

Challenges in the Electricity Sector: 2025–2050

10 GW OF CCS POWER IS CRUCIAL FOR UK'S ENERGY TRANSITION

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GE VERNOVA



10 GW OF CARBON CAPTURE AND SEQUESTRATION (CCS) POWER CAN BE CRUCIAL TO HELP REDUCE CARBON EMISSIONS IN THE UK POWER SECTOR BY 2035

To help meet the UK's 2050 net zero target, legally binding five-year 'carbon budgets' are set at least 12 years in advance by the Climate Change Committee (CCC), acting as steps aimed towards the 2050 target. Each carbon budget sets the pathway to net zero emissions for the UK across all sectors as well as a pathway for each individual sector. To date, six carbon budgets have been set which aim to limit emissions across all sectors to approximately 78% of 1990 levels by 2037. CCC also performs an analysis to project a Balanced Net Zero Pathway, which recommends a generation portfolio for the electricity sector that helps comply with the carbon budgets and supports other sectors transition to net zero. The most recent carbon budget calls for gas power with CCS to generate 30 TWh, or 6% of UK electricity in 2035.¹ Similarly, analysis by the Department for Energy Security and Net Zero (DESNZ)², recognises the need for up to 10 GW of power generation capacity with CCS by 2035.

In addition, National Grid and Scottish & Southern Energy (SSE) forecast a need of a total of 32 GW of gas with CCS in a low carbon power system. For England, National Grid³ calls for nearly 17 GW of gas with CCS capacity in 2050. For Scotland, SSE⁴ calls for 15 GW in the same year. Furthermore, a GE Vernova study, Reaching Net Zero Carbon in Great Britain⁵, found that over 27 GW of gas with CCS capacity is required in 2050 to help reduce the total cost of a net zero electricity system which also supports electrification of heating, transportation, and industry. For all cases, ~1 GW of new gas with CCS capacity would need to come online every year on average from 2027–2050. Aiming to achieve this rate of growth is important in economically decarbonising* the power sector.

GE Vernova’s Reaching Net Zero Carbon in Great Britain analysis (see Figure 2) found that the Base Case power system (B), with 27.2 GW of gas with CCS, is projected to have a wholesale levelised cost of electricity that is 23% lower in 2035 than a High Wind system (A) with only 3.2 GW of gas with CCS, which was examined as a sensitivity case. Costs in the High Wind Sensitivity case (A) are driven higher relative to the Base Case (B) by capital and fixed costs, as more installed capacity is required to maintain reliability by compensating for renewable derating factors and increased curtailment.

*Decarbonisation in this paper is intended to mean the reduction of carbon emissions on a kilogram per megawatt hour basis

Base Case Capacity Expansion (GW)

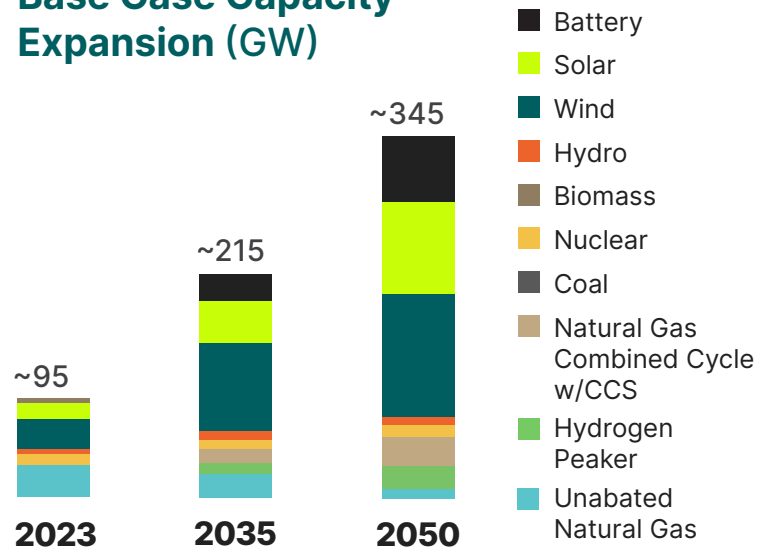


Figure 1 - Base Case Capacity Expansion

Source: GE Vernova’s Consulting Services business model



The UK has a detailed vision for the creation of a competitive marketplace for CCS in three phases.⁶ Phase 1 includes the creation of a CCS segment for 20–30 megatonnes per annum (Mtpa) CO₂ by 2030. The industry shall cover four operational clusters with the respective transport and storage (T&S) infrastructure underway as well as first CCS projects deployed across all major sectors. Phase 2 is from 2030 to 2035 and will be focused on the expansion of the industry as well as the transition to competitiveness. The confidence in CO₂ storage increases and additional capture projects continue to deploy, the UK expects a diminishing need for Government financial support. Phase 3 represents the time from 2035 onwards, during which, the CCS segment is aiming to be self-sustaining and thus requiring little financial support from Government. According to the UK's vision, the storage sites will not only be competitively pricing their services domestically but also internationally. It also states that the required T&S infrastructure will be available and capture projects will continue to support the Net Zero goal by 2050. With this foundation for delivering the needed support in place, the next step is successful development of the UK's first gas with CCS power plant. The three CCS power projects shortlisted for Government revenue support so far: Net Zero Teesside Power, Whitetail Clean Energy and Keadby 3 Carbon Capture Power Station, could contribute to 14–21% of the annual

capture capacity needed by 2030.⁷ Given the long-cycle nature of such large infrastructure projects however, it is important that those plants move forward swiftly with their Final Investment Decision (FID), construction and commissioning. Additional projects are now need to support the ambitious 2035 goal.

To enable FID, the UK has devoted substantial resources to develop business models that guarantee the financial viability of emerging technologies. Specifically, the establishment of a dedicated contract, Dispatchable Power Agreement (DPA), ensures that gas power plants equipped with CCS can be dispatched before unabated gas power plants. These DPAs are set to receive support from the £20 billion earmarked by the UK Government for CCS in the spring of 2023.

Staying on schedule for awarding this funding is paramount in successful execution of the Net Zero Strategy. On the other hand, delays in FID and subsequent delays in operational readiness of those projects can have significant negative consequences for the environment and the domestic economy.

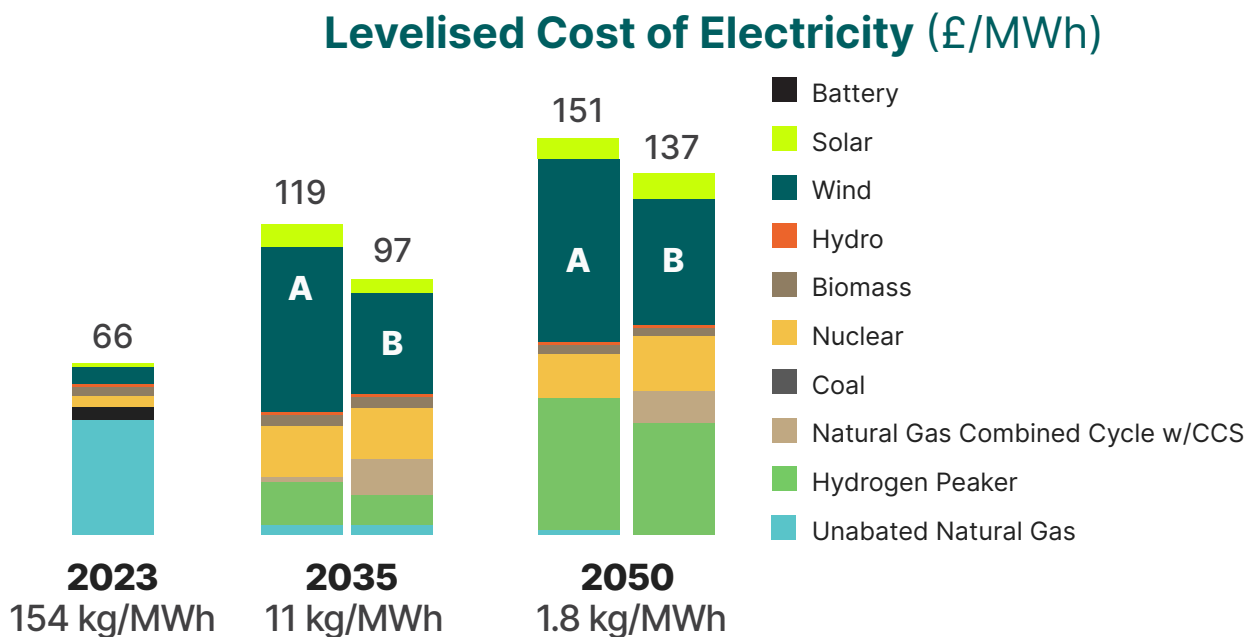


Figure 2 - Levelised Cost of Electricity
Source: GE Vernova's Consulting Services business model

OPPORTUNITIES

1 LOWER SYSTEM COST

As highlighted in GE Vernova's study above, emissions reduction can be achieved at a lower total system cost by combining the forces of renewables and abated gas turbines. Despite short-term cost pressures on lower-carbon power generation resources of all kinds, investing in gas power with CCS is projected to make decarbonising the UK power sector more affordable.

2 JOB CREATION & TRANSITION

We expect the emerging CCS industry to not only create new direct and indirect jobs, but also to contribute to upskill UK workers as those projects require specialised skills and expertise. According to the UK Government's CCS Vision the CCS industry is expected to deliver up to 50,000 jobs by 2030.

According to a report prepared by Vivid Economics for Net Zero Teesside (NZT),⁸ it is estimated that NZT will generate 4,500 direct jobs annually from 2024 to 2028. Furthermore, national deployment could lead to up to 18,000 direct jobs annually by 2030.

3 ECONOMIC GROWTH

The development and expansion of CCS infrastructure can spur growth in related industries such as engineering, construction, and manufacturing, as well as related sectors. Vivid Economics estimates that "national deployment of CCUS could support up to £1.6 billion in direct GVA annually by 2030"⁸.

With continued confidence in the industry, there could be a vast potential for the domestic CCS industry to contribute to economic growth and investment attraction, especially in regions where the technology will be deployed.

4 SUPPLY CHAIN & STORAGE OPPORTUNITIES

On top of the domestic opportunities, there could be an important prospect to generate value globally. The UK is uniquely positioned to become a leader in providing storage services to countries with less favourable geology or policies for storage. The London Protocol, an international agreement that was established to protect the marine environment from pollution caused by waste dumped into the ocean, provides useful guidelines on the types and quantities of material that can be stored enabling the cross-border transportation of CO₂ between participating states.

Vivid Economics estimates that the export of CCUS goods and services could support up to £1.2 billion in direct GVA annually by 2040.

CHALLENGES

1 UNNECESSARY EMISSIONS

First and foremost, delays in the deployment of renewable projects may lead to unnecessary emissions that put at risk the UK's Net Zero goals. According to the CCC, extensive electrification of heat and transport can result in a doubling of electricity demand by 2050. Lower-carbon generation will be key to advance Net Zero objectives and it is therefore essential that the capacity additions come from renewable energy and/or abated technologies such as power generation with CCS. Baringa's report on renewables supply chain readiness highlights the risk of falling short on renewable targets, especially the doubling of the UK's offshore wind fleet to 50 GW by 2030. This increases the urgency of developing other lower-carbon electricity generation sources.



2 LOSING INVESTOR & INDUSTRY CONFIDENCE

Delays in Government decision making can have negative effects on both investor and industry confidence. Investor confidence has been growing with the increased recognition of its importance in mitigating climate change. The allocation of £20 billion Government funding for the sector in 2023 was a significant commitment that contributed to this confidence as well as the advancement of supportive policies and business models. To keep the momentum with investors, it can be useful that the funding is now also allocated to concrete projects like Net Zero Teesside.

There are endless investment opportunities available around the globe and many countries are moving forward with the development of a CCS industry, so there could be a risk that delays in decision making could drive some of the available capital away from the UK to other geographies.

CCS has been embraced as a critical technology in the UK decarbonisation strategy. In response the industry has already invested significant money to support UK power and CCS projects, developing a pipeline that is close to meeting the UK's 2035 ambition. Pausing the timelines could put those companies under pressure, which might lead to abandon projects.

3 LOSING A GLOBAL LEADER POSITION

The UK has been actively positioning itself as a leader in CCS development. The UK Government has initiated various CCS projects and programmes to advance the technology and infrastructure needed for large-scale deployment.

Hesitation to make the necessary decision for funding allocation for the first project could lead to stakeholders questioning the previously expressed commitment. With potentially fading investor and industry confidence this may put the global leadership position at risk to the benefit of other strong players.

CONCLUSIONS

According to the “Countdown to 2035” report of Atkins Réalis in 2024⁹, the UK’s current annual build rate of new energy generation is not sufficient to achieve the ambitious 2035 target for Net Zero and thus puts the security of electrical supply at risk. Their analysis in 2023 found that instead of the required 15.5 GW annual build rate to meet the 2035 system goals, only 4.5 GW were actually built in 2022. Atkins Réalis doubts that it will be realistic to increase the build rate to the required levels in such a short amount of time and urges that swift and low risk deployment is now needed.

In conclusion, the urgency of the energy transition for the UK cannot be overstated. By swiftly deploying abated technologies, such as 10 GW of Power CCS in particular, the country can help address climate change, enhance energy security, stimulate economic growth and assert a role of leadership on the global stage. Delaying the transition only prolongs practices that may impact both the environmental and economic targets. It is imperative for the UK to act decisively on initiated projects like NZT to expedite the transition towards a cleaner, more sustainable energy future.





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