Electricity.

Energy majors

Oil majors are transitioning towards becoming energy majors. Their expertise naturally fits with areas such as geothermal (ie seismic/drilling), hydrogen and energy storage (ie hydrogen in old oil & gas fields), carbon capture and storage (ie carbon stored in old oil & gas fields) as well as offshore wind (ie subsea/drilling). That is not to say that all oil majors are pursuing all of these areas. Their experience in project appraisal, development, construction and operation in differing fiscal environments also can be applied to renewable energy development. Early movers among super-majors include TotalEnergies, Shell, BP and Eni, with Exxon and Chevron also now starting to embrace the energy transition. We also note that other upstream O&G companies have expertise in some of the above areas and so have potential to transition towards less carbon-exposed business models. European-listed upstream O&G companies that are pursuing decarbonisation strategies include Tullow Oil and Harbour Energy.

Exhibit 13: Companies featured in this report

Company	Ticker	Sector	Country of primary listing	Share Price (local currency)	Market cap ($m)	TSR* 12 months	TSR* year-to-date
Pure play renewables companies**							
Tesla	TSLA	Consumer discretionary	US	658.80	682,523	6%	-38%
Schneider Electric	SU	Industrials	France	123.00	75,166	-3%	-27%
Oersted	ORSTED	Utilities	Denmark	787.10	47,756	-15%	-4%
Vestas	VWS	Industrials	Denmark	168.06	24,495	-28%	-16%
EDP Renováveis	EDPR	Utilities	Portugal	22.97	23,683	17%	5%
Enphase	ENPH	Information Technology	US	169.28	22,858	18%	-7%
SolarEdge	SEDG	Information Technology	NULL	253.45	14,038	-2%	-10%
Siemens Gamesa Renewable Energy	SGRE	Industrials	Spain	17.78	13,000	-34%	-16%
Brookfield Renewable Partners	BEP.UN	Utilities	Canada	46.84	10,053	-1%	4%
Plug Power	PLUG	Industrials	US	15.76	9,111	-47%	-44%
PKN Orlen	PKN	Energy	Poland	71.34	7,136	-2%	-4%
Neoen	NEOEN	Utilities	France	40.25	4,627	13%	5%
Ormat Technologies	ORA	Utilities	US	79.35	4,449	14%	0%
Varta	VAR1	Industrials	Germany	77.26	3,335	-38%	-33%
Bloom Energy	BE	Industrials	US	15.61	2,782	-32%	-29%
Itron	ITRI	Information Technology	US	50.11	2,258	-47%	-27%
Terna Energy	TENERGY	Utilities	Greece	17.80	2,214	55%	31%
ITM Power	ITM	Industrials	UK	288.00	2,212	-23%	-27%
Voltalia	VLTSA	Utilities	France	21.60	2,211	-8%	10%
Nel	NEL	Industrials	Norway	13.23	2,159	-25%	-13%
Ballard Energy	BLDP	Industrials	Canada	8.78	2,042	-57%	-45%
Energy Vault	NRGV	Industrials	US	13.39	1,791	39%	35%
Nordex	NDX1	Industrials	Germany	10.42	1,789	-42%	-25%
SMA Solar Technology	S92	Information Technology	Germany	43.92	1,636	-4%	17%
Fluence	FLNC	Industrials	US	9.46	1,630	-73%	-73%
Ceres Power	CWR	Industrials	UK	656.60	1,570	-38%	-34%
Smart Metering Systems	SMS	Industrials	UK	841.00	1,406	3%	2%
FuelCell Energy	FCEL	Industrials	US	3.63	1,331	-61%	-30%
Polenergia	PEP	Utilities	Poland	74.40	1,162	-6%	1%
McPhy Energy	MCPHY	Industrials	France	15.43	463	-42%	-29%
Everfuel	EFUEL	Energy	Norway	55.30	452	-29%	45%
Proton Motor Power Systems	PPS	Industrials	UK	12.50	243	-55%	-40%
Invinity Energy Systems	IES	Industrials	UK	63.50	92	-61%	-31%
Ocean Power Technologies	OPTT	Industrials	US	0.93	52	-58%	-37%
Loop Energy	LPEN	Industrials	Canada	1.95	52	-76%	-56%
Provaris Energy	PV1	Energy	Australia	0.07	26	4%	-33%
Eco Wave Power	ECOWVE	Utilities	Sweden	5.00	23	-40%	-12%
Simec Atlantis Energy	SAE	Industrials	UK	2.47	22	-70%	57%
Carnegie Clean Energy	CCE	Utilities	Australia	0.00	21	0%	-33%
Active Energy	AEG	Energy	UK	0.16	11	-80%	-21%
Windar Photonics	WPHO	Information Technology	UK	14.25	10	-47%	-19%
Renewable energy infrastructure funds**							
Greencoat UK Wind	UKW	REIF	UK	148.70	4,318	19%	8%
Renewables Infrastructure Group	TRIG	REIF	UK	131.80	4,095	9%	1%
Foresight Solar	FSFL	REIF	UK	120.00	917	31%	22%
Gresham House Energy Storage	GRID	REIF	UK	148.00	812	30%	16%
Bluefield Solar Income Fund	BSIF	REIF	UK	130.50	811	11%	8%
Gore Street Energy Storage	GSF	REIF	UK	120.00	724	21%	3%
Premier Miton Global Renewables Trust	PMGR	REIF	UK	189.00	43	24%	-3%
Utilities with renewables activities**							
Iberdrola	IBE	Utilities	Spain	11.42	78,878	3%	11%
National Grid	NG.	Utilities	UK	1,227.00	56,059	35%	16%
EDF	EDF	Utilities	France	8.48	34,007	-19%	-11%
Engie	ENGI	Utilities	France	12.78	33,413	10%	5%
RWE	RWE	Utilities	Germany	42.30	30,704	35%	21%
E.ON	EOAN	Utilities	Germany	9.93	28,148	3%	-15%

Exhibit 13: Companies featured in this report

SSE	SSE	Utilities	UK	1,867.50	24,981	28%	15%
SNAM	SRG	Utilities	Italy	5.56	20,051	21%	7%
Veolia	VIE	Utilities	France	26.11	19,635	5%	-19%
AES	AES	Utilities	US	21.43	14,312	-14%	-11%
Red Electrica	REE	Utilities	Spain	19.90	11,558	29%	6%
Centrica	CNA	Utilities	UK	85.32	6,315	56%	19%
Drax	DRX	Utilities	UK	717.00	3,597	67%	20%
Tauron Polska	TPE	Utilities	Poland	3.51	1,438	4%	32%
Jersey Electricity	JEL	Utilities	UK	535.00	78	2%	-12%
Industrials/conglomerates with renewables activities**							
Siemens	SIE	Industrials	Germany	114.82	104,761	-12%	-23%
GE	GE	Industrials	US	74.53	82,033	-30%	-21%
ABB	ABB	Industrials	Switzerland	29.78	61,582	-10%	-20%
Acciona	ANA	Utilities	Spain	186.00	10,952	36%	11%
Alstom	ALO	Industrials	France	24.52	9,838	-45%	-21%
Thyssenkrupp	TKA	Materials	Germany	8.37	5,596	-13%	-14%
Mytilineos	MYTIL	Industrials	Greece	16.85	2,584	16%	11%
BayWa	BYW6	Industrials	Germany	47.30	1,831	22%	25%
Terna Group	GEKTERNA	Industrials	Greece	9.50	1,055	0%	0%
2G Energy	2GB	Industrials	Germany	105.80	509	13%	3%
Pressure Technologies	PRES	Energy	UK	88.50	34	4%	31%
O&G companies with renewables activities/decarbonisation strategies**							
Exxon	XOM	Energy	US	96.30	405,668	72%	61%
Chevron	CVX	Energy	US	175.41	344,648	76%	52%
Shell	SHEL	Energy	UK	2,378.50	222,163	80%	49%
TotalEnergies	TTE	Energy	France	53.95	151,132	49%	24%
BP	BP.	Energy	UK	427.85	103,805	44%	32%
Eni	ENI	Energy	Italy	14.12	54,648	51%	19%
Harbour Energy	HBR	Energy	UK	428.20	4,965	4%	23%
Hellenic Petroleum	ELPE	Energy	Greece	6.68	2,191	16%	12%
Tullow Oil	TLW	Energy	UK	54.65	984	7%	18%
Software companies with renewables activities**							
Microsoft	MSFT	Information Technology	US	262.52	1,963,396	5%	-22%
Oracle	ORCL	Information Technology	US	69.83	186,317	-11%	-19%
IBM	IBM	Information Technology	US	134.39	120,875	3%	3%
Private renewables companies**							
Aclara Technologies					Private		
Aggreko					Private		
dCarbonX					Private		
Eco Energy World					Private		
eleXsys					Private		
Enercon					Private		
Leclanché					Private		
Moventas					Private		
RES Group					Private		
Stork					Private		
Thyssenkrupp Nucera					Private		
Vattenfall					Private		
visaVento					Private		
Windtex					Private		
ZF Wind Power					Private		

Source: Edison Investment Research, Refinitiv. Prices as at 25 May 2022. Note: *Total shareholder return. **Includes energy storage and grid management.

General disclaimer and copyright

This report has been prepared and issued by Edison. Edison Investment Research standard fees are £60,000 pa for the production and broad dissemination of a detailed note (Outlook) following by regular (typically quarterly) update notes. Fees are paid upfront in cash without recourse. Edison may seek additional fees for the provision of roadshows and related IR services for the client but does not get remunerated for any investment banking services. We never take payment in stock, options or warrants for any of our services.

Accuracy of content: All information used in the publication of this report has been compiled from publicly available sources that are believed to be reliable, however we do not guarantee the accuracy or completeness of this report and have not sought for this information to be independently verified. Opinions contained in this report represent those of the research department of Edison at the time of publication. Forward-looking information or statements in this report contain information that is based on assumptions, forecasts of future results, estimates of amounts not yet determinable, and therefore involve known and unknown risks, uncertainties and other factors which may cause the actual results, performance or achievements of their subject matter to be materially different from current expectations.

Exclusion of Liability: To the fullest extent allowed by law, Edison shall not be liable for any direct, indirect or consequential losses, loss of profits, damages, costs or expenses incurred or suffered by you arising out or in connection with the access to, use of or reliance on any information contained on this note.

No personalised advice: The information that we provide should not be construed in any manner whatsoever as, personalised advice. Also, the information provided by us should not be construed by any subscriber or prospective subscriber as Edison's solicitation to effect, or attempt to effect, any transaction in a security. The securities described in the report may not be eligible for sale in all jurisdictions or to certain categories of investors.

Investment in securities mentioned: Edison has a restrictive policy relating to personal dealing and conflicts of interest. Edison Group does not conduct any investment business and, accordingly, does not itself hold any positions in the securities mentioned in this report. However, the respective directors, officers, employees and contractors of Edison may have a position in any or related securities mentioned in this report, subject to Edison's policies on personal dealing and conflicts of interest.

Australia

Edison Investment Research Pty Ltd (Edison AU) is the Australian subsidiary of Edison. Edison AU is a Corporate Authorised Representative (1252501) of Crown Wealth Group Pty Ltd who holds an Australian Financial Services Licence (Number: 494274). This research is issued in Australia by Edison AU and any access to it, is intended only for "wholesale clients" within the meaning of the Corporations Act 2001 of Australia. Any advice given by Edison AU is general advice only and does not take into account your personal circumstances, needs or objectives. You should, before acting on this advice, consider the appropriateness of the advice, having regard to your objectives, financial situation and needs. If our advice relates to the acquisition, or possible acquisition, of a particular financial product you should read any relevant Product Disclosure Statement or like instrument.

New Zealand

The research in this document is intended for New Zealand resident professional financial advisers or brokers (for use in their roles as financial advisers or brokers) and habitual investors who are "wholesale clients" for the purpose of the Financial Advisers Act 2008 (FAA) (as described in sections 5(c) (1)(a), (b) and (c) of the FAA). This is not a solicitation or inducement to buy, sell, subscribe, or underwrite any securities mentioned or in the topic of this document. For the purpose of the FAA, the content of this report is of a general nature, is intended as a source of general information only and is not intended to constitute a recommendation or opinion in relation to acquiring or disposing (including refraining from acquiring or disposing) of securities. The distribution of this document is not a "personalised service" and, to the extent that it contains any financial advice, is intended only as a "class service" provided by Edison within the meaning of the FAA (i.e. without taking into account the particular financial situation or goals of any person). As such, it should not be relied upon in making an investment decision.

United Kingdom

This document is prepared and provided by Edison for information purposes only and should not be construed as an offer or solicitation for investment in any securities mentioned or in the topic of this document. A marketing communication under FCA Rules, this document has not been prepared in accordance with the legal requirements designed to promote the independence of investment research and is not subject to any prohibition on dealing ahead of the dissemination of investment research.

This Communication is being distributed in the United Kingdom and is directed only at (i) persons having professional experience in matters relating to investments, i.e. investment professionals within the meaning of Article 19(5) of the Financial Services and Markets Act 2000 (Financial Promotion) Order 2005, as amended (the "FPO") (ii) high net-worth companies, unincorporated associations or other bodies within the meaning of Article 49 of the FPO and (iii) persons to whom it is otherwise lawful to distribute it. The investment or investment activity to which this document relates is available only to such persons. It is not intended that this document be distributed or passed on, directly or indirectly, to any other class of persons and in any event and under no circumstances should persons of any other description rely on or act upon the contents of this document.

This Communication is being supplied to you solely for your information and may not be reproduced by, further distributed to or published in whole or in part by, any other person.

United States

Edison relies upon the "publishers' exclusion" from the definition of investment adviser under Section 202(a)(11) of the Investment Advisers Act of 1940 and corresponding state securities laws. This report is a bona fide publication of general and regular circulation offering impersonal investment-related advice, not tailored to a specific investment portfolio or the needs of current and/or prospective subscribers. As such, Edison does not offer or provide personal advice and the research provided is for informational purposes only. No mention of a particular security in this report constitutes a recommendation to buy, sell or hold that or any security, or that any particular security, portfolio of securities, transaction or investment strategy is suitable for any specific person.

Frankfurt +49 (0)69 78 8076 960
Schumannstrasse 34b
60325 Frankfurt
Germany

London +44 (0)20 3077 5700
280 High Holborn
London, WC1V 7EE
United Kingdom

New York +1 646 653 7026
1185 Avenue of the Americas
3rd Floor, New York, NY 10036
United States of America

Sydney +61 (0)2 8249 8342
Level 4, Office 1205
95 Pitt Street, Sydney
NSW 2000, Australia