Renewables Annual Report

Advancing the Green Agenda: An overview of the UK's Renewable Energy Landscape

July 2024

IDEAS | PEOPLE | TRUST

BDO

Contents

Introduction

David Bevan

Advisory CF, Partner
UK Head of Renewables, Chair

Over the last 15 years the UK has built a renewable energy industry of which it should be proud. Blessed with favourable weather conditions, and driven by financial incentives, UK renewables-derived generation has grown from almost nothing in 2009 to almost half of total generation in 2023. A thriving support services industry centred around the development, construction, operation and ownership of renewables infrastructure has emerged and competes globally.

The tailwinds for future growth are strong. Most renewables generation has almost no variable cost and doesn't require the burning of carbon intensive fossil fuels. The industry has been key to the UK's early progress towards its decarbonisation commitments designed to limit global warming, and is a key element of future progress. The IEA forecasts renewables' share of electricity generation to grow to 74% by 2028.

However, the low-hanging fruit of the last 15 years has been gathered and although the future growth drivers are still clear, barriers are emerging in the UK. Access to a transmission and distribution grid (designed for centralised, large scale thermal generation) is now limited for all forms of distributed energy resources. Subsidies are harder to justify politically.

From a global perspective, other countries are catching up and, in some cases, driving development with significant investment incentives. New technologies and applications are emerging, but their rate of adoption and ultimate success is uncertain. This is changing the dynamics of a global industry with global supply chains, where the political and economic calculus is becoming more complex.

Our report explores the UK's position in the global renewable energy industry and examines the challenges to, and potential solutions that will drive, future renewables growth.

Key findings

The UK has made significant progress in reducing CO2 emissions by 50% since 1990.

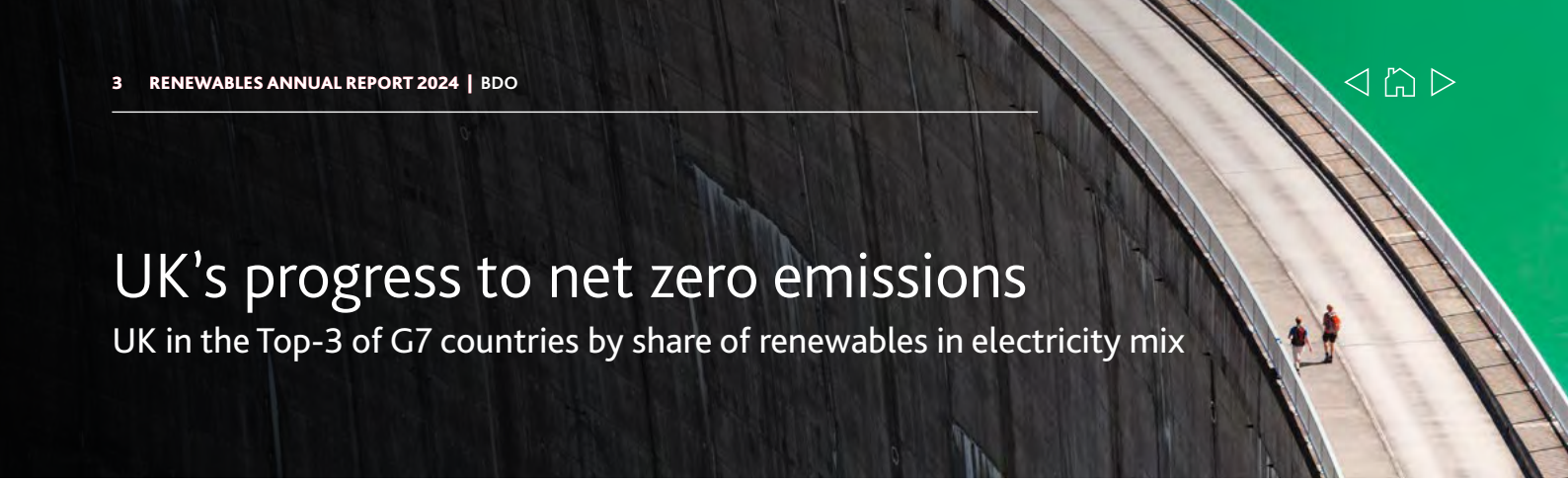
In 2023, renewables accounted for 47% of electricity generation compared to 37% in 2019.

The UK emerged as the fourth largest clean energy investor worldwide. Investments in the UK's energy transition soared by 84.3% compared to 2022, primarily fuelled by investments in the electric vehicle market and the growth of renewable energy infrastructure.

Stormy conditions throughout 2023 enabled wind farms to generate almost a third of UK electricity.

The UK was the third largest country for ClimateTech funding and London continues to be a prominent deal hub with the most ClimateTech deals in Q1 2024.

Renewable industry overview

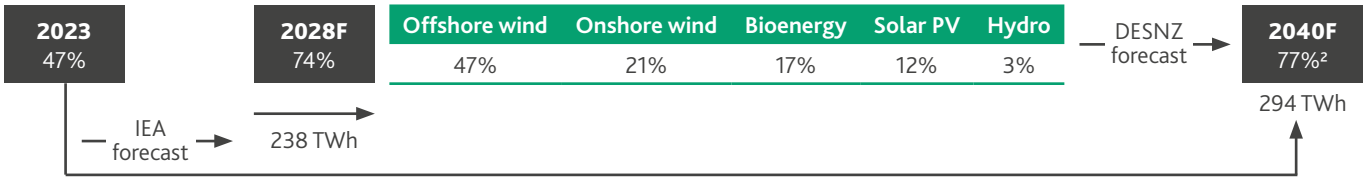


UK's progress to net zero emissions

UK in the Top-3 of G7 countries by share of renewables in electricity mix

Although the UK has made significant progress in reducing CO_2 emissions (by 50% since 1990), more needs to be done to reach its legally binding targets and help restrict global warming to 1.5°C above pre-industrial levels. In 2023, renewables accounted for 47% of electricity generation compared to 37% in 2019. Renewable capacity is expected to grow by 44 GW over 2023-2028, mainly through offshore wind and utility-scale PV. The annual targeted build-out rate is around 4 GW[1]. The UK must maintain momentum in order to achieve it's net-zero goals.

Share of renewables in the UK's energy mix



European countries and the USA all plan to boost the proportion of renewables in their energy mix over the coming decade. For example, Estonia is forecasted to reach 95% of energy production from renewables in 2028, up from 46% in 2023. Over 70% of Europe's renewable capacity growth during 2023-2028 is to be fuelled by competitive auctions led by Germany, the UK, France, Turkey and Italy. Corporate PPAs and commercial projects will drive another 20%.

2023	**69%[3]**	**60%**	**43%**	**27%**	**21%**	**21%**
2028F	+5 p.p.	+23 p.p.	+16 p.p.	+10 p.p.	+8 p.p.	+13 p.p.

xx% Share of renewables in 2023 +x p.p. Change vs 2023

Selected factors stimulating the development of renewables

99% (-2 p.p.)
Distribution of funds via state-owned companies and administrative agencies (e.g. Enova).

83% (+11 p.p.)
Establishment of the Danish Green Investment Fund to co-finance projects for sustainable development.

74% (+9 p.p.)
Provision of loans, capital discounts, and technical assistance for project developers via Altum[4].

47% (+16 p.p.)
Tax breaks & financial aid for renewables, support of new energy technologies, and advanced smart grid.

Source: GOV.UK website; IEA website; RenewableUK website; Electricity Maps website; DESNZ — Energy and emissions projections 2022 to 2040 — [2023]; Ember — Grids for Europe's energy transition — [2024]; Baringa — UK renewables deployment supply chain readiness study — [2024]; Media overview.

Notes: (1) Up to 2030 for offshore wind and up to 2035 for solar; (2) DESNZ does not provide a breakdown by renewable technology for legal and commercial reasons; (3) As of 2022; (4) A state-owned financial institution that implements energy efficiency and renewable energy programmes not covered by the grants provided by the Central Finance and Contracting Agency.

UK's progress to net zero emissions

UK in the top-3 of G7 countries by share of renewables in electricity mix

Key challenges facing the renewable energy sector in the UK and in other G7 countries

1 Delays in connecting to the grid, long queues, insufficient equipment capacity and the need for grid adaptation to newer technologies are some of the challenges faced by the UK. Other G7 countries are struggling with similar issues. For instance in France and Italy there is insufficient capacity for solar projects, while the USA is struggling to provide transmission access for a number of projects.

2 The UK is hampered by supply chain constraints, particularly in offshore wind and transmission. Germany and the Netherlands, on the other hand, acquire a substantial share of their supply through a centralised procurement model by TenneT[5] and this further limits the availability of crucial network components for the UK and other countries.

3 The Government is providing mixed signals to the market. It has removed subsidies for renewables, set a low ceiling price and changed policies. This has discouraged bidders in the CfD auction (AR5), which attracted no offer for offshore wind projects.

4 The lack of specialist offshore support vessels is slowing the installation of large offshore wind farms and their connection to the grid.

5 The planning process is slow for large-scale projects with four to five years often needed to get approval for an offshore wind farm.

6 The introduction of the Electricity Generator Levy (EGL) undermines the UK's stated energy transition goals and is less favourable than the oil & gas companies' tax regime.

7 The Government has issued new oilfield licences which may hamper the development of clean energy infrastructure and increase the reliance on fossil fuels.

8 The severe shortage of design and commissioning engineers, project managers, installation technicians and other key personnel is a serious constraint for the industry.

9 Green energy investment trusts have recently struggled to raise equity to invest in green assets due to large discounts on net asset value.

10 Renewable energy projects rely on imported critical metals and minerals. This dependence, particularly on China, is a risk in future development of renewable energy.

11 Growing demand from interconnectors, offshore wind and National Grid upgrades has created a shortage of HVDC cables.

Notes: (5) The Netherlands grid operator.

Policy and regulations

Targeted and timely policy is crucial to attract investments and remain competitive globally

Key climate targets

Decarbonisation of electricity	100% (2035)	100% (2040)	100% (2035)
Reduction of emissions by 2030	68% (vs 1990)	60% (vs 1990)	43%[6] (vs 1990)
Reduction of emissions by 2050	Net zero		

The UK's abundant wind and offshore opportunities, coupled with incentives to start developing renewables allowed the country to become an early leader in decarbonisation. The Government's Powering Up Britain plan announced in March 2023 sets out plans to reach net zero emissions by accelerating the deployment of renewables, which would put the UK on course to surpass both the EU and US.

However, industry relies on strong signalling from Governments to boost confidence in making investment decisions. Recent announcements by the UK Government and opposition parties could lead to a reduction in investment in the UK renewables sector. These announcements include:

Delay of the 2030 ban on the sale of new petrol and diesel cars for five years.

Postponing the ban on installing oil and LPG boilers to 2035 in new buildings.

Cancellation of policies regarding the upgrade of property energy efficiency.

Issuance of over 100 new oil and gas licences during future rounds.

The above measures were introduced to ease the immediate financial burden on households[7]. However, some climate scientists and energy experts have criticised these decisions as they risk increasing consumer costs in the longer term. The delay of net zero policies risks undermining the country's strong credibility as a destination for green investments as it signals the UK's deferment of its ambitious goals.

Policy development

The UK's renewables policy has progressed in past years but the Government must not lose momentum in achieving green targets globally. The deferment of the second consultation on Review of Electricity Market Arrangements (REMA) from autumn 2023 to March 2024, with the finalisation set for mid-2025, could suggest that UK policies on key green technologies are developing slower than in other countries. For example:

Hydrogen

Despite ambitions to become a global leader as stated in the Hydrogen Strategy (2021), the UK slipped in the Hydrogen Progress Index[8] due to uncertainty of policies and support mechanisms.

Hydrogen Progress Index

2nd (2021) → **8th** (2023)

In December 2023, the first UK green hydrogen funding round awarded £2bn to 11 projects (125 MW), only half of the submitted capacity.

Battery Production

Recent announcements by Tata Group and HM Government and their intention to invest over £4bn in a UK Gigafactory shows a recommitment to battery production in the UK following the collapse of the lithium-ion gigafactory Britishvolt in early 2023. In this area the UK lags behind the likes of the USA, which is already in its second tranche of subsidies to boost domestic battery production and reduce battery costs by c.30%.

Carbon Capture, Utilisation, and Storage (CCUS)

The UK underperformed its peers in CCUS policy, starting significant steps only in 2023.

Nov 2021	Aug 2022	May 2023	Dec 2023
Allocation of £8.7bn[9] investments (IIJA)	Favourable CCUS tax credit changes (IRA)	20 carbon storage licences	CCUS Vision is published

A company must procure independent audits of its storage capacity assumptions to receive a licence or the Government support package under the CCUS Programme. This can potentially slow down the roll-out of CCUS facilities, which are currently in the early stages of development.

Source: GOV.UK website; European Commission website; Energy Monitor website; International Energy Agency website; Climate Change Committee website; Hydrogen UK and Energy Networks Association — International Hydrogen Progress Index — [2023]; Media overview.

Notes: (6) The US target is 50-52% compared to 2005, a peak year for emissions, which might be translated into 43% if using 1990 as a base year; (7) By postponing some decarbonisationdeadlines and increasing cash grant under the boiler upgrade scheme by 50% to £7,500; (8) Developed by Hydrogen UK and Energy Networks Association; (9) The numbers are converted from USD to GBP due to the average annual exchange rate of the IRS.

UK policies not driving investments renewables

Planning, tax and technology policies all have a significant role to play in decarbonisation

National Policies

UK's policies on decarbonisation have varied from the ambitious to the disappointing. For example, the ambitious target to ban sales of new petrol and diesel cars by 2030 was groundbreaking but has now been pushed back to 2035. This resulting uncertainty has contributed to a 14% slowdown of electric car registrations in 2023.

The relaxation of the UK's EV targets could delay UK car manufacturers aligning with original EU targets.

There are still concerns that infrastructure cannot yet meet the demand created by EVs. More investment is required by the UK government and industry into EV infrastructure and broader initiatives such as UK battery production, domestic solar energy production and energy usage incentives schemes.

Local Planning Policy

Onerous and slow planning processes and delays in connecting new renewable energy assets to the grid have made it harder to bring low-carbon projects into operation.

The Connections Action Plan, published in November 2023, outlines a vision for an effective connection regime that speeds up the planning process and improves the UK's attractiveness to investors.

63%

of energy decision-makers[10] are moving or planning to move investments from the UK to a more sustainability-friendly market.

800GW

possible power connection queue in the UK by the end of 2024, while customers are offered connection dates in the late 2030s.

Tax Policy

The UK's R&D tax regime supports science and technology investment and is a substantial driver of innovation. However, the regime could provide more targeted support for the renewables sector. HMRC has increased the number of tax enquiries which has led to delays in receiving R&D tax credits. Meanwhile, the EGL is an additional 45% tax on extraordinary profits from the production of wholesale electricity[11]. These tax regimes create a more challenging environment for renewables. The Government should provide greater tax breaks for companies developing green technologies to accelerate the transition to net zero.

Current Global Support Funding/tax breaks[12]

The following highlights that the US Inflation Reduction Act (IRA) has set a new benchmark for government support for clean technologies. Some countries have already presented their own comprehensive responses to support the development of renewables as follows;

IRA

Tax incentives: Corporate: £173.7bn
Consumer: £34.6bn

Green Deal Industrial Plan

Additional funding of REPowerEU: £217.4bn

2023 Budget

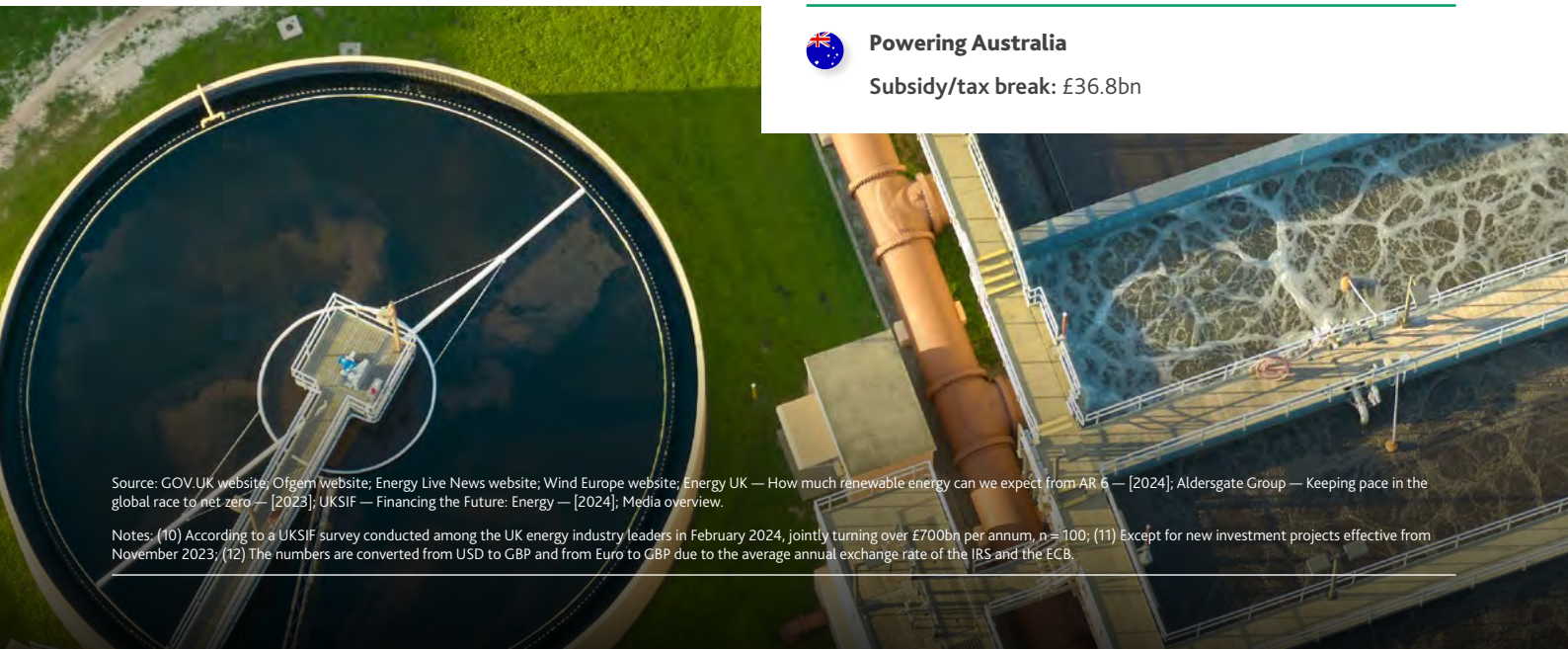
Subsidy/tax break: £64.3bn

EV incentive package

Subsidy/tax break: £58.1bn

Powering Australia

Subsidy/tax break: £36.8bn



Source: GOV.UK website; Ofgem website; Energy Live News website; Wind Europe website; Energy UK — How much renewable energy can we expect from AR 6 — [2024]; Aldersgate Group — Keeping pace in the global race to net zero — [2023]; UKSIF — Financing the Future: Energy — [2024]; Media overview.

Notes: (10) According to a UKSIF survey conducted among the UK energy industry leaders in February 2024, jointly turning over £700bn per annum, n = 100; (11) Except for new investment projects effective from November 2023; (12) The numbers are converted from USD to GBP and from Euro to GBP due to the average annual exchange rate of the IRS and the ECB.

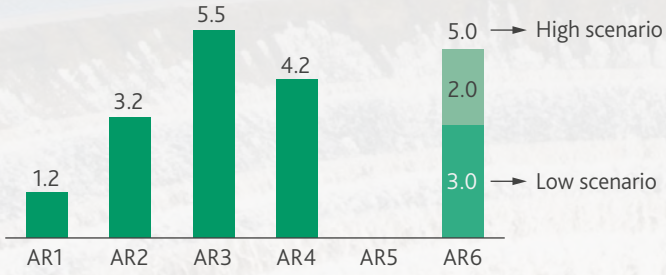
UK policies not driving investments renewables cont.

Planning, tax and technology policies all have a significant role to play in decarbonisation

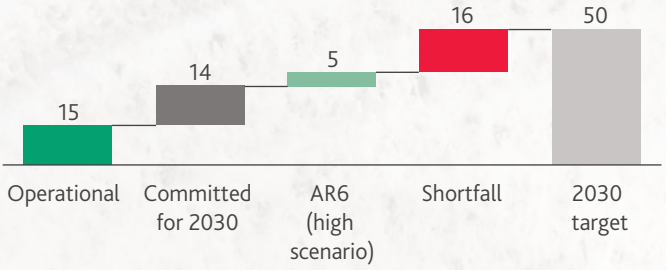
A low strike price cap for offshore wind (£44/MWh) contributed to the failure of the AR5 auction. The setback of AR5 means that AR6 and AR7 need to fill a capacity shortfall of 21 GW if the UK is to meet its offshore wind target.

Despite the largest announced budget for CfD of over £1bn, AR6 parameters are estimated to secure only 3.0-5.0 GW, leaving a shortfall of at least 16.0 GW for AR7. Further budget increases or revisions of parameters, for example load factors and reference prices, will be crucial to reaching 50.0 GW of offshore wind by 2030.

Offshore wind capacity by CfD AR (2014-2024), GW



Progress towards the UK's offshore wind target, GW, as of March 2024



Among the obstacles being faced by the renewable energy sector are high interest rates pushing up the costs of investment in infrastructure.

The Government has sought to boost investment with tax incentives such as uncapped 'full expensing' first year allowances, which are available for expenditure incurred on new qualifying plant and machinery investments. This measure was made permanent by Finance Act 2024.

We have seen renewable energy infrastructure projects which are capital intensive, such as BESS, solar and offshore wind development, benefitting from full expensing. The availability of tax relief in year one should improve cash flow by lowering corporation tax liabilities in the year of the investment, freeing reserves for further investment. The cash flow benefits should also be of particular help to companies facing high borrowing costs. However, the interaction of full expensing with the restriction on deductibility of losses carried forward could limit benefits and means careful planning is required when considering full expensing claims.

The growing demand for renewably sourced electricity supplies in the UK means there is a recognised need for the Government to continue increasing support for the many planned renewable energy projects.

Viran De Silva

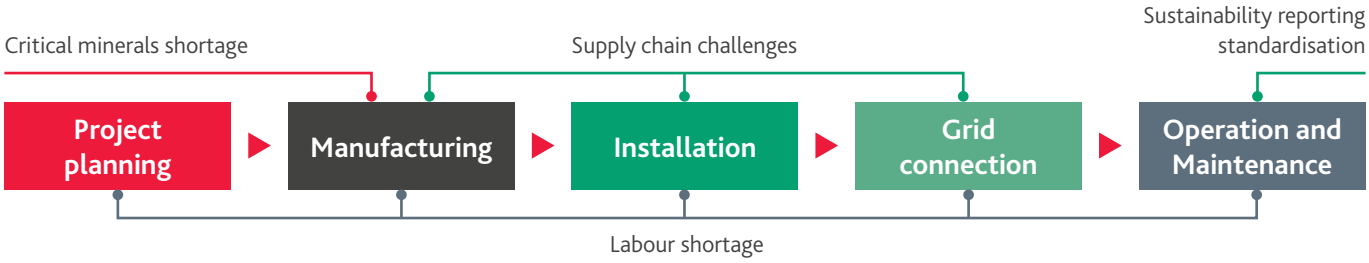
Tax M&A Associate Director | BDO

Key areas requiring government support

Can enhanced sustainability reporting drive investment in renewables?

The transition to green energy and the growing implementation of renewable technologies requires government support across the entire value chain. The rising number of renewable projects and plans to upgrade and/or expand the existing grid are dependent on both skilled labour and resilient supply chains.

Key areas across the renewable value chain that need government support



Labour shortage

The UK's engineering sector is facing a skilled labour shortage. This might hinder the path to net zero, which is estimated to need between 135,000 to 725,000 new jobs.

>90%

of the UK's oil & gas workforce have skills suitable for the offshore renewable sector.

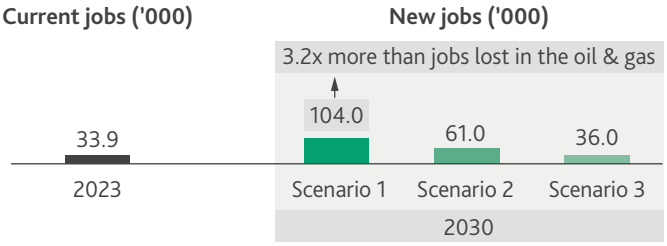
bp and EnBW

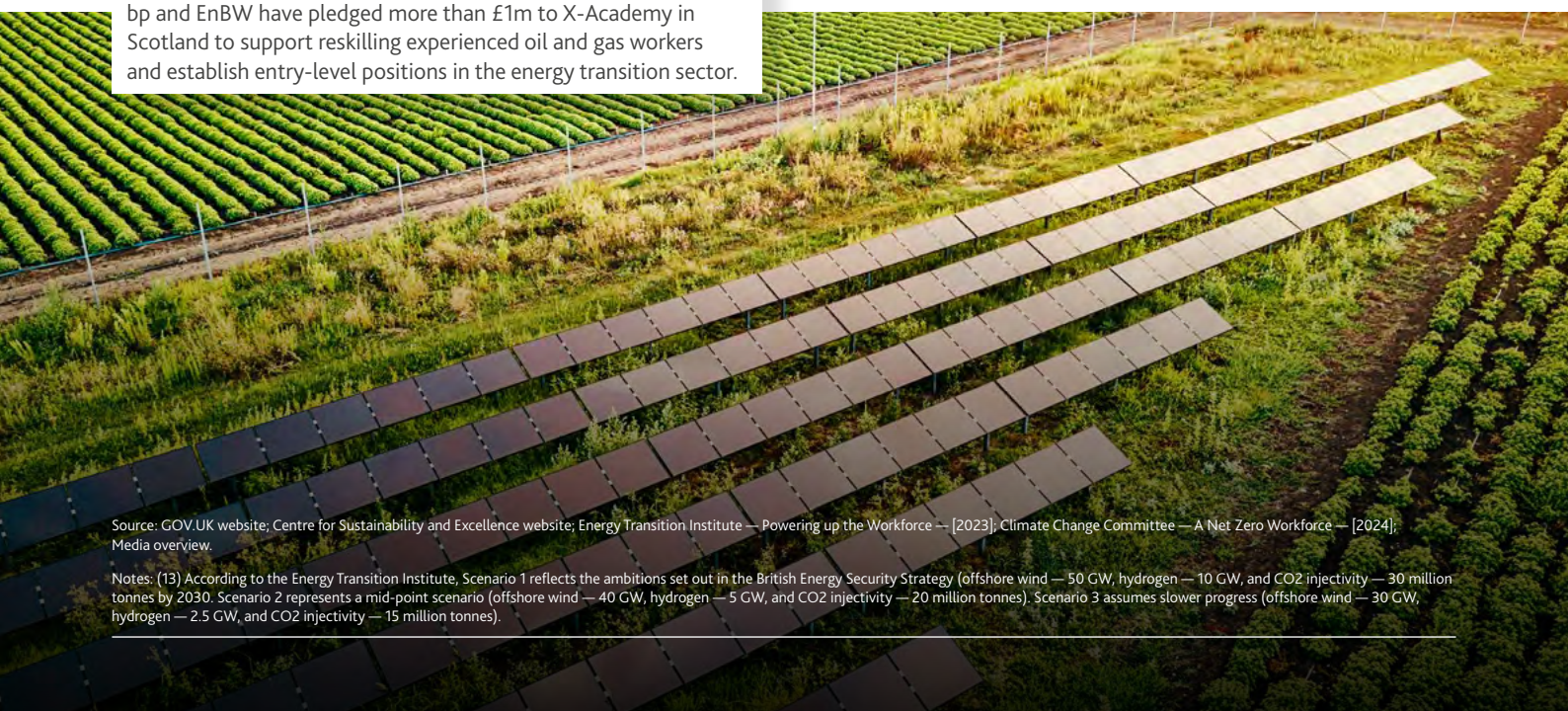
Given the similarity in skills and equipment required, energy players have already started reskilling and upskilling efforts.

bp and EnBW have pledged more than £1m to X-Academy in Scotland to support reskilling experienced oil and gas workers and establish entry-level positions in the energy transition sector.

Renewable offshore energy workforce[13]

Targeted training is needed to bridge the skills gap and we hope to see these measures included in the Net Zero Strategy and Nature Workforce Action Plan that was expected in H1 2024. At a regional level, the EU set up the renewable energy skills partnership under the Pact for Skills in March 2023, which is designed to fulfil upskilling and reskilling needs.





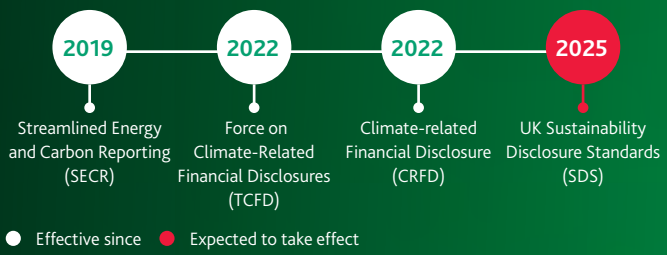
Source: GOV.UK website; Centre for Sustainability and Excellence website; Energy Transition Institute — Powering up the Workforce — [2023]; Climate Change Committee — A Net Zero Workforce — [2024]; Media overview.

Notes: (13) According to the Energy Transition Institute, Scenario 1 reflects the ambitions set out in the British Energy Security Strategy (offshore wind — 50 GW, hydrogen — 10 GW, and CO2 injectivity — 30 million tonnes by 2030. Scenario 2 represents a mid-point scenario (offshore wind — 40 GW, hydrogen — 5 GW, and CO2 injectivity — 20 million tonnes). Scenario 3 assumes slower progress (offshore wind — 30 GW, hydrogen — 2.5 GW, and CO2 injectivity — 15 million tonnes).

Can enhanced sustainability reporting drive investment in renewables? Cont.

Sustainability reporting standardisation

The UK has complex corporate and investor sustainability laws and reporting requirements including several regulations:



The UK SDS is expected to endorse IFRS Sustainability Disclosure Standards[14] and align with the EU CSRD, with a view to adopting IFRS standards as the foundation of any future sustainability-related legislative requirement. This will increase standardisation and consistency in GHG reporting, enabling companies to better understand and communicate their sustainability-related risks and opportunities. It should also encourage stronger disclosures which will help investors to make informed decisions, potentially stimulating financial flows towards green tech sectors like renewables.

Companies operating in this sector must prepare for evolving regulatory requirements and leverage opportunities to contribute to the net-zero transition. A key to successful realisation of the growth opportunities will be integrating broader sustainability objectives and social impact within the strategy. This may include upskilling and reskilling the workforce to meet changing skill requirements, improving or revitalising infrastructure, and contributing to regional economic prosperity.

The UK could partner with educational institutions and industry players to develop green skill programmes and apprenticeships as well as facilitating business investments in upskilling and reskilling. Implementing mandatory reporting standards could build trust in the renewable sector and supporting companies to meet these requirements could provide valuable insights for policy development.

Source: GOV.UK website; Centre for Sustainability and Excellence website; Energy Transition Institute — Powering up the Workforce — [2023]; Climate Change Committee — A Net Zero Workforce — [2024]; Media overview.

Notes: 14) Developed by the International Sustainability Standards Board, IFRS Sustainability Disclosure Standards (IFRS S1 and IFRS S2) require companies to provide information about sustainability-related risks and opportunities to enhance investor-company dialogue.

Access to critical minerals and supply chain resilience are vital

Critical minerals shortage

The UK has defined 18 critical minerals and Rare Earth Elements (REE) such as cobalt and lithium, that are essential for clean energy technologies ranging from wind turbines and solar panels to EV and battery storage.

Key materials for energy transition (selected), million tonnes

Copper	Nickel	Lithium	Cobalt

Top-3 countries with the largest reserves in 2023

Copper	Nickel	Lithium	Cobalt
1 Chile	1 Indonesia	1 Chile	1 Congo
2 Peru	2 Australia	2 Australia	2 Australia
3 Australia	3 Brazil	3 Argentina	3 Cuba/ Indonesia

Global material reserves in 2023

Copper	Nickel	Lithium	Cobalt
1,000	>130	28	11

Global material production in 2023

Copper	Nickel	Lithium	Cobalt
22	3.6	0.2	0.2

Global resources

Copper	Nickel	Lithium	Cobalt
5,600	>350	105	145

Material requirements for the energy transition by 2050/ cumulative demand from all sectors by 2050

Copper	Nickel	Lithium	Cobalt
650/1,135	100/170	20/21	6/11

Currently, copper and nickel estimated reserves are insufficient to meet the demand from energy transition as well as from all other sectors. The key challenges for expanding available reserves are: long timescales for developing new mines, the reliance on innovation and new technologies such as direct lithium extraction and deep sea mining, notwithstanding its environmental impact.

China accounts for 68.6% of global production of Rare Earth Elements (REE). It also dominates the UK's supply chain. This puts question marks over the UK's ability meet the growing demand for minerals in the renewable energy supply chain.

China's share of the UK's import of selected critical minerals, 2023

REEs	Bismuth	Tungsten
74.2%	82.1%	91.9%

The UK will need to import many of its critical minerals as well as enhance its recycling infrastructure to bolster its domestic capabilities for achieving net zero. The UK has several key policies that aim to secure a stable supply of critical raw materials: Critical Minerals Strategy (2022), Critical Minerals Strategy Refresh (2023) and Critical Imports and Supply Chains Strategy (2024). There is room for improvement as these documents do not set specific targets, timeframes, benefits or a clear implementation plan.

Low recycling rates also pose a risk to the critical minerals supply chain. The UK must scale up recycling capabilities and increase investments in the required infrastructure.

Some UK companies are already commercialising innovative ways to recycle critical minerals:

HyProMag Magnet Recycling	Ionic Technologies	Altilium Clean Technology
Rare earth permanent magnets		EV batteries

One of the priorities of the Critical Minerals Strategy is to optimise the use of critical minerals in circulation. Standardising and incentivising investments in the UK's recycling facilities might mitigate the risks of a shortage of critical minerals and reduce the reliance on imports.

Access to critical minerals and supply chain resilience are vital cont.

Supply chain challenges

Cable shortage

600,000 km of electric lines need to be upgraded or added in the UK by the end of 2030 to meet climate targets.

Manufacturing in the net zero supply chain

The UK lacks manufacturing capacity in the wind energy supply chain[15] such as facilities for wind turbine nacelle production.

Limited port capacity

Deep-water port capacity threatens offshore wind asset deployments. There is a need for substantial investments in expanding ports' quayside and laydown area size, load capacity and channel depth and width.

Standardising waste collection, processing and providing stimulus to invest in recycling facilities would send strong signals to the market and contribute to securing the UK's critical materials supply chain.

The UK should consider introducing incentives for companies to invest in recycling technologies and regulating the responsible use and recycling of rare minerals. Established market frameworks and competitive enticements could improve the domestic supply chain and the ability to meet the growing demand from renewable energy projects. The UK could also provide new grants, revenue guarantees and policies to unlock private investments in renewable energy infrastructure and supply chain resilience.

Source: GOV.UK website; UN Comtrade website; RenewableUK website; European Council website; USGS — Mineral Commodity Summaries — [2024]; Energy Transitions Commission — Material and Resource Requirements for the Energy Transition — [2023]; IEA — Critical Minerals Market Review — [2023]; House of Commons Foreign Affairs Committee — A rock and a hard place: building critical mineral resilience — [2023]; Baringa — UK renewables deployment supply chain readiness study — [2024]; Media overview.

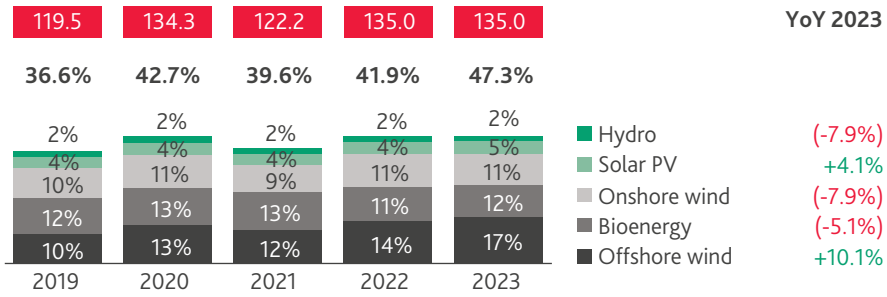
Notes: (15) Including wind turbine nacelles, towers, and foundations compared to Germany, Denmark, Spain, and France.

Technologies

Progress towards net zero through renewable energy development

In 2023, renewables made their largest ever contribution to the energy mix. Wind capacity overtook combined-cycle gas power stations for the first time. However, consumers' attitudes towards renewables became slightly less positive.

Renewables' share in total electricity generation in the UK[16]



	YoY 2023
Hydro	(-7.9%)
Solar PV	+4.1%
Onshore wind	(-7.9%)
Bioenergy	(-5.1%)
Offshore wind	+10.1%

xx.x Total generation of renewable electricity, TWh

Stormy conditions throughout 2023 enabled wind farms to generate almost a third of UK electricity, a new milestone in clean energy production. Despite experiencing reduced average daily sunlight hours, solar power generation increased to reach a historic high of 13.8 TWh.

Consumers' attitudes towards renewables in 2023

85% total support

in winter 2023[17] (-3 p.p. compared to in winter 2022).

#1 Solar

the most supported source as of spring 2023[18].

Source: GOV.UK website; DESNZ website; Catapult website; Ofgem website; LCCC website; DESNZ — Public Attitudes Tracker: Winter 2023 — [2024]; DESNZ — Public Attitudes Tracker: Spring 2023 — [2023]; Ofgem — Feed-in Tariff — [2020-2021]; Ofgem — Smart Export Guarantee — [2020-2023]; Media overview.

Notes: (16) Extracted from DESNZ database; (17) According to DESNZ Public Attitudes Tracker conducted during November–December 2023 among energy consumers, n = 3,743; (18) According to DESNZ Public Attitudes Tracker conducted during March–April 2023 among energy consumers, n = 4,410.

Progress towards net zero through renewable energy development cont.

In 2023, a total of 2.7 GW of capacity was added across all renewable technologies. Solar PV constituted 28.2% of the total generation capacity, but contributed only 5% of renewable electricity generation due to its relatively low load factor. Onshore and offshore wind installations grew by a total capacity of 1.4 GW and 3.4 GW, respectively.

	Onshore wind	Offshore wind	Bioenergy	Solar PV	Hydro	Total
Cumulative installed capacity, GW						
2023	15.4	14.7	8.3	15.9	1.9	56.3
YoY	▲ +3.6%	▲ +5.9%	▲ +0.6%	▲ +9.2%	▲ +0.04%	▲ +5.1%
Load factor, %						
2023	24.5	39.5	47.3	10.3	31.4	28.1
YoY	▼ (-2.9 p.p.)	▼ (-1.4 p.p.)	▼ (-3.0 p.p.)	▼ (-0.3 p.p.)	▼ (-2.7 p.p.)	▼ (-1.8 p.p.)
UK's goal by 2030, GW						
	30	50	n/a	40	n/a	n/a

Selected tariffs to support renewable energy capacity installation

Renewables Obligation
2002-2017

The scheme obliged electricity suppliers to buy a proportion of energy from renewable sources.

Feed-In-Tariff
2010-2019

Payments to renewable energy generators based on the amount of electricity produced and exported to the grid.

CfD
2014-current

Guarantees a generator revenues at a strike price for a certain period of time.

Capacity market
2018-current

Mechanism to ensure that electricity supply meets demand.

Smart Export Guarantee
2020-current

Rewards small-scale renewable electricity producers for providing their surplus electricity to the grid.

What is the future for the UK's older renewables assets?

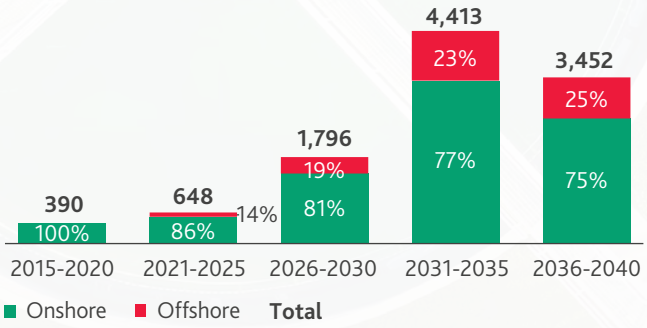
Some of the UK's older renewable energy installations, particularly wind farms and solar arrays, are reaching the end of their designed lifespan or End of Life (EoL). Over the coming decade, decisions will need to be taken on the end-of-life of these facilities. The primary focus of both government and owners should be on wind farms, the UK's oldest established renewable technology.

8.8
the average age of UK wind assets calculated based on their commissioning year.

509
UK turbines older than 25 years in 2023.

5.2GW
of wind generation capacity projected to be obsolete by 2030[19].

Number of wind turbines reaching 20 years of operation by period in the UK[20]



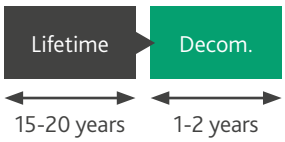
Source: IEEFA website; Vattenfall website; RenewableUK website; GOV.UK website; DESNZ — Public Attitudes Tracker: Spring 2023 — [2023]; WTW — Wind power: extending beyond the design life — [2023]; ORE Catapult — End-of-life planning in offshore wind — [2021]; Media overview.

Notes: (19) Assuming a typical design life of wind turbines is 20 years; (20) Calculated based on the commissioning year of wind projects, extracted from RenewableUK database.

What is the future for the UK's older renewables assets? Cont.

Decommissioning

Renewable Energy Sources are decommissioned when repowering or life extension is either impossible or uneconomic. At the end of life, the site must be cleared of all project-related equipment and land returned to its original use.



Life extension

Involves upgrading components, implementing maintenance programs, ensuring regulatory compliance and assessing economic viability of prolongingthe lifespan.

Repowering

Repowering is the replacement and/ or reconfiguration of old equipment, fundamentally changing operating characteristics and capabilities. It aims to use technological advancements to increase wind turbine efficiency and capacity.

Complete decommissioning is the least popular choice for wind farm EoL management in the UK. Operators are increasingly turning to life extension and repowering strategies; using technological advancements to increase and extend wind turbine capacity. Repowering is up to ten times more costly per MW than life extension, which includes only the cost of Long-Term Energy (LTE) and any extra costs of repairs. However, wind farms that reach the end of their initial consent period will not receive direct subsidies such as Renewable Obligation Certificates for their extended operational life and increased costs of financing.

Selected cases of different facilities' EoL scenarios in the UK

1. Bu wind farm

3 turbines onshore
Operational since 2002

- **Decommissioned** in 2014
- Repowering granted for three turbines of a similar output but was not implemented.

2. Armistead wind farm

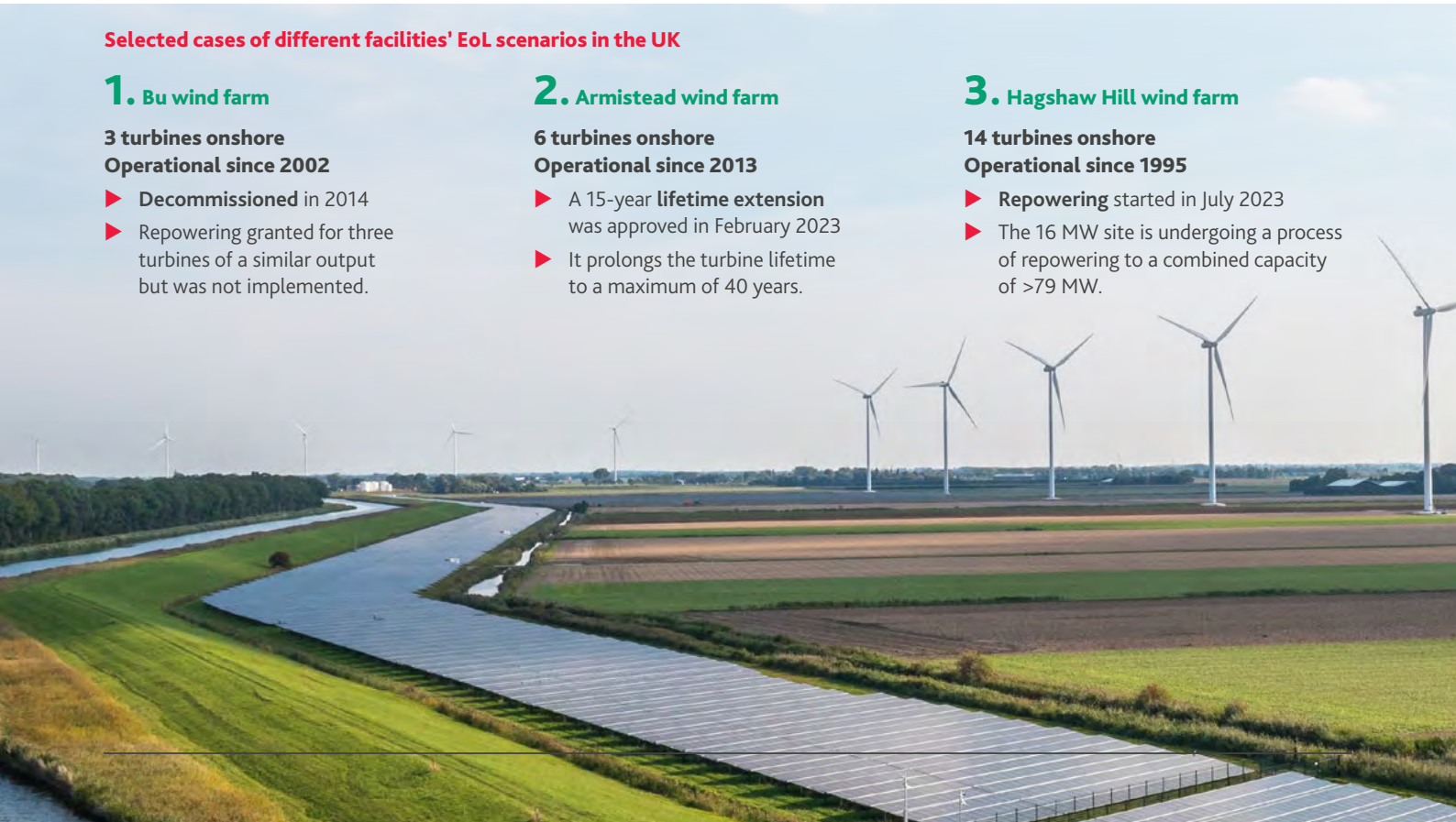
6 turbines onshore
Operational since 2013

- A 15-year **lifetime extension** was approved in February 2023
- It prolongs the turbine lifetime to a maximum of 40 years.

3. Hagshaw Hill wind farm

14 turbines onshore
Operational since 1995

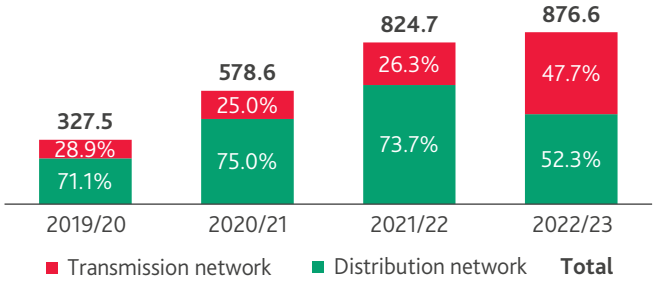
- **Repowering** started in July 2023
- The 16 MW site is undergoing a process of repowering to a combined capacity of >79 MW.



Renewable Energy Sources (RES) and the UK grid; the need for infrastructure upgrades

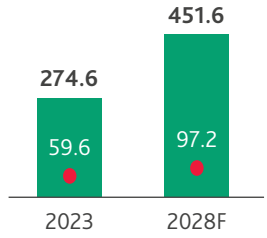
Power grids serve as the backbone of energy systems and play a crucial part in facilitating the integration of RES during the energy transition. The expansion of large-scale RES and other projects across the UK has resulted in a surge in network connection applications. Existing networks do not have the capacity to cope and network operators are struggling to address these inadequacies.

Connection applications received by ESO[21] capacity, GW



	Transmission network	Distribution network	Total
CAGR 2019 - 2023	+64.1%	+25.3%	+38.8%

EV rollouts in the UK, thousand



	CAGR 2019 - 2023
Battery EV sales	+10.5%
Charging stations	+10.3%

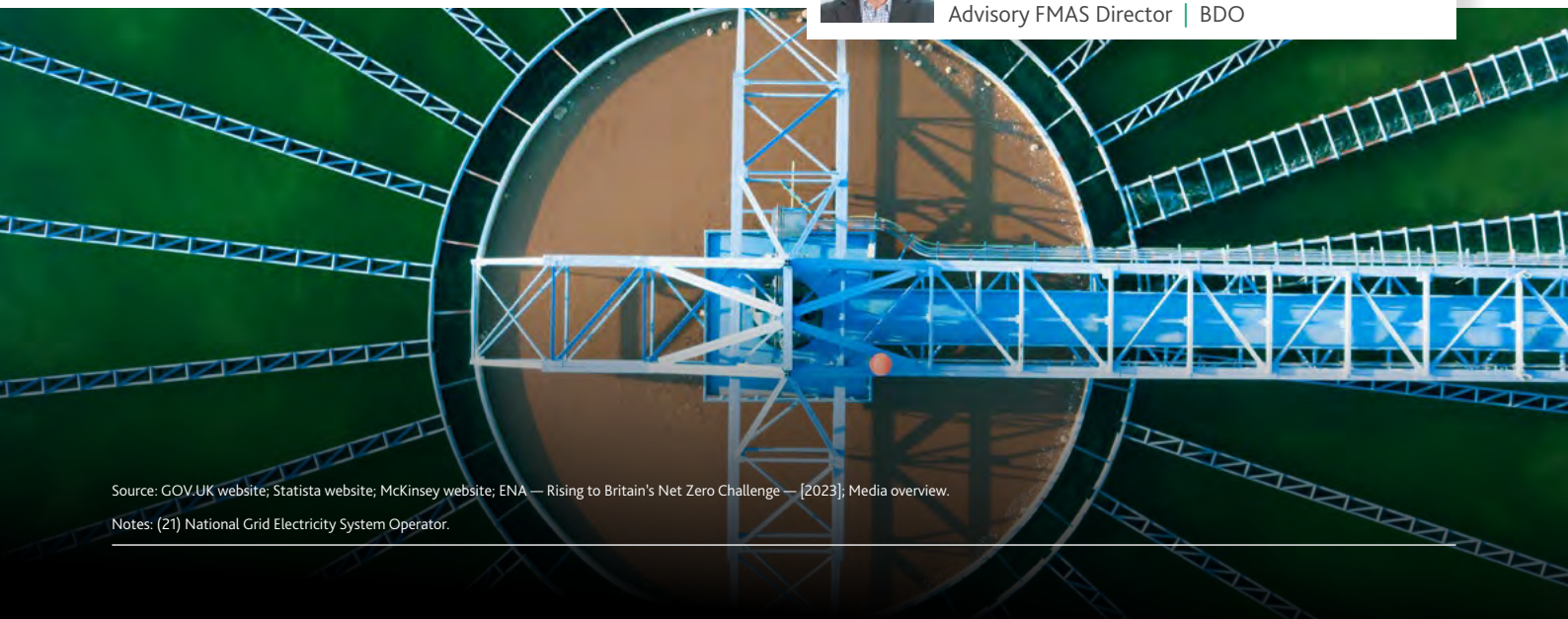
Achieving a net zero economy involves more than generating renewable electricity, it requires substantial infrastructure investment for electricity transmission, storage, and managing variability. The UK's extensive electricity grid, with its high and lower voltage networks, needs significant upgrades to support the shift to net zero by 2050.

The UK's Energy Security Strategy aims for 50GW of offshore wind by 2030, necessitating major transmission enhancements to deliver power where it's needed. The National Grid's 'Great Grid Partnership' is a step towards this, planning nine significant upgrades by 2030.

The government predicts a surge in electricity's share of energy demand and peak demand by 2050, suggesting a need for £100-240 billion investment in grid infrastructure. To integrate the growing share of renewable energy, initiatives like the National Grid's 'Technical Limits' programme are crucial for reducing grid connection delays, potentially accelerating offers for numerous projects.

In summary, the investment required for infrastructure to harness and utilise the anticipated renewable energy is substantial.

Andy Hucknall
Advisory FMAS Director | BDO



Source: GOV.UK website; Statista website; McKinsey website; ENA — Rising to Britain's Net Zero Challenge — [2023]; Media overview.

Notes: (21) National Grid Electricity System Operator.

RES and the UK grid; the need for infrastructure upgrades

Key issues of RES integration into the grid

Network inadequacy

546 GW

backlog of capacity to be connected in 2023, of which **55.5%** was renewables.

Number of queued projects rose from **600** in May 2023 to **1,000** by September 2023

Waiting time for a connection surged from **18m** in 2020 to **5 years** in 2023

60-70%

of projects in the queue ultimately fail to connect

35%

of offers require transmission network reinforcements

Smart grid technology, integrating state-of-the-art metering infrastructure, sensors and automation, optimises electricity flow by reducing transmission and distribution losses.

Instability of system

96 GJ

the ESO's ambition to maintain minimum system inertia by 2025.

The adoption of intermittent RES has increased utility frequency and voltage fluctuations. Addressing the inertia deficit caused by increased use of RES is crucial as the grid becomes more prone to frequency variations.

In 2019, the UK experienced a blackout due to unexpected shutdowns at the Hornsea offshore wind farm and Little Barford gas-fired power plant.

As of 2023, 159 GW of energy storage capacity essential for system stability was in the queue to be connected.

Grid management and monitoring require optimisation through advanced technologies such as synchronous condensers, synthetic inertia algorithms and virtual synchronous machines.

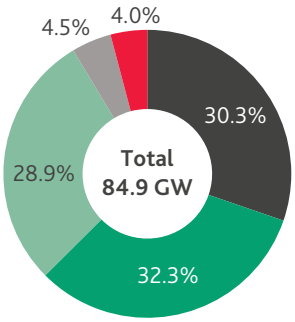
The growing role of Battery Energy Storage Systems (BESS) and new technologies

The increasing significance of RES and the electrification of the energy sector are driving the surge in Battery Energy Storage Systems. Integrating energy storage systems enhances Grid flexibility and ensures a stable and reliable power supply by enabling it to respond to fluctuations in supply and demand.

The UK's current energy storage overview

Cumulative installed capacity, GW	BESS	Pumped hydro storage
2023	3.5	2.7
YoY	▲ +66.7%	▲ +35.0%
Share as of 2023	56.5%	43.5%

Battery storage infrastructure as of 2023



	CAGR 2020 - 2023
Development	+78.7%
Planning	+152.6%
Consents approved	+43.4%
Under construction	+85.0%
Operational	+47.1%

Battery rollouts in the UK in 2023

34

new battery projects became operational.

80 MW

average size of a project entering the planning system.

108

total operational battery projects (>5 MW).

>98 MW Systems

Dollymans, Clay Tye, Bumpers, Richborough Energy Park.

The variability of renewable energy generation itself presents challenges in terms of predictability, matching supply and demand and utilising excess supply.

The use of battery energy storage systems (BESS) for both storing electricity and for grid management services is rapidly developing. BDO has recently supported the financing of a portfolio of synchronous condensers to provide additional inertia to the grid, reducing the risk of 'blackouts'.

When electricity supply exceeds demand, instead of paying generators to reduce generation (known as 'curtailment'), the excess electricity can be used to produce hydrogen that can be stored. The stored hydrogen can be used later to produce electricity when demand exceeds supply, thus providing a means of balancing the grid across time, as well as being used to reduce emissions by replacing natural gas or coal, particularly in heavy industries and potentially in domestic heating, or used for the production of 'green' ammonia.

Although this report indicates that 80% of planned UK hydrogen production intends to use electricity from renewable sources, so called 'green hydrogen', many facilities will use natural gas instead ('grey hydrogen'). Carbon capture and storage to remove emissions ('CCUS') can be combined with grey hydrogen production ('blue hydrogen') or gas powered electricity generation to reduce emissions.

In addition to the investment in carbon capture, significant investment in infrastructure will be required in a network of pipelines to transport the liquified captured carbon and storage facilities in depleted oil and gas fields.

We are also seeing new investment in one of the most traditional forms of energy storage, pumped hydro.

The need for investment in infrastructure to manage the intermittency of renewable energy planned to be generated is also significant.

Andy Hucknall

Advisory FMAS Director | BDO

The growing role of BESS and new technologies cont.

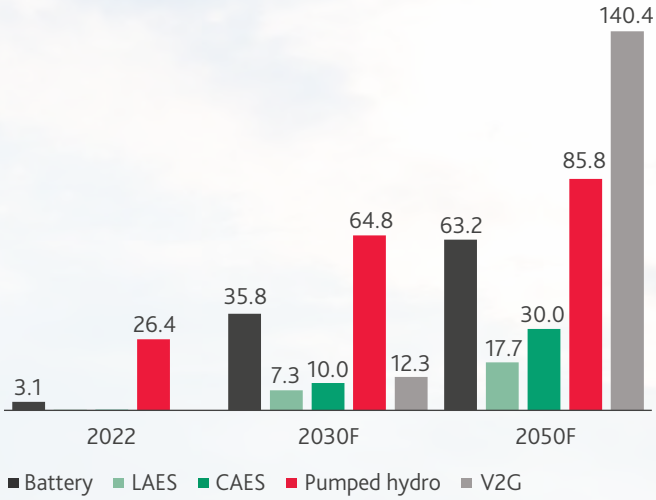
The ESO faces challenging operational issues such as the need for accurate and timely asset information, adaptation to increased battery storage dispatch and updating legacy dispatch tools. The Open Balancing Platform was launched to address these issues and enhance the ESO's balancing capabilities and overall system operation.

Impact of emerging technologies on energy landscape

Li-ion batteries accounted for 95% of the UK storage projects pipeline in 2023. The industry anticipated the need for cost reductions and an expansion of storage duration. Government projections suggest that upcoming technologies such as Compressed Air Energy Storage (CAES), Liquid Air Energy Storage (LAES), and Vehicle to Grid ('V2G[23]') are set to become increasingly influential. Among them, V2G technology is expected to lead the pack, generating the most significant energy output by 2050.

It is projected that from 2035, 10% of the total EV batteries in the UK will be accessible via V2G and smart charging to offer flexibility at any given moment. The implementation of smart meters, smart grids and regulatory modifications will encourage vehicle owners to actively adopt V2G solutions. The Government launched the £12.6m V2X Innovation Programme in March 2022 for large-scale, widespread electricity system flexibility through smart, flexible, secure and accessible technologies.

Stored energy by technology[22], GWh



Selected V2X Innovation Programme projects in the UK

1. ev.energy Ltd

£183.3k[24]

The V2X-Flex project aims to develop a prototype software that simplifies domestic use of V2X bi-directional chargers.

2. Otaski Energy Solutions Ltd

£142.7k

Developed a smart street lamppost for charging electric vehicles and redistributing power to the grid.

3. Agile Charging Ltd

£133.9k

BEVScanV2X project aims to overcome battery degradation by creating a cost-efective tool to maximise battery life.

Source: GOV.UK website; RenewableUK website; Department for Business and Trade — UK Battery Strategy — [2023]; ESO — Future Energy Scenarios — [2023]; Media overview.

Notes: (22) According to the ESO's Future Energy Scenario 'Leading the Way'; (23) The V2G technology involves utilising EVs as energy storage sources, which can then be utilised to feed energy back into the grid; (24) Project grant.

Investments in hydrogen economy to achieve net zero

The UK Government has identified hydrogen as a critical technology to help achieve net zero emissions by 2050. It has committed to working with the industry to achieve 1GW of electrolytic hydrogen production capacity in construction or operation by 2025 and 10 GW of low-carbon hydrogen production capacity by 2030. Hydrogen can be used as feedstock for industry, fuel for industry, transportation and for residential heating.

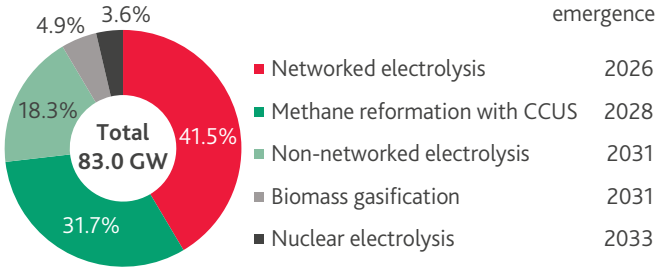
104

electrolytic production projects were in the hydrogen project pipeline in 2023.

Combined, these projects are expected to result in a total capacity of 12.4 GW, or 51.6% of total low-carbon capacity, by 2035. Over 80% of electrolytic projects in the current pipeline will rely on either wind or solar as this will be a crucial enabler in reducing the levelised cost of hydrogen and in driving scale.

According to the National Grids Future Energy Scenarios (FES), capacity for green and blue hydrogen will also expand in the coming years. Furthermore, hydrogen produced from surplus electricity can be stored for long durations and utilised in hydrogen-to-power facilities to provide supply-side flexibility and backup capacity for the grid.

Hydrogen production capacity by technology in 2050[25]



The emerging hydrogen economy presents many opportunities, not only for the UK but across the globe. There are many environmental benefits that hydrogen presents, which will be critical in achieving net zero targets. As industries move on from relying on fossil fuels, hydrogen is an alternative candidate that could facilitate mass decarbonisation. Furthermore, due to hydrogen's abundance, it is a source of energy that reduces dependency on foreign commodities. From a commercial perspective, a recent study led by Hydrogen UK anticipates that a hydrogen economy could create 64,000 job opportunities within the UK and generate over £7 billion in gross value annually by 2030.

However, following the excitement of the UK announcing their hydrogen strategy in the summer of 2021, questions have been asked over the UK's presence in the hydrogen race, with other countries' policies and incentives being referenced in such debates. For instance, the France 2030 investment plan pledges €1.9bn for the hydrogen sector, compared to the UK's £240m of funding (via the Net Zero Hydrogen Fund). Leaders in the industry have also suggested that the US' green projects policies and funding have moved ahead of the UK.

This may deter hydrogen businesses from investing in the UK and move elsewhere, unless the domestic support improves further. Fortunately, international competition is healthy for the progress of hydrogen technology, and it will certainly pressure the UK to provide further investment.

Will Isaacs
Tax R&D Manager | BDO

Source: GOV.UK website; DNV — Energy Transition Outlook UK — [2024]; HM Government — UK Hydrogen Strategy — [2021]; ESO — Future Energy Scenarios — [2022-2023]; HydrogenUK — Electrolytic Hydrogen Production — [2023]; Media overview.

Notes: (25) According to the ESO's Future Energy Scenario 'System Transformation.

Investments in hydrogen economy to achieve net zero cont.

The UK Government launched the Hydrogen Allocation Rounds (HARs) funding mechanism to support low-carbon hydrogen production. HAR1[26] provides both CAPEX and revenue support when operational. This funding helps overcome the operating cost gap between low-carbon hydrogen and high-carbon counterfactual fuels.

Potential evolution of Hydrogen Allocation Rounds

17 successful projects invited to negotiations

11 successful projects with **125 MW** of combined capacity

2bn of revenue support from the **HPBM** and over **£90m** from **NZHF**

Key offtake: Industry **230 MW** of electrolytic capacity

Support up to **875 MW** of low-carbon hydrogen

Support up to **1.5 GW** of low-carbon hydrogen

HAR1 2022-2023 → **HAR2 2023-2025** → **HAR3-4 2025-2027** → **HAR5-7 2027-2030**[27]

Hydrogen strike price in 2023[4]

Green hydrogen has a higher strike price than other renewables[25] due to the cost of electrolysers and the setup of ancillary renewable energy, which is one of the industry's challenges.

Hydrogen		Tidal	Wind	Solar
£175/MWh	vs	£73MWh	£64MWh	£61MWh

Selected operational projects related to green hydrogen production and utilisation in the UK

1. GeoPura

The solution uses solar PV or wind energy to produce hydrogen and hydrogen-based zero-emission fuels.

2. easyJet

Modern aero engine that uses green hydrogen generated by wind and tidal power.

3. Siemens Energy

A £3.5m ammonia cracker prototype to produce green hydrogen at an industrial scale.

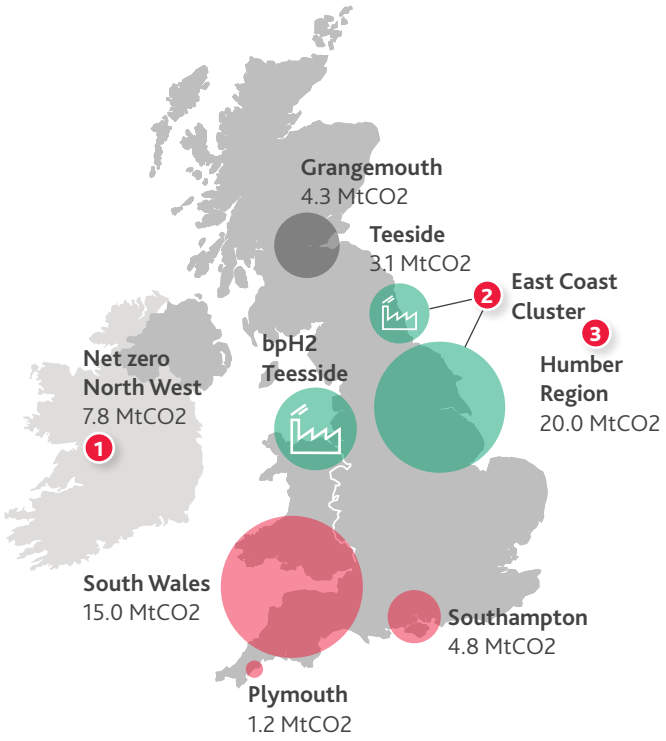
Source: GOV.UK website; DNV — Energy Transition Outlook UK — [2024]; HM Government — UK Hydrogen Strategy — [2021]; ESO — Future Energy Scenarios — [2022-2023]; HydrogenUK — Electrolytic Hydrogen Production — [2023]; Media overview.

Notes: (26) The first green hydrogen allocation round; (27) No specific target yet; (28) Strike price for HAR1 successful projects (real 2012 prices); (5) CfD AR6 strike prices (real 2012 prices).

CCUS-enabled hydrogen production to achieve net zero for industrial clusters

CCUS can reduce emissions from hydrogen production, especially when integrated with steam methane reforming plants. The UK aims to have up to 1 GW of CCUS-enabled hydrogen in construction or operation by 2025. To achieve this goal, the UK Government announced the Cluster Sequencing programme in 2021.

Major UK industrial cluster annual emissions[29]



Number of CCUS-enabled hydrogen production projects in G7 countries by status in 2023

Operational	5	4	1	1
Other[31]	39	9	3	2

Operational	0	0	0
Other[31]	18	4	3

The UK has committed to deploy CCUS in two steps:

Track-1
Mid 2020s

- Net zero North West Cluster
- East Coast Cluster.

Track-2
2030

- Acorn in Scotland Cluster
- Viking CCS in Humber Cluster.

The Cluster Sequencing programme, backed by £20bn Government support, aims to unlock private investment. The initial funding will support a range of innovative CCUS technologies that have the potential to accelerate decarbonisation and realise economic benefits by creating 50,000 jobs by 2030.

In 2023, there were 18 CCUS-enabled hydrogen production projects with a total initial production capacity of over 6.8 GW/y. Two of these were included in the Track-1 project negotiation list.

Source: GOV.UK website; IRENA website; DNV — Energy Transition Outlook UK — [2024]; HM Government — UK Hydrogen Strategy — [2021]; ESO — Future Energy Scenarios — [2022-2023]; HydrogenUK — CCUS-Enabled Hydrogen Production Report — [2023]; Media overview

Notes: (29) Latest available data of annual emissions from large point sources; (30) The Track-1 clusters are part of the Government's plan to deploy CCUS technology to capture and store 20-30 MtCO2 per year by 2030; (31) Including projects in concept, feasibility study, and FID/construction stages and phases.

CCUS-enabled hydrogen production to achieve net zero for industrial clusters cont.

Selected CCUS-enabled hydrogen production projects in the UK in 2023

1 Vertex Hydrogen HyNet
Offtake: Industry

2026	1,000
2030	4,000

3 HumberHub
Offtake: Power, heat, industry, transport

2027	720
2027	720

2 H2HSaltend
Offtake: Industry, power

2027	600
2027	600

2 H2Teesside
Offtake: Industry

2027	500
2030	1,000

2 H2NorthEast
Offtake: Industry

2028	355
2030	1,000

Key:

- X **Cluster - Track-1 included**
- X **Cluster - FEED**[32]
- Start year — Initial prod. capacity, MW[33]
- Peak year — Peak prod. capacity, MW

Key challenges related to CCUS-enabled hydrogen

Hydrogen transport and storage (T&S) infrastructure

The unintended release of hydrogen into the atmosphere presents a fire risk and increases the atmospheric lifetime of methane, a potent greenhouse gas.

CO_2 T&S infrastructure

Significant uncertainty exists regarding the risks, liabilities and cost implications of developing CO2 storage sites which are essential for CCUS projects.

The overall challenge

Any emissions must be captured and stored to mitigate emissions when delivering hydrogen/green electricity to industry. Currently, only 53% of industrial emissions are within investment clusters.

Source: GOV.UK website; IRENA website; DNV — Energy Transition Outlook UK — [2024]; HM Government — UK Hydrogen Strategy — [2021]; ESO — Future Energy Scenarios — [2022-2023]; HydrogenUK — CCUS-Enabled Hydrogen Production Report — [2023]; Media overview

Notes: (32) The purpose of the FEED study is to enable a FID; (33) According to the project proposal.

Investments in renewables

Economic challenges and M&A activity in renewables

In 2023, the global renewable sector experienced a 29.7% Year over Year (YoY) reduction in deal numbers and a 27.9% reduction in deal values. This was mainly due to high interest rates, recession concerns and geopolitical tensions.

The decline in M&A activity affected most technologies except geothermal. The green energy transition remains the main driver of M&A activity across the power sector but Government regulation, supply security and portfolio optimisation are also significant factors.

M&A deals in the renewable sector in 2023		
Global	4,857	▼ (-29.7%)
Europe	1,659	▼ (-21.9%)
Asia	1,623	▼ (-38.7%)
North America	1,225	▼ (-22.5%)

X.X% Change YoY

G7 countries ranked by number of renewable M&A deals over 2020-2023[35]

710	189	137	125	124	86	64

Deals in the cleantech sector[34] in the UK in 2023		
Number of deals	243	▼ (-10.0%)
Deals value	£1.9bn	▼ (-5.0%)

X.X% Change YoY

Top-3 renewable companies in the UK by the number of deals over 2020-2023[35]

Octopus Energy	Lightsource bp	Cubico Sustainable Investments
30	23	18

Throughout this annual report we have spoken a lot about policies, not just in the UK but globally. Policies are important drivers to changing our behaviours. The UK has historically had some clear, early strategies which have enabled the growth of renewables in the UK. Take the Utilities Act in 2000 which brought in the requirements for renewables to factor into the generation mix. This has led to further policies and subsidies to incentivize and support the uptake. Overall the development has been positive with the UK being early adopters. The challenge the UK faces, as we have noted in this report, is maintaining this momentum to achieve net zero by 2035.

With the delaying of REMA until 2026 and the recent announcement to continue investment in gas power fired stations, one could argue the Government's signaling is confused. It is clear from this report there are many areas of focus across the whole value chain, the need to decarbonize for the energy transition; challenges around technologies and value for consumers, access to raw materials, skills and funding.

An interesting move by the Government in recent months was the announcement of the Green Industries Growth Accelerator (GIGA), part of the wider £4.5bn announced in the autumn statement to increase investment in strategic manufacturing sectors which includes clean energy. The aim of this fund is to increase investment manufacturing capabilities in the UK for CCUS and Hydrogen, small scale nuclear and offshore and onshore wind. Alongside this the Energy Act 2023, which was released at the end of 2023, sets out some frameworks to support all areas of the energy transition. Both of these are seen as positive moves, but the challenge is turning these into policies which businesses can invest in long term, and that offer value for money to consumers.

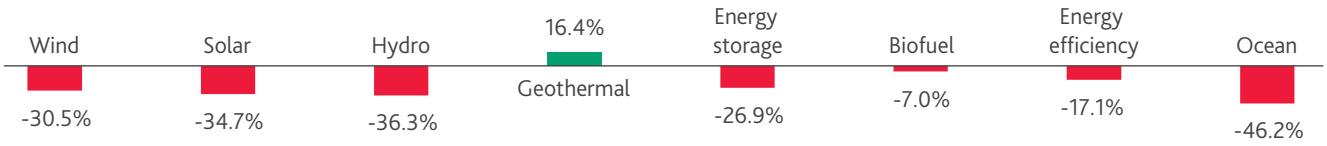
Caroline Hulmston
Audit Director | BDO

Source: Statista website; Energy Monitor website; Power Technology website; London Stock Exchange website; BCG website; Beauhurst — The deal 2023 — [January 2024]; Media overview.

Notes: (34) Including technologies such as renewable energy, EVs, carbon capture and storage, bio-based plastics, recycling, battery storage, and alternative fuels; (35) From January 2020 to January 2023.

Economic challenges and M&A activity in renewables cont.

The YoY change in the number of renewable energy M&A deals by technology worldwide in 2023



Selected M&A deals[36] in the UK renewable sector

Energy transmission

July 2023 **Diamond Transmission Corporation Limited**

Danish energy company Orsted and its partners sold its transmission assets of Hornsea 2 Offshore Wind Farm for £1.2bn to Diamond Transmission Partners Hornsea Two.

Energy storage

October 2023 **West Burton Energy**

Power generator West Burton Energy acquired Thorpe Marsh Green Energy Hub Limited and Thorpe Marsh Energy Park Limited, two utility-scale battery storage development projects[37].

Solar energy generation

January 2024 **AlphaReal**

AlphaReal, the specialist real estate investment manager, completed the acquisition of a 40.4 MW newly commissioned solar farm Bubney Energy Centre in Shropshire.

Biogas/biomethane

September 2023 **Engie**

The UK anaerobic digestion market continues to grow and attract M&A activity, including Engie's £65.0m acquisition of UK-based biomethane producer Ixora Energy.

Biogas/biomethane

November/December 2022 **bp, Shell**

Shell and BP led the charge by acquiring Nature Energy and Archaea Energy respectively for a total of £4.8bn. Biomethane can play an important role in decarbonising heat and transportation.

Out of 23 IPOs conducted on the LSE in 2023, six companies were involved in the renewable energy value chain, mainly in raw materials exploration and extraction, accounting for 1.3% (£12.8m) of the total raised capital.

Focus of activity of the renewables-related IPOs in the UK

Metals One	Altona Rare Earths Plc	Golden Metal Resources	Fulcrum Metals	Celsius Resources	Oneiro Energy
Battery metals (e.g. nickel, cobalt, copper)	Rare Earths Element	Tungsten, gold, copper, silver, zinc	Gold, base metal, uranium projects	Copper, gold	REE, cobalt, lithium, CCS, and blue hydrogen[38]
Exploration and/or mining					Acquisition

Source: Statista website; Energy Monitor website; Power Technology website; London Stock Exchange website; BCG website; Beauhurst — The deal 2023 — [January 2024]; Media overview.

Notes: (36) The most recent deals in 2023 and/or 2024, with deal targets in different technologies; (37) The project will be the world's largest battery project with a capacity of 1.4 GW (once completed); (38) The acquisition focus also includes upstream gas exploration and nuclear energy.

Clean energy equity investments in renewables

Despite reduced renewable energy M&A activity, critical near-term deal drivers such as corporate portfolio transformation, ESG-related acquisitions and digitalisation efforts will lead to new opportunities.

UK climate-tech companies collectively raised £2.2bn in 2023, primarily through VC/PE investments. Equity investments in clean energy generation companies in the UK increased by 40% YoY, reaching £1.3bn.

Climate-tech corporate financing[39] by market in 2023, £bn[40]

20.3	17.2	3.5	2.3	2.2	1.5	1.5

Selected companies that raised VC in renewable technologies in the UK

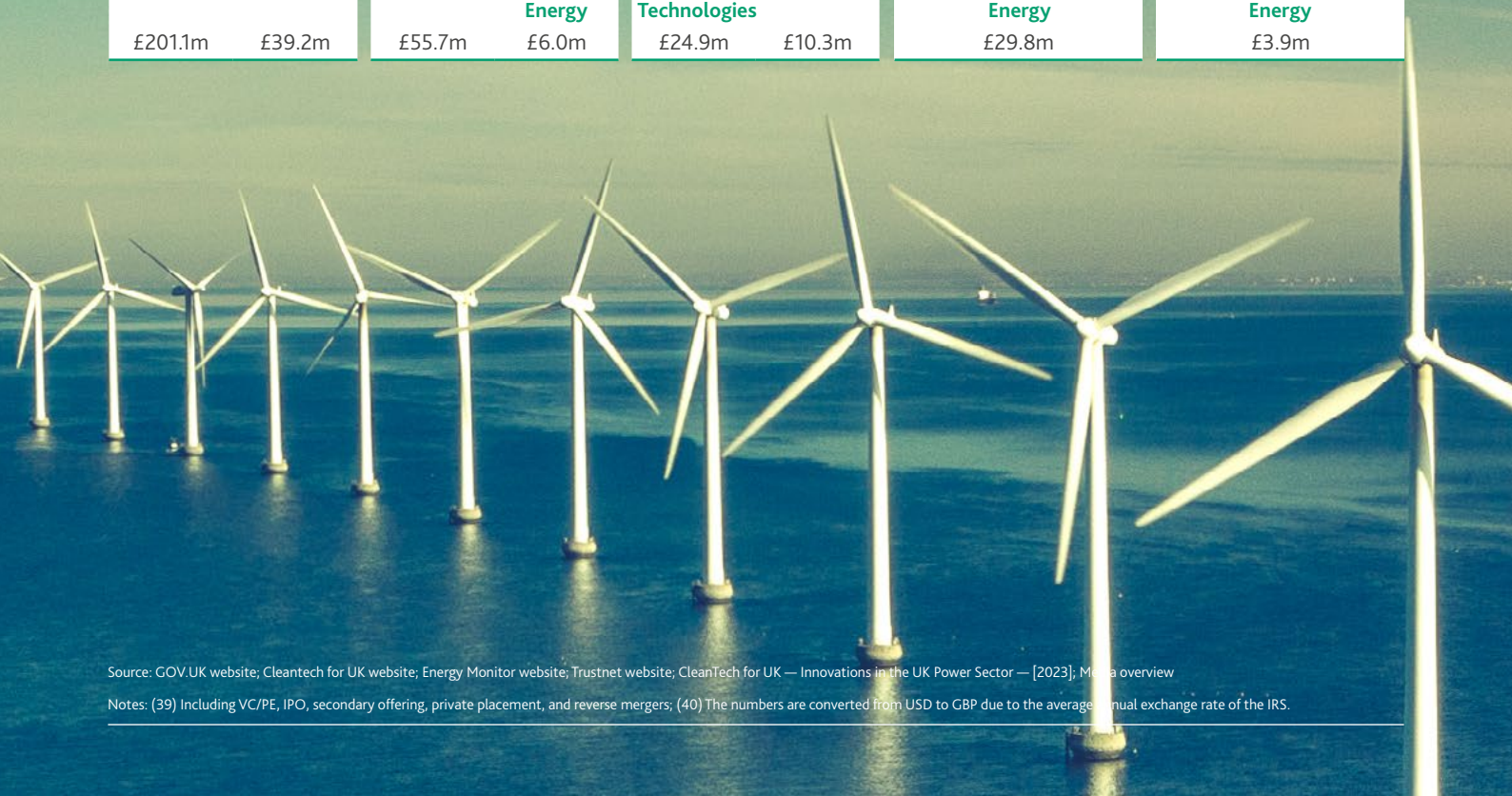
Energy storage	Hydrogen	Energy networks	Solar	Wind
Batteries, mechanical storage, thermal storage, battery management software	Hydrogen production, electrolysers, fuel cells, storage & transport	Transmission, distribution, DER, VPP management	Optimised solar PVs, cells, and new business models	Software and mechanical innovation for wind turbines

Total VC deal value during 2017-2022[40]

Energy storage	Hydrogen	Energy networks	Solar	Wind
£728.0m	£195.8m	£107.6m	£85.7m	£67.1m

Active companies and their latest VC deals in 2023-2024[40]

Energy storage		Hydrogen		Energy networks		Solar	Wind
Field	Gravitricity	GeoPura	Oort Energy	Reactive Technologies	Piclo	Naked Energy	Kitemill Energy
£201.1m	£39.2m	£55.7m	£6.0m	£24.9m	£10.3m	£29.8m	£3.9m



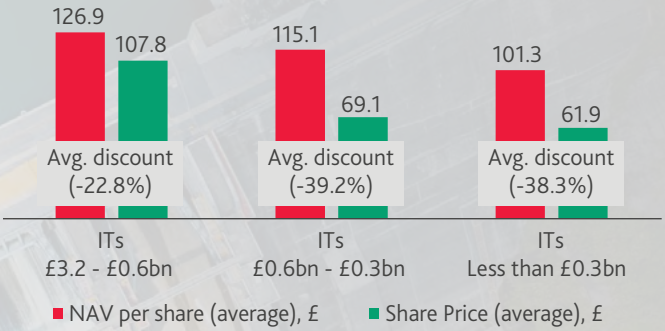
Source: GOV.UK website; Cleantech for UK website; Energy Monitor website; Trustnet website; CleanTech for UK — Innovations in the UK Power Sector — [2023]; M[illegible]a overview

Notes: (39) Including VC/PE, IPO, secondary offering, private placement, and reverse mergers; (40) The numbers are converted from USD to GBP due to the average [illegible]nual exchange rate of the IRS.

Clean energy equity investments in renewables cont.

Comparison of the UK's renewable energy yieldcos[41] NAV vs Share Price as of 26 April 2024

- As of 26 April 2024, listed yieldcos in the UK experienced share price discounts to their NAV, ranging from 12.1% to nearly 60.9%
- This restricts their ability to raise equity funds and therefore make new investments
- Investment Trusts (ITs) remain a convenient, relatively liquid way to invest in a broad range of UK and overseas renewables infrastructure, an asset class which may otherwise be inaccessible to all but the largest and or most specialised investors.



Key factors impacting renewable investment trusts in the UK

Discounts to NAV, high inflation and high interest rates are impacting investment trusts' ability to invest in renewables.

European regulations have added complexity to investment trust structures and a perception of higher costs that is affecting investor appetite.

Investment Trusts focused on specific renewable technology are exposed to market volatility and risks related to technological development that leaves them heavily reliant on Government policies.[42]

Source: GOV.UK website; Cleantech for UK website; Energy Monitor website; Trustnet website; CleanTech for UK — Innovations in the UK Power Sector — [2023]; Media overview

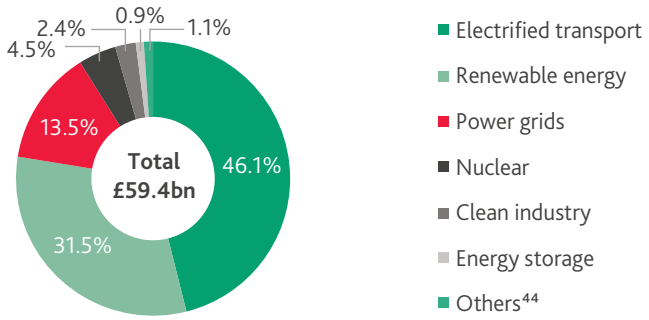
Notes: (41) 17 renewable energy Infrastructure ITs were analysed, ranged by their market capitalisation; (42) Such as the £400m UK Hydrogen Strategy published in December 2023.

A surge in UK investments in green energy transition

Global investment in the green energy transition[43] reached a record £1.4tn in 2023, marking a 17.1% YoY increase. This was driven by the determination of Governments and companies to meet their net-zero targets, as well as substantial investment growth in the EMEA and Americas regions. China retained its position as the largest investor, while the EU members collectively invested £274.2bn.

The UK has emerged as the fourth largest clean energy investor worldwide. Investments in the UK's energy transition have soared by 84.3% compared to 2022, primarily fuelled by investments in the electric vehicle market and the growth of renewable energy infrastructure. Similarly, the UK was the third largest country for ClimateTech funding and London continues to be a prominent deal hub with the most ClimateTech deals in Q1 2024.

Investment mix in green energy transition in the UK in 2023

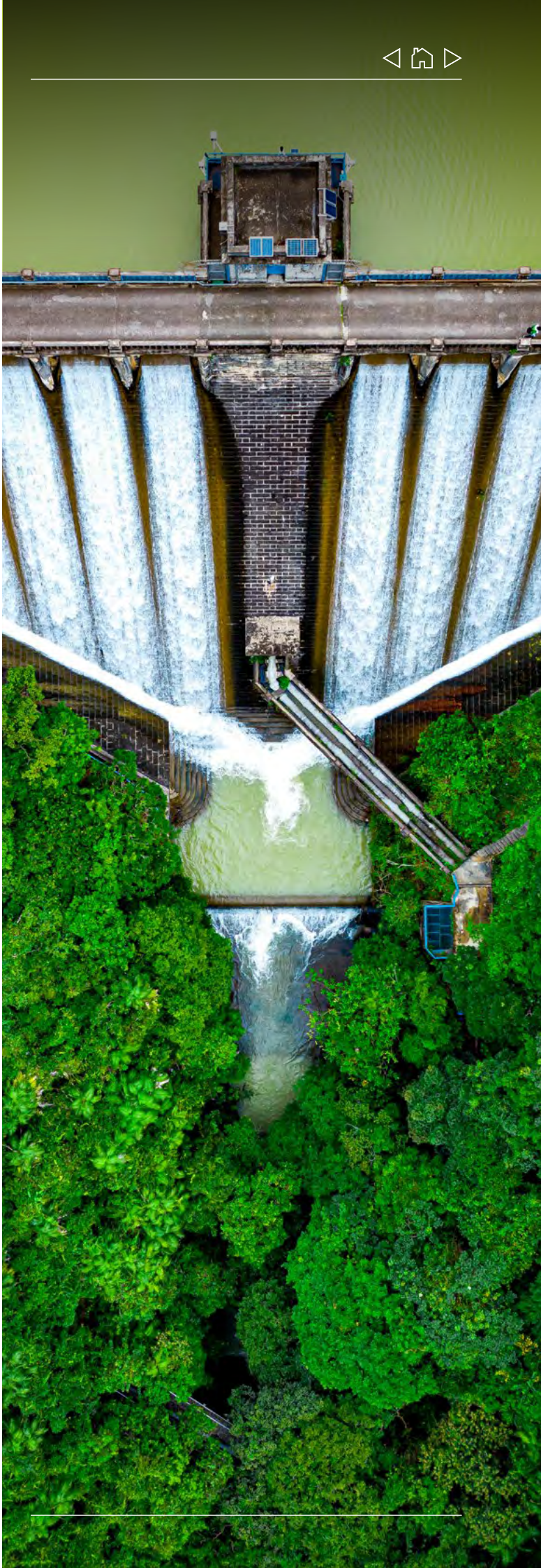


Investments in green energy transition in 2023, £bn[45]	543.6	243.8	76.7	59.4
As a share of GDP 2023, %	3.8	1.1	2.2	2.2

Investments in green energy transition in 2023, £bn[45]	44.6	25.7	23.9
As a share of GDP 2023, %	1.8	0.8	1.4

Source: GOV.UK website; Sustainable Views website; Companies' websites; Bloomberg NEF — Energy Transition investment trends 2023 — [2024]; Net Zero Insights — State of Climate tech 2023 — [2024]; Net Zero Insights — State of Climate tech Q1 2024 — [2024]; Media overview.

Notes: (43) Investments in the deployment of net-zero-aligned technology and infrastructure, including renewables, electrified transport, power grids and others; (44) CCUS, hydrogen, electrified heat, and clean shipping; (45) No available data on Canada. The numbers are converted from USD to GBP due to the average annual exchange rate of the IRS.



A surge in UK investments in green energy transition cont.

The UK's selected Government investments in renewable energy in 2023

£960m
was allocated for the Green Industries Growth Accelerator targeting capacity in offshore wind, networks, CCUS, hydrogen and nuclear.

95
clean energy projects in the UK, with a total budget of £227m, including onshore wind, solar and tidal, were selected for Government funding.[46]

£10m
funding was distributed to support local renewable projects, such as small-scale wind farms, rooftop solar panels and EV charging points.

UK Government funding encourages long-term investments in the renewable energy sector. The interaction between private investments and public funding is essential for driving inclusive and sustainable economic development and promoting the development of innovative technologies.

Selected companies' investments[47] in the UK renewable energy sector over 2023-2024

Solar	
RWE	Construction of its first solar farm in the UK as **part of seven solar projects.**
Environmena	**£270m** to build 500 MW of generating solar assets and pipeline by 2025.

Wind	
SeAH	**£367m** in wind monopile manufacturing factory.
RWE, MASDAR	**£11bn** in the UK's offshore wind sector to launch a 3 GW wind farm.

Energy transmission	
Iberdrola	**£12bn** in the UK's electricity grid and renewable generation capacity over 2024-2028.
Sonnedix	**£435m** to construct renewable energy pipeline.

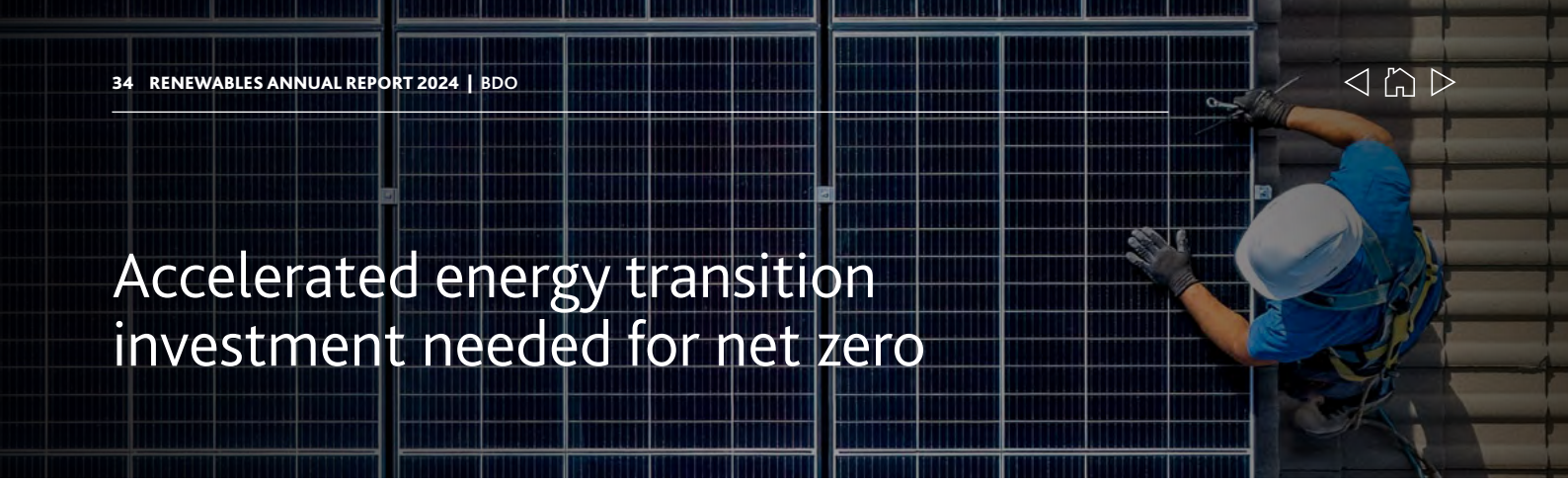
Hydrogen & CCUS	
Shell	**£800m** annually in hydrogen and CCUS projects over 2024-2025.

Bioenergy	
MGT Teeside	**£650m** in building a biomass station to generate power through wood waste.

Energy storage	
RES Group	Plans to build a **49.9 MW** Holmston Farm energy storage in Scotland.
TagEnergy, Harmony Energy	**£60m** in building two 50 MW battery storage facilities.

Source: GOV.UK website; Sustainable Views website; Companies' websites; Bloomberg NEF — Energy Transition investment trends 2023 — [2024]; Net Zero Insights — State of Climate tech 2023 — [2024]; Net Zero Insights — State of Climate tech Q1 2024 — [2024]; Media overview.

Notes: (46) The results of the first annual round of Contracts for Difference, the Government's flagship renewable energy scheme; (47) The examples of the most recent investments in 2023 and 2024, with focus on different technologies.



Accelerated energy transition investment needed for net zero

To achieve net zero targets, global clean energy investments will need to reach £3.9tn per year by 2030, compared to the £1.4tn spent in 2023. The UK would need to nearly double its clean energy investment per year by 2030 to match its net zero ambitions while having the lowest multiplier among the leading energy transition economies.

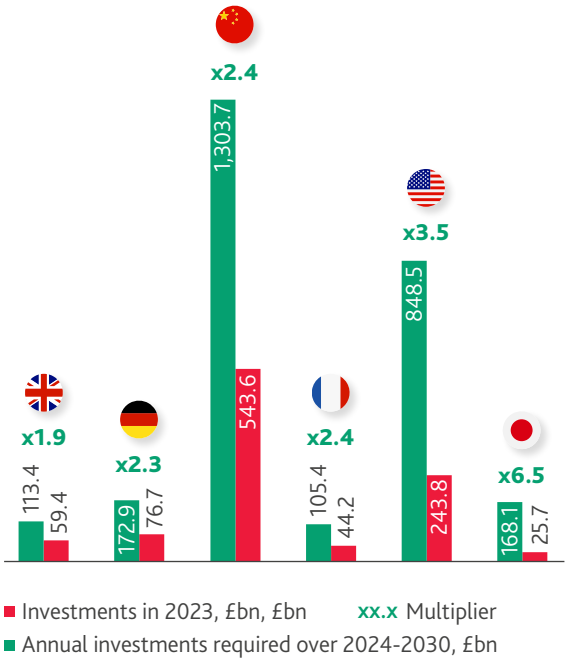
The existing gap between the required investments in renewable and low-carbon energy sources and the current UK Government policies underlines the need to attract more private finance.

In 2023, the largest energy consumption sector in the UK was transport (41.8%), followed by domestic consumption or households (25.8%), industry (16.7%), and services (15.8%).

Required investments in renewable energy in the UK to achieve net zero by 2050

NatWest Group	Energy UK	Climate Change Committee
>£900bn	**£500bn**	**£394.4bn**
estimation as of December 2023.	estimation as of February 2023.	estimation as of December 2020.

Multiplier[48] to align 2023 green energy transition investments with net-zero goals by 2030



Public investment in the UK electricity supply sector over 2020-2030, £bn

£104bn	£19bn	£85bn
Required	Investment gap	Planned and committed

Source: GOV.UK website; Sustainable Views website; Bloomberg NEF — Energy Transition investment trends 2023 — [2024]; NatWest — Energy Transition Report — [023]; Frontier Economics — The UK's net zero investment gaps — [2022]; Climate Change Committee — The Sixth Carbon Budget — [2020]; Media overview.

Notes: (48) The multiplication factor for the 2023 investment levels to match the average annual investment needs across 2024 to 2030 to align for net zero. No available data on Canada and Italy.

Accelerated energy transition investment needed for net zero cont.

Public transport

Investments in public transport in the UK will boost annual GDP by £52bn by 2030 through productivity gains and create 140,000 new transport jobs, as well as make a significant contribution to achieving net zero.

Road transport

Addressing road transport emissions, which constitute over half of all transportation emissions in the UK, is a central focus, including the purchase and leasing of EVs, EV charging infrastructure, and battery technology.

Gigafactories

87% of the UK transport sector[49] advocates for a consistent Government approach to public-private partnerships, including investment prospectuses for sites of gigafactories to encourage investments in the UK.

Consumer perspective

The slow progress towards achieving net zero emissions led to £2,100 additional annual costs for UK households in 2023.

£700 still driving a petrol car instead of an EV.	**£615** still using a gas boiler instead of a heat pump[50].	**£245** fossil fuels and climate impact on food prices.
£235 no solar PV panels[3] on a home.	**£200** missed insulation upgrades to a home.	**£105** use mains electricity with only 40% renewables.

The UK could have saved £70bn on its energy bill over the past decade if the appropriate investments had been made.

The UK's transition to net zero emissions drives investment growth. In 2023, the UK's net-zero economy[51] grew by 9.0%, attracting £14bn of Foreign Direct Investment and creating over 20,600 new jobs. However, there is still not enough investment to achieve net zero emissions. The UK will need to almost double its annual clean energy investments over 2024-2030. In addition, weakening net zero policies, such as halting the roll-out of EVs and heat pumps and supporting new oil and gas drilling, could hinder future green investments.

The renewable sector has seen growing global investment, however, the UK may struggle to remain competitive on an international stage. Regulatory uncertainty, technical barriers, skill shortages and an increasing investment gap must all be addressed if the UK is to attract the investment in renewable energy that is needed to achieve net zero by 2050.

The sector faces other challenges such as connecting renewables to the National Grid, speeding up the planning process and addressing issues with the Contract for Difference (CfD) regime. The priorities must be to establish a more favourable regulatory environment that will attract investments and to introduce effective incentives.

Industry, investors, government and consumers all have key roles to play in ensuring the UK does tackle the challenges to the development of renewables and make substantial progress towards achieving its net zero commitments.

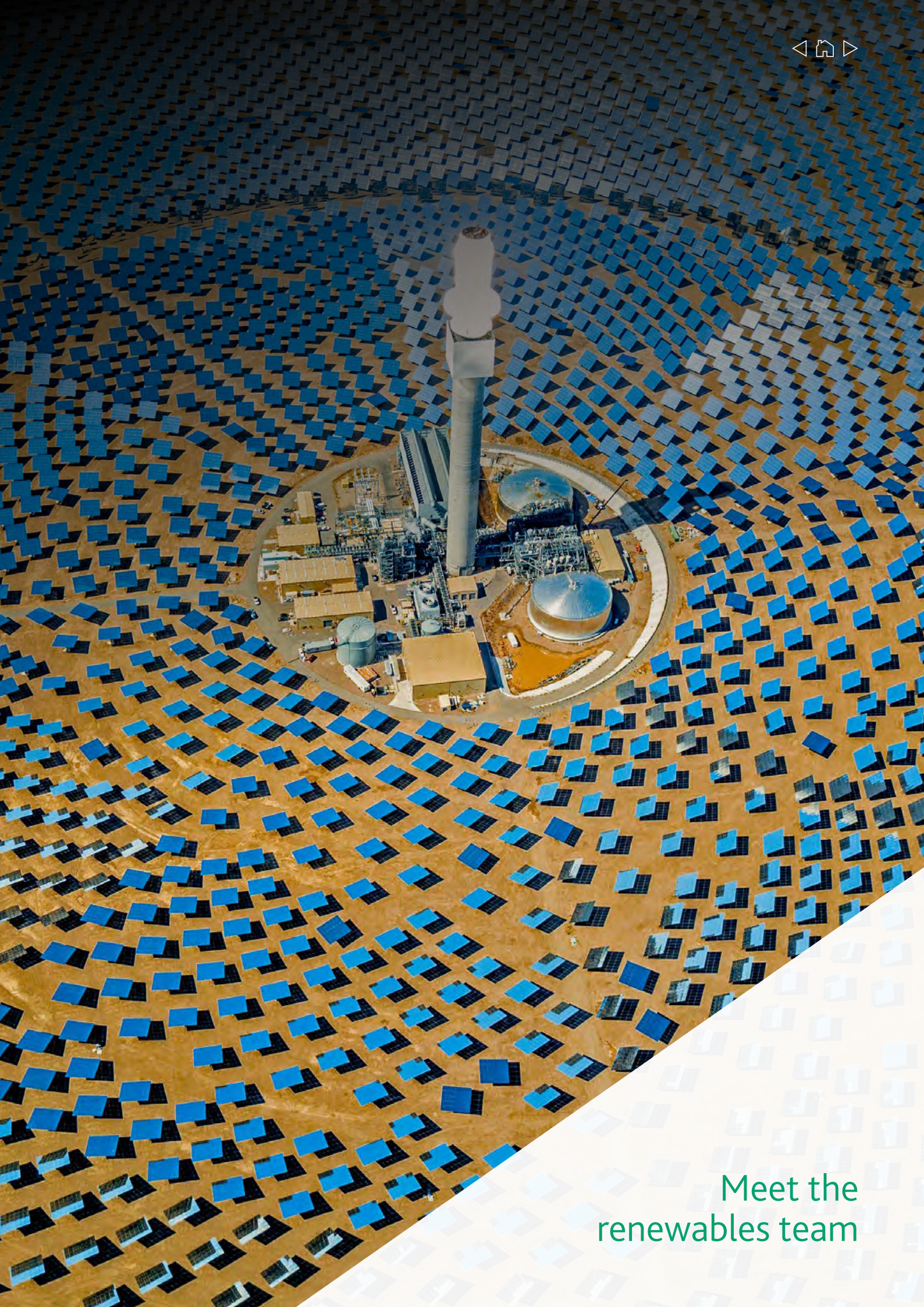
Source: GOV.UK website; Sustainable Views website; Bloomberg NEF — Energy Transition investment trends 2023 — [2024]; NatWest — Energy Transition Report — [023]; Frontier Economics — The UK's net zero investment gaps — [2022]; Climate Change Committee — The Sixth Carbon Budget — [2020]; Media overview.

Notes: (49) According to the survey conducted by the UK Sustainable Investment and Finance Association among 100 decision-makers from across the UK energy sector, whose companies have a combined turnover of around £700bn, published in February 2024; (50) The average cost of an air source heat pump and solar panels is between £9,500 and £28,000; (51) Comprises 16 sub-sectors, including renewable energy, carbon capture, green finance, low-carbon, and energy efficiency.

Glossary

Glossary

AR	Allocation Round
CAES	Compressed Air Energy Storage
CAPEX	Capital expenditures
CAGR	Compound annual growth rate
CCUS	Carbon capture, utilisation, and storage
CfD	Contract for Difference
CO_2	Carbon dioxide
CSRD	Corporate Sustainability Reporting Directive
DER	Distributed Energy Resources
DESNZ	Department for Energy Security and Net Zero
EGL	Electricity Generator Levy
EMEA	Europe, the Middle East and Africa
EoL	End-of-Life
ESG	Environmental, social, and governance
ESOS	Energy Savings Opportunity Scheme
EV	Electric vehicle
FEED	Front End Engineering Design
FES	Future Energy Scenarios
FID	Final investment decision
FiT	Feed-in Tariff
G7	Canada, France, Germany, Italy, Japan, the UK and USA
GDP	Gross Domestic Product
GHG	Greenhouse gases
GW	Gigawatt
H_2	Hydrogen
HARs	Hydrogen Allocation Rounds
HMRC	His Majesty's Revenue and Customs
HPBM	Hydrogen Production Business Model
HVDC	High-voltage direct current
IEA	International Energy Agency
IFRS	International Financial Reporting standards
IIJA	Infrastructure Investment and Jobs Act
IPO	Initial Public Offering
IRA	Inflation Reduction Act
ISSB	International Sustainability Standards Board
IT	Investment Trust
LAES	Liquid Air Energy Storage
LCCC	Low Carbon Contracts Company
LCOE	Levelised cost of electricity
LPG	Liquefied petroleum gas
LSE	London Stock Exchange
LTE	Lifetime Technical Evaluation
M&A	Merges & Aquisitions
MtCO2e	Metric tonnes of carbon dioxide-equivalent
MW	Megawatt
NAV	Net asset value
NZHF	Net Zero Hydrogen Fund
PE	Private Equity
PPAs	Power Purchase Agreement
PV	Photovoltaics
REEs	Rare earth elements
REMA	Review of Electricity Market Arrangements
RES	Renewable energy sources
ROC	Renewable Obligation Certificates
SDS	UK Sustainability Disclosure Standards
SECR	Streamlined Energy and Carbon Reporting
SEG	Smart Export Guarantee
T&S	Transport and Storage
TCFD	Task Force on Climate-Related Financial Disclosures
TWh	Terawatt hour
V2G	Vehicle-to-Grid
V2X	Vehicle-to-Everything
VC	Venture Capital
VPP	Virtual Power Plants
YoY	Year-over-year



Meet the renewables team

Meet the renewables team

For more information on our sector credentials, or to receive our thought-leadership reports in any of our other sectors, please get in touch

David Bevan

Advisory CF, Partner
UK Head of Renewables, Chair
david.bevan@bdo.co.uk

Marc Reinecke

Audit Partner
Global Head of Renewables
marc.reinecke@bdo.co.uk

Steven Levine

Tax R&D Partner
steven.levine@bdo.co.uk

Konrad Langworth

Advisory CF
Assoc Director
konrad.langworth@bdo.co.uk

Caroline Hulmston

Audit Director
caroline.hulmston@bdo.co.uk

Edward Eddy

Tax R&D Senior Manager
edward.eddy@bdo.co.uk

Ian Morgan

Advisory BSO
Director
ian.morgan@bdo.co.uk

Lee Jefferson

Tax
M&A Partner
lee.jefferson@bdo.co.uk

William Isaacs

Tax R&D Manager
william.isaacs@bdo.co.uk

Andy Hucknall

Advisory FMAS Director
andy.hucknall@bdo.co.uk

Viran De Silva

Tax M&A Assoc Director
viran.desilva@bdo.co.uk

John Strowger

Advisory BR Partner
john.strowger@bdo.co.uk

Sam Boundy

Tax
M&A Partner
sam.boundy@bdo.co.uk

FOR MORE INFORMATION:

David Bevan
david.bevan@bdo.co.uk

www.bdo.co.uk

42025077