OPINION

Financing the Energy Mix in the Era of Energy Transition

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Abstract

As the global energy sector undergoes a transition amidst concerted efforts to reach net zero greenhouse gas (GHG) emissions, so are financing demands shifting towards cleaner, low-carbon technologies, while policies of many banks, government lenders and development financing institutions shift away from the financing of fossil fuel projects. At the same time, geopolitical events have caused some regions to refocus on energy security and diversity of supply. However, a difference in policy focus is emerging between the two key energy import markets of East Asia and Europe, whilst other jurisdictions that are forecast to experience steep and sustained population growth over the next decade (such as India and many countries across Africa) are understandably focused on energy growth ahead of energy transition. While some commentators see a long-term alignment between the achievement of energy security for all and a transition away from fossil fuels, tension remains in the near-term between competing policy objectives, which is reflected in the approaches of different financial institutions to the energy transition.

Introduction

In the concluding agreement at the COP 28 UN Climate Change Conference, world leaders called on nations to transition away from fossil fuels. Against this backdrop, the energy transition continues to gather momentum in developed and developing markets.

However, the need to strike a balance between accelerating the energy transition and ensuring energy security has become particularly pronounced in European policy decisions in recent years, with significant investment in infrastructure for the import of liquefied natural gas (LNG) to displace Russian pipeline gas.[1]

Globally, oil demand is expected to peak in the mid-2020s before a substantial 48% decline by 2050.[2] Natural gas demand is expected to increase until 2040 before declining in response to higher decarbonisation ambitions.[3] Meanwhile, renewable energy is estimated to account for approximately 65–85% of the power generation globally by 2050, with the share of renewables in the power mix projected to double in the next 15 years.[4]

This article considers the challenges of financing traditional fossil projects today and the future opportunities for investment in clean energy initiatives, including carbon capture, energy storage/electrification, clean hydrogen projects and renewables.

Global energy transition policies compared

The transition to net zero remains a key priority for policymakers and market participants, but recent events have illustrated that continued support from the oil and gas industry is still viewed as necessary.

Current or planned capacity from renewable energy projects is insufficient to meet the increasing global energy demand, supply-chain issues constrain the rate at which renewable power generating capacity can be increased, and there is inadequate grid capacity to deal with the distribution of renewable power in many markets. In addition, most renewable technologies rely on intermittent sources of power and therefore are unable to meet 100% of local or regional energy demands without significant over-capacity or storage capacity, each coming at an investment cost that is in many cases prohibitive.

While significant investment and progress is being made in developing energy storage solutions (some of which are described below), and despite renewed investment focus in some jurisdictions on the role of

[1] European Commission, "REPowerEU: affordable, secure and sustainable energy for Europe", *https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe_en*.
[2] McKinsey & Co, "Global Energy Perspective 2023" (November 2023), *https://www.mckinsey.com/~/media/mckinsey/industries/oil%20and%20gas/our%20insights/global%20energy%20perspective%202023/global-energy-perspective-2023.pdf?shouldIndex=false*.
[3] McKinsey & Co, "Global Energy Perspective 2023" (November 2023).
[4] McKinsey & Co, "Global Energy Perspective 2023" (November 2023).

nuclear power, most industry commentators consider that natural gas (transported by pipeline or shipped as LNG) will continue to play a key role in generating power for the foreseeable future, even whilst coal power generation is phased out in most parts of the world.[5]

Policy makers in the key Asian energy import markets have consistently backed the long-term role of natural gas in their energy mix, with several South-East Asian countries recently joining the more established regional importers of natural gas.[6] Key policy drivers at play have continued to be lowest-cost energy supply and security of energy supply. Air quality (particularly in areas of high population density), rather than global warming, appears to have informed the drive to displace some coal power production with gas power, particularly in China.[7]

In Europe, disruption to oil, gas and coal supply caused by Russia's invasion of Ukraine in February 2022 has distorted short-term energy investment decisions. In response to the invasion of Ukraine (which came at a time when energy prices already were elevated due to natural gas shortages and weak winds in regions that relied on wind power production), policymakers reacted by securing alternate fuel supplies and additional gas storage capacity, increasing LNG-import capacity as well as electricity generation from oil and coal, and extending the lifespans of some nuclear power plants.[8]

However, these policy decisions should be seen in the context of a stronger commitment by Europe to shift away from fossil fuels and towards renewable energy in the medium term.

This can be seen most clearly in the REPowerEU initiative, a proposal implemented by the EU to meet the twin objectives of establishing energy sources independent of Russia while transitioning to a "net zero" carbon economy. Under the REPowerEU policy and the amended EU Renewable Energy Directive (RED III), the EU is committed to use over 42.5% of renewable power in its energy mix by 2030 with the aspiration of reaching 45% of renewable power by 2030.[9] This is in contrast to certain Asian policy objectives over the same time horizon, with Japan and South Korea committed to using 36–38% and 21.6%, respectively, of renewable power in their energy mixes by 2030 (informed in part by the lack of accessible domestic renewable energy sources). [10], [11]

Notwithstanding this clear policy shift, and the fact that natural gas use in Europe is projected to peak in the next few years, fossil fuels will continue to play a role in the European energy mix for the foreseeable future, and policymakers in Europe continue to grapple with the extent and nature of this role.

For example, the European Parliament voted in July 2022 to allow certain natural gas and nuclear power activities to be designated as environmentally sustainable economic activities under the EU's sustainable finance taxonomy. The pool of capital available for such projects may therefore be broader as they are classified as sustainable investments.[12]

In the US, the development of cost-effective technology to access huge "non-conventional" domestic natural gas resources accelerated a shift away from coal power and the rapid transition of the US to a net exporter of energy over the last decade. The Inflation Reduction Act, which was passed into law in August 2022, signalled the US government's recognition of the need to accelerate the development of clean energy technologies.[13] As described below, the legislation provides a high level of federal investment support for such projects, and may be considered a response to China's global dominance in the production of PV solar panels following the State Council's Decision to Accelerate the Development of Strategic Emerging Industries in 2010.

Although much of the investment to be generated by the Inflation Reduction Act may be focused on domestic energy consumption, it is expected that projects developed with its support may also export clean energy solutions (such as green ammonia) to Europe and Asia.

Evolution of fossil fuel investment policies

The divergence of government policies towards fossil fuels around the world has led to a natural divergence of equivalent lending policies amongst government-backed lenders, such as export credit agencies (ECAs). Whilst many European ECAs have ceased lending to new oil and gas projects, Asian ECAs, for example, have not.

Similarly, a divergence of lending policies—and commitment to such policies—has emerged amongst international commercial banks. Between 2016 and 2020, 55% of the world's 60 largest commercial and investment banks increased financing in the fossil fuel sector, with

[5] McKinsey & Co, "Global Energy Perspective 2023" (November 2023).
[6] International Energy Agency (IEA), "Southeast Asia Energy Outlook 2022 – Key Findings", *https://www.iea.org/reports/southeast-asia-energy-outlook-2022/key-findings*.
[7] The World Bank, "China: Fighting Air Pollution and Climate Change through Clean Energy Financing", *https://www.worldbank.org/en/results/2020/06/21/china-fighting-air-pollution-and-climate-change-through-clean-energy-financing* (21 June 2020).
[8] IEA, "Russia's invasion of Ukraine has sparked a global energy crisis"—World Energy Outlook—Executive summary (2022), *https://www.iea.org/reports/world-energy-outlook-2022/executive-summary*.
[9] European Commission, "Renewable energy targets" (October 2023), *https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-targets_en*.
[10] Reuters, "Japan aims for 36–38% of energy to come from renewables by 2030", (22 October 2021), *https://www.reuters.com/business/energy/japan-aims-36-38-energy-come-renewables-by-2030-2021-10-22/*.
[11] ESG News, "South Korea Unveils $313 Billion Green Financing Plan to Combat Climate Change" (25 March 2024), *https://esgnews.com/south-korea-unveils-313-billion-green-financing-plan-to-combat-climate-change/*.
[12] S&P Global, "EU Parliament greenlights gas, nuclear in green taxonomy in final vote" (6 July 2022), *https://esgnews.com/south-korea-unveils-313-billion-green-financing-plan-to-combat-climate-change/*.
[13] Energy.gov, Loan Programmes Office, "Inflation Reduction Act of 2022", *https://www.energy.gov/lpo/inflation-reduction-act-2022*.

the remaining 45% decreasing fossil fuel financing during such period.[14] Although 49 out of the world's 60 largest banks committed to net zero emission targets and many others introduced restrictions on lending to fossil fuel projects,[15] the International Energy Agency (IEA)'s *Oil 2023* report found that global upstream investments in oil and gas are on track to reach their highest levels since 2015.[16] Furthermore, those 60 largest banks have together invested $5.5 trillion in fossil fuel companies between 2016 and 2023.[17]

Many development finance institutions (which, alongside ECAs and commercial banks, have traditionally been the main sources of debt financing for oil and gas projects) have also introduced policies that prevent or restrict their ability to finance oil and gas projects. Whilst such institutions' lending policies have been informed by government policy and investor or customer pressure, sources of private capital with different investor considerations have become a more important source of debt financing to fossil fuel projects. For example, the eight largest buyout funds in the world collectively oversee US$216 billion worth of fossil-fuel assets, and many private equity firms are vocal about the need for the oil and gas sector to invest significantly in emission-reducing technologies such as carbon capture and storage (CCS), green hydrogen and ammonia, and sustainable aviation fuels.[18], [19]

In the capital markets, asset managers are continuing to develop ESG policy initiatives which guide investment decisions. Some leading asset managers have moved to exclude thermal coal, arctic oil and oil sands from their investment funds.[20] In addition, certain sovereign wealth funds and pension funds are divesting their oil and gas assets entirely.[21] However, significant capital market investment in fossil fuels prevails. As of 2023, the 25 largest asset managers in Europe and five largest in the US collectively invested US$3.5 billion in bonds over the preceding 18 months.[22]

Across the spectrum of investors, lending policies have been, or may need to be, revisited in the context of technological advances to reduce GHG emissions from fossil fuel projects (including, for example, through the use of carbon capture technology). Just as some governments have been struggling to come to terms with the role of oil and gas in the energy transition amidst rapidly evolving technologies and competing claims about their efficiencies and impacts, so are lenders being required to balance the competing interests of lobbying groups in determining sustainable lending policies.

Whether or not a particular bank, investment firm and fund chooses to continue investing in fossil fuel projects and on what basis, it seems clear that an assessment will need to be made with respect to climate impact.

Allocating investments between fossil fuels and renewables

In 2021, investment in renewable energy sources accounted for the majority of annual investments in power generation despite energy from renewable sources representing only 13% of total power generation.[23] According to the IEA, as of 2023, for every US$1 spent globally on fossil fuels, US$1.70 is spent on clean energy technologies.[24]

However, even with increased investment when compared to fossil fuels, investment levels in clean energy technologies remain far below what is required to bring about a peak and decline in fossil fuel use globally.[25] According to the IEA, for every US$1 spent on fossil fuels, US$5 should be spent on clean energy and another US$4 on efficiency and end-use to achieve net zero emissions in 2050.[26]

The level of investment into renewable power in different regions is impacted by a number of factors, including the cost of capital in emerging markets. For example, the cost of capital for a solar project in 2021 was found to be between two to three times more expensive in emerging markets than in advanced economies and China.[27]

On the other hand, the record prices for oil and gas in 2022 meant that global net income from oil and gas production was estimated to reach nearly US$4 trillion.[28]

[14] CNBC, "These are the world's largest banks that are increasing and decreasing their fossil fuel financing" (April 2022), *https://www.cnbc.com/2021/04/22/which-banks-are-increasing-decreasing-fossil-fuel-financing-.html*.
[15] *The Banker*, "Cover story: Why are banks still financing fossil fuels?" (October 2023).
[16] IEA, *Oil 2023: Analysis and forecast to 2028* (June 2023), *https://iea.blob.core.windows.net/assets/6ff5beb7-a9f9-489f-9d71-fd221b88c66e/Oil2023.pdf*.
[17] Banking on Climate Chaos—Fossil Fuel Finance Report 2023, *https://www.bankingonclimatechaos.org/wp-content/uploads/2023/08/BOCC_2023_vF.pdf*.
[18] CBS News, "Movement to defund fossil fuels is coming for the private equity industry" (September 2022), *https://www.cbsnews.com/news/private-equity-fossil-fuels-defund-climate-finance-pollution/*.
[19] Private Equity News, "PE firms defend oil and gas investments" (September 2022), *https://www.penews.com/articles/pe-firms-defend-oil-and-gas-investments-20220915*.
[20] Robeco press release, "Robeco extends exclusion of investments in fossil fuels to all its funds" (24 September 2020), *https://www.robeco.com/files/docm/docu-20200924-press-release-fossil-fuel.pdf*.
[21] S&P Global Ratings, "A cross-sector look at the energy transition", *https://www.spglobal.com/_assets/documents/corporate/31-08-2022-infrastructure-and-energy-outlook-august-2022-eng.pdf*.
[22] *Capital Monitor*, "Asset managers continue to fund fossil fuel expansion" (July 2023), *https://capitalmonitor.ai/asset-class/fixed-income/asset-managers-continue-to-fund-fossil-fuel-expansion/*.
[23] *BP Statistical Review of World Energy 2022*, *https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2022-full-report.pdf*.
[24] International Energy Agency, "World Energy Investment 2023 – Overview and Key Findings", *https://www.iea.org/reports/world-energy-investment-2023/overview-and-key-findings*.
[25] International Energy Agency, *World Energy Outlook 2022*, *https://www.iea.org/reports/world-energy-outlook-2022*.
[26] International Energy Agency, *World Energy Outlook 2022*.
[27] International Energy Agency, *World Energy Outlook 2022*.
[28] International Energy Agency, *World Energy Outlook 2022*.

The total debt of private oil and gas companies is reported to have reduced by approximately US$180 billion between 2020 and 2022.[29]

Both McKinsey[30] and S&P[31] have forecasted that investments in gas will likely have a dual purpose going forward and that there will be continued investment in repurposing assets which would otherwise have been stranded due to the transition to green energy. For example, power plants and pipes can be used to supply hydrogen, natural gas networks can be used to transport biomethane and hydrogen, oil refineries can be modified for use as bio-refineries and salt caverns which store natural gas could be used to store hydrogen.[32]

There are already shifts in this direction. For example, as of 2020, two refineries in Italy, one in France and five in the US underwent full conversions to produce only biofuels, while several others remained capable of processing fossil fuels but added biofuel processing capacity.[33]

Clean energy investment

The outlook for continued investment in renewable projects in the long term remains positive. Since 2020, the IEA Government Energy Spending Tracker estimated that governments had allocated US$343 billion for clean energy investment.[34] In addition to increased investment, lawmakers have removed several barriers to the development of renewables projects.

For example, a major historical challenge facing investment in renewables projects in the US and Europe is the difficulty in obtaining permits for these projects. We are now seeing regulators seeking to address these hurdles to expedite investment. For example, REPowerEU has required EU Member States to establish "renewables go-to areas" which are designated areas where the process for obtaining permits for renewables investments is accelerated.[35]

In 2021, the EU implemented the "Fit for 55" proposal which targets decreasing the EU's emissions by at least 55% by 2030.[36] The proposal includes measures such as revising energy taxation; increasing the percentage of renewable energy in the energy mix to 40% by 2030; shifting dependence on natural gas to renewable and low carbon gases; reforming the EU emissions trading system; establishing a carbon border adjustment mechanism (to ensure that production is not relocated to non-EU countries negating the EU's emissions reducing efforts within its Member States); and seeking to increase use of sustainable aviation fuels and renewable and low-carbon fuels in maritime transport through the ReFuelEU Aviation and FuelEU Maritime regulations.[37]

The Inflation Reduction Act commits US$370 billion for investments in clean energy and climate action and supports a number of clean energy technologies including solar, wind, electric vehicles, carbon capture and hydrogen.[38] This is in addition to the US$190 billion committed under the Infrastructure Investment and Jobs Act 2021 for investing in clean energy and emissions reduction technologies along with improving the electrical grid and other core infrastructure.[39]

Private equity funds and asset managers are increasing investments in renewables and low carbon fuels, with multibillion-dollar funds dedicated to achieving net zero attracting investment from pension plans, sovereign wealth funds, insurance companies, financial institutions and family offices.

Financing carbon capture, usage and storage (CCUS) projects

Although current investment in CCUS projects accounts for a very small share of global investment in clean energy and efficiency technologies, the CCUS market has seen a recent and rapid increase in growth. In 2023 alone, the capacity of all CCUS facilities in development has increased by more than 40%.[40] If all CCUS projects that are currently planned are realised by 2030, the global CCUS capacity will increase 12 times.[41]

Operational CCUS facilities are largely concentrated in North America, with the US announcing 73 new facilities in 2023.[42] The American CCUS sector developed historically as a means to enhance oil recoveries in the region, which has led to the development of CO2 infrastructure such as an extensive pipeline network in some states. However, the recent increase in CCUS

[29] Center on Global Energy Policy (Columbia University), *Investing in Oil and Gas Transition Assets En Route to Net Zero* (2 March 2023), *https://www.energypolicy.columbia.edu/publications/investing-in-oil-and-gas-transition-assets-en-route-to-net-zero-2/#:~:text=The%20total%20debt%20of%20private,%2C%20Figure%20A%2D1)*.
[30] McKinsey & Co, "Converting refineries to renewable fuels: no simple switch" (21 June 2023), *https://www.mckinsey.com/industries/oil-and-gas/our-insights/converting-refineries-to-renewable-fuels-no-simple-switch*.
[31] S&P Global Ratings, "A cross-sector look at the energy transition".
[32] S&P Global Ratings, "A cross-sector look at the energy transition".
[33] S&P Global Commodity Insights: "Reduce, repurpose, reinvent: Long-term refinery outlook defined by diverging regional imperatives", *https://www.spglobal.com/commodityinsights/en/ci/research-analysis/reduce-repurpose-reinvent-longterm-refinery-outlook.html*.
[34] International Energy Agency, *World Energy Investment 2022* (June 2022), *https://www.iea.org/reports/world-energy-investment-2022*.
[35] European Commission, "RePowerEU: new mapping tool supports identification of go-to areas for renewables" (18 May 2022), *https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/repowereu-new-mapping-tool-supports-identification-go-areas-renewables-2022-05-18_en*.
[36] European Commission, press release, "Commission welcomes completion of key 'Fit for 55' putting EU on track to exceed 2030 targets legislation" (9 October 2023), *https://ec.europa.eu/commission/presscorner/detail/en/IP_23_4754*.
[37] Council of the European Union, *Fit for 55*, *https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55/*.
[38] The White House, *BUILDING A CLEAN ENERGY ECONOMY: A GUIDEBOOK TO THE INFLATION REDUCTION ACT'S INVESTMENTS IN CLEAN ENERGY AND CLIMATE ACTION* (January 2023), *https://www.whitehouse.gov/wp-content/uploads/2022/12/Inflation-Reduction-Act-Guidebook.pdf*.
[39] The White House, *BUILDING A CLEAN ENERGY ECONOMY: A GUIDEBOOK TO THE INFLATION REDUCTION ACT'S INVESTMENTS IN CLEAN ENERGY AND CLIMATE ACTION* (January 2023), *https://www.whitehouse.gov/wp-content/uploads/2022/12/Inflation-Reduction-Act-Guidebook.pdf*.
[40] McKinsey & Co, "Global Energy Perspective 2023: CCUS outlook" (24 January 2024), *https://www.mckinsey.com/industries/oil-and-gas/our-insights/global-energy-perspective-2023-ccus-outlook*.
[41] McKinsey & Co, "Global Energy Perspective 2023: CCUS outlook" (24 January 2024).
[42] Carbon Capture Journal, "2023 Global Status of CCS Report" (13 November 2023), *https://www.carboncapturejournal.com/news/2023-global-status-of-ccs-report/5862.aspx?Category=all#:~:text=Increasing%20momentum%20for%20carbon%20capture,351%20projects%20in%20development%20worldwide*.

investment in the US has been driven by revenue support both at the state and federal level (e.g. low carbon fuel standard credits from California and federal tax credits) that is focused on emission reduction.[43]

Outside of North America, revenue support for CCUS projects has in the past primarily relied upon voluntary carbon credits. However, many other governments are introducing revenue support packages to stimulate investments in the sector. For example, the UK government has pledged up to £20 billion for UK CCUS projects,[44] and is negotiating business models with those projects that have been selected to form the first project "clusters" in the UK.[45]

The EU Innovation Fund, which aims to invest up to €30 billion by 2030 for clean energy initiatives, selected four carbon capture projects in its 2021 first call for grants out of a total seven successful applicants across sectors.[46] As of 2024, the Innovation Fund supports 26 industrial carbon management projects, with investments totalling more than €3.3 billion.[47]

The largest CCUS project outside of North America has been announced in Saudi Arabia, and a number of projects have been announced or are under development in the Asia-Pacific region. In each case, government support is critical to attract the debt financing needed to meet the significant capital cost required.

Financing battery manufacture and storage projects

The role of batteries in the clean energy transition cannot be understated. Battery storage enables utilities and grid operators to ensure that the electrical system remains dependable when faced with intermittent renewable energy sources such as wind and solar, and battery production is critical to meet the escalating electric vehicle market. The UK government has demonstrated focus on attracting investment for battery storage projects: the Department for Business, Energy and Industrial Strategy (BEIS) provided over £32 million to five winners of the Longer Duration Energy Storage (LODES) competition, which aimed to scale up energy storage technologies and capabilities.[48] The BEIS also approved a number of battery energy storage system (BESS) projects in the UK last year, including: (i) planning permission for three grid-scale battery energy storage systems in the UK with a total capacity of 221 MW;[49] (ii) investment in a 200MW/400MWh battery energy storage system (BESS) in Scotland;[50] and (iii) a three-hour duration 171MWh BESS in England.[51] Investment in the UK to date has been significant, evidenced by the UK deploying 833MW of battery energy storage in 2022: a significant contribution to Europe's total 4.5 GW of battery storage capacity that year.[52] Globally, the size of global energy storage capacity has been equal to 67% of year-on-year growth, and BloombergNEF has forecast a 23% compound annual growth rate until 2030.[53]

Whilst the outlook for such projects is optimistic, challenges of financing such projects persist. A key obstacle in the UK is that the revenue stream from a battery storage project is complex and potentially uncertain, which could explain why profits in battery storage projects in 2023 have seen a drop of 71% compared to the highs of 2021 and 2022.[54] Volatility in energy prices, as we have seen over the last year, could signal potentially higher revenues for battery projects; however, this could also lead to unexpected use of battery assets leading to quicker-than-expected degradation.[55] The development of onshore and offshore wind projects have broken new records in the UK (generating over 21.8 GW for the first time in December 2023),[56] largely in part due to a well-established contracts-for-difference (CfD) mechanism designed to provide the generator with a stable and certain price over the lifetime of the contract. However, a similar regime does not currently exist for battery storage projects, with revenue streams often made

[43] Congressional Budget Office, "Carbon Capture and Storage in the United States" (December 2023), *https://www.cbo.gov/publication/59832*.
[44] Global CCS Institute, "The UK Government Unveils Significant CCS Funding in 2023 Spring Budget" (16 March 2023), *https://www.globalccsinstitute.com/news-media/press-room/media-releases/the-uk-government-unveils-significant-ccs-funding-in-2023-spring-budget/*.
[45] Carbon Capture and Storage Association, "Government sets out next steps for CCUS Clusters" (30 March 2023), *https://www.ccsassociation.org/all-news/ccsa-news/government-sets-out-next-steps-for-ccus-clusters/*.
[46] Global CCS Institute, "Four CCS Projects to be Funded through the EU Innovation Fund" (17 November 2021), *https://www.globalccsinstitute.com/news-media/latest-news/three-ccs-projects-to-be-funded-through-the-eu-innovation-fund/*.
[47] European Commission, "Carbon capture, storage and utilisation" (2024), *https://energy.ec.europa.eu/topics/oil-gas-and-coal/carbon-capture-storage-and-utilisation_en*.
[48] Solar Power Portal, "Five UK-based long-duration energy storage projects to receive over £32 million in BEIS funding" (28 November 2022), *https://www.solarpowerportal.co.uk/five_uk_based_long_duration_energy_projects_to_receive_over_32_million_in_b/#:~:text=In%20a%20bid%20to%20boost,Energy%20Storage%20(LODES)%20competition*.
[49] Solar Power Portal, "EDF secures planning permission for three grid-scale BESS projects" (15 September 2023), *https://www.solarpowerportal.co.uk/edf_secures_planning_permission_for_three_grid_scale_bess_projects/*.
[50] Solar Power Portal, "Banks Renewables to invest £100m in 400MWh BESS in Scotland" (6 October 2023), *https://www.solarpowerportal.co.uk/banks-renewables-to-invest-100m-in-400mwh-bess-in-scotland/*.
[51] Solar Power Portal, "BayWa r.e. given greenlight for 171MWh three-hour BESS" (12 October 2023), *https://www.solarpowerportal.co.uk/baywa-r-e-given-greenlight-for-171mwh-three-hour-bess/*.
[52] Solar Power Portal, "UK deploys almost 1GW of battery energy storage in 2022 as Europe hits 4.5GW capacity" (20 April 2023), *https://www.solarpowerportal.co.uk/uk_deploys_almost_1gw_of_battery_storage_as_europe_hits_4-5gw_capacity/#:~:text=The%20UK%20deployed%20833MW%20of,and%20Aurora%20Energy%20Research%20respectively*.
[53] Energy Storage News, "Global energy storage market to experience 23% CAGR until 2030 – BNEF" (27 March 2023), *https://www.energy-storage.news/global-energy-storage-market-to-experience-23-cagr-until-2030-bnef/*.
[54] LCP Delta, *press release* (12 September 2023), *https://delta.lcp.com/press-release/gb-bess-storage-profits-have-seen-a-major-downturn-in-2023-increasing-the-need-for-investors-to-adopt-sophisticated-strategies-to-maintain-profitability-lcp-delta/*.
[55] "What Investors Want to Know: Project-Financed Battery Energy Storage Systems" *Fitch Ratings* (20 June 2023), *https://www.fitchratings.com/research/infrastructure-project-finance/what-investors-want-to-know-project-financed-battery-energy-storage-systems-20-06-2023*.
[56] "Wind turbines generate more than half of UK's electricity due to Storm Pia" *The Guardian* (21 December 2023), *https://www.theguardian.com/environment/2023/dec/21/wind-turbines-more-than-half-uk-electricity-storm-pia*.

up of a combination of: (i) wholesale market revenues; (ii) long-term contracts with the National Grid; and (iii) capacity market revenues.

Financing arrangements have been able to mitigate the risks associated with this typical "stack" of revenue streams by requiring a greater proportion of equity funding (as compared to renewables projects) or implementing cash sweep mechanisms, but it is clear that initiatives by the UK public sector to stabilise income streams will de-risk battery storage financings and provide greater opportunities for projects of this kind to be developed.

Meanwhile, the debt financing of battery gigafactories has witnessed a steep growth, with at least 22 battery gigafactories planned in Europe alone. Production capacity is set to rise from 460 GWh in 2025 to 730 GWh in 2030.[57]

Financing green hydrogen projects

The exponential growth in investments into green hydrogen in recent years has been remarkable, with announcements made around the world into green hydrogen projects for domestic/regional industrial use (such as steel production in Scandinavia), domestic fertilizer production (such as in the US), and for the export of green ammonia. Similar to the development of CCUS, these projects require government support to be competitive in the near-term, as compared to existing hydrogen production projects, which use unabated natural gas or coal production technologies that result in significant carbon emissions into the atmosphere.

While many "giga-scale" green hydrogen projects have been announced for the future, a liquid market for green hydrogen is presently lacking, which creates a challenge for the negotiation of the long-term offtake contracts necessary to attract project financing.[58] Public sector involvement to underwrite such risks would increase bankability, along with other novel financing instruments to blend public and private capital[59]—increasing investor confidence and boosting project financings of green hydrogen projects.

Financiers will also be wary of the technology risk that comes with hydrogen projects. Although electrolysis technology is by no means new, there is at present a limited track record for electrolyser deployment in hydrogen projects. With greater electrolyser deployment at scale, costs are expected to fall and technology advancements likely to increase. However, for first-move projects, lenders will expect to carefully examine constructor and electrolyser manufacturer warranties in order to de-risk technology exposure—with material maintenance reserves and warranties (supported by insurance and necessary credit support). Hydrogen projects are therefore expected to be expensive for first-mover developers, creating a barrier for certain prospective market entrants.

Financing renewable energy projects

The UK's offshore wind capacity can somewhat be considered its crown jewel in terms of its clean energy ambitions. The UK's pipeline of offshore wind projects has reached almost 98 GW as of June 2023, second only to China with 157 GW.[60]

The marked expansion of the UK's offshore wind industry is in no small part due to the aforementioned CfD mechanism which ensures a guarantee of a steady revenue stream, allowing project developers to access financing at lower interest rates.

Whilst pricing challenges persist, as shown by the UK government's failure to attract any offshore wind bids at the latest CfD allocation round five,[61] government support is clearly vital in ensuring a thriving renewables sector. Starting in March 2023, the UK government has committed to annual CfD auctions rather than the previous biennial auctions to maintain public sector support and ensure that debt financing remains attractive.

Conclusion

It is predicted that fossil fuels will continue to play an important part in the energy transition in light of energy security considerations and affordability concerns. Russia's invasion of Ukraine and the ensuing embargoes and sanctions propelled governments to increase their trade of natural gas and to consider longer-term solutions for energy independence and secured investment in renewables. This trend may only be exacerbated by the continuing instability in some oil and gas-producing regions.

In parallel, there is currently insufficient renewable capacity to support energy demand and insufficient storage capacity for renewable energy to cater for fluctuations in seasonal demands.

Financings of CCUS, battery storage and clean hydrogen projects are gaining momentum. Despite considerable activity in this space, greater public sector support—similar to the CfD mechanism that the UK government used successfully in the context of offshore wind—will be needed to fast-track these types of projects and accelerate the energy transition.

[57] Transport & Environment, "Batteries" (November 2023), *https://www.transportenvironment.org/challenges/cars/batteries/#:~:text=Gigafactories,to%20730%20GWh%20in%202030*.
[58] S&P Global, "Source and scale are biggest challenges as hydrogen interest grows", *https://www.spglobal.com/en/research-insights/articles/source-and-scale-are-biggest-challenges-as-hydrogen-interest-grows*.
[59] World Economic Forum, "3 ways to accelerate financing for clean hydrogen projects" (12 January 2023), *https://www.weforum.org/agenda/2023/01/davos23-accelerate-financing-clean-hydrogen-projects/*.
[60] RenewableUK, "UK Offshore Wind pipeline nears 100GW as Global pipeline tops 1.23TW" (12 June 2023), *https://www.renewableuk.com/news/643056/UK-Offshore-Wind-pipeline-nears-100GW-as-Global-pipeline-tops-1.23TW.htm#:~:text=12%20June%202023&text=The%20pipeline%20includes%20projects%20at,under%20construction%2C%20consented%20or%20planned.&text=The%20UK%20total%20pipeline%20was,and%20Brazil%20fifth%20with%2063GW*.
[61] "Offshore wind drops out of UK auction on costs, risking climate goals" *Reuters* (8 September 2023), *https://www.reuters.com/sustainability/climate-energy/latest-uk-renewables-auction-fails-attract-offshore-wind-bids-2023-09-08/*.

The key concerns for policy makers and investors will therefore be: (i) balancing short-term needs for affordable power and long-term needs for renewable output and clean energy solutions; and (ii) ensuring that reductions in fossil fuel investments are sequenced such that they do not decline at a rate faster than investment in clean technology.