LCP Delta

The Power Market Outlook 2023

Is GB on track to meet net zero power?

Sponsored by SSE

NOVEMBER 2023

Contents

Foreword

The limited recent progress made in the power sector is putting 2030 and 2035 decarbonisation targets at risk

The power sector has been at the forefront of the UK's decarbonisation efforts. Power sector emissions in 2022 had fallen to 74% below 1990 levels, a greater fall than any other sector. But the job is not done. Emissions in the power sector need to continue to decrease significantly to reach key decarbonisation targets for 2030 and 2035.

With its fourth Energy Strategy in three years published earlier this year, the UK government has made many ambitious commitments for the GB power sector. This includes ambitions to more than triple our offshore wind capacity to 50GW by 2030 and fully decarbonise the power sector, subject to security of supply, by 2035.

This new annual report from LCP Delta, sponsored by SSE, provides an assessment of whether the GB power system is on track. It aims to give readers an independent assessment of progress in the power sector and provide government with key recommendations to deliver its established decarbonisation pathway.

Our analysis finds that the limited progress in several key technology areas means the emissions reductions needed to reach the UK's Nationally Determined Contribution (NDC) for 2030 and the fully decarbonised GB power sector target for 2035 are both at risk. The failure of the Allocation Round 5 (AR5) Contract for Difference (CfD) auction to procure any offshore wind is a massive blow to hitting decarbonisation targets, while progress has also stalled in other technology areas, such as Long Duration Storage and Carbon Capture and Storage.

The changing investment landscape over the past 18 months, combined with market uncertainty due to proposed market reforms, means there is additional pressure to attract the private sector investment needed. The government needs to focus on speeding up delivery and help the sector build the assets that are needed to decarbonise.

"Our analysis finds that the limited progress made since COP26 means the UK's 2030 Nationally Determined Contribution (NDC) and the fully decarbonised GB power sector target for 2035 are both at risk."

Chris Matson
Partner

Key Recommendations

The government should look to enact our 8 recommendations to get the decarbonisation of the power sector back on track

1

Procure 25GW across AR6 and AR7:

Auction parameters need to be set to procure 25GW offshore wind across the next two CfD auctions to reach 50GW by 2030.

2

Reform planning:

Planning reforms need to be effective in reducing timelines by at least 2 years to ensure we bring forward all available offshore wind sites where appropriate.

3

Review offshore wind cost estimates:

Urgently review and publish updated offshore wind cost estimates to enable setting of appropriate Administrative Strike Prices (ASPs) in the next CfD auctions.

4

Evolve the CfD framework:

Consider reforms including potential changes and the lengthening of Contract for Differences (CfD) to attract the required bidding for offshore wind projects.

5

Support deployment of LDES:

Establish a competitive cap and floor support mechanism for Long Duration Electricity Storage (LDES) given the acute need for LDES in GB.

6

Deploy 7GW of CCS by 2030:

Recognise the importance of low carbon thermal technologies by aiming to deploy 7GW of Carbon Capture and Storage (CCS) by 2030 to reduce system costs and carbon emissions.

7

Reasonable timelines for policy decisions:

Key policy decisions need to be made in a timely manner to reduce market uncertainty and avoid delays in investment.

8

Account for cost of capital:

Decisions on market reform must account for the impacts that rising cost of capital could have on consumers and the investment required to decarbonise.

Executive Summary

Across the 9 different power sector technologies assessed by LCP Delta, only 2 are on track to reach the levels needed by 2030 and 2035. This is putting NDC and CB6 targets for 2030 and 2035 at risk.

Technology	2022/23 Progress	Achievability of required level
Offshore Wind		
Solar		
Onshore Wind		
Low Carbon Thermal		
Long Duration Electricity Storage		
Short Duration Storage		
Nuclear		
Interconnectors		
Networks		

Limited progress / significant risk to achievability	Some progress / some risk to achievability	Moderate progress / moderate risk	Good progress / on track to achieve	Too early to tell

Significant risk

Nationally Determined Contribution (NDC) for 2030

The power sector needs to decrease emissions from 54MTCO2 in 2023 to 14-17MTCO2 in 2030 to meet the international NDC commitment of 68% reduction in domestic emissions from 1990 levels.

With the lack of progress across key technologies combined with recent announcements lowering ambition in other sectors, meeting the 2030 NDC is looking increasingly unlikely.

Some risk

Carbon Budget 6 (CB6) for 2035

To meet CB6 the government has committed to fully decarbonise the power sector, subject to security of supply, by 2035, with 99% of generation needing to come from low carbon sources.

Enough time remains to achieve this target, but government needs to act quickly to get key technologies back on track to ensure they can reach the levels required.

LCPDelta

Current ambitions for the GB power sector

Modelling the future GB power sector under the government's current commitments and targets

UK Government's current plans for the power sector

To achieve the emissions reduction needed, the government has set out various commitments, ambitions and targets for the GB power sector

Power Sector Targets

Decarbonisation	**Fully decarbonise the power sector,** subject to security of supply, by 2035. This requires 99% of generation to come from low carbon sources.
Offshore Wind	Ambition to deliver up to **50GW of offshore wind by 2030**, with up to 5GW coming from floating offshore wind by 2030.
Nuclear	Ambition to deploy up to **24GW of nuclear power capacity by 2050.**
Solar	Ambition for a **fivefold increase in solar capacity by 2035** to reach 70GW of ground and rooftop capacity together.
Hydrogen	**2030 low carbon hydrogen production target of 10GW**, with electrolysers contributing at least 50% (5GW) of this.
Networks	**Halve the time it takes to build new transmission network infrastructure** and transition to a strategically designed network.
Interconnectors	Aiming for at least **18GW of interconnection capacity by 2030,** over double the current capacity.
Market Reform	**Make decisions on the future electricity market arrangements** through the Review of Electricity Market Arrangements (REMA) programme.

To achieve:

2030 Emissions

Reduce power sector emissions by 69-74%* from 2023 to meet the UK's Nationally Determined Contribution (NDC) as submitted to the UN in 2020.

2035 Emissions

Reduce power sector emissions by 80-83%* from 2023 levels to meet the Carbon Budget 6 (CB6) legally binding domestic target.

Low cost, reliable system

Ensure security of supply, and minimise costs for consumers, whilst electricity demand increases 40-60% by 2035 as other sectors electrify.

*Emission target levels for power sector taken from Net Zero Strategy. 14-17MT in 2030 and 9-11MT in 2035

The Current Ambition scenario

LCP Delta's Current Ambition scenario represents a potential pathway for the power sector that meets government commitments

To assess whether the UK is on track, LCP Delta has created a "*Current Ambition*" scenario that meets each of the government ambitions for the GB power sector and builds further low carbon generation to meet net zero.

The Current Ambition scenario acts as a benchmark and reaches the fully decarbonised target by 2035 and is net zero consistent by 2050. The scenario sees large growth across all low carbon technologies and meets the following government technology ambitions:

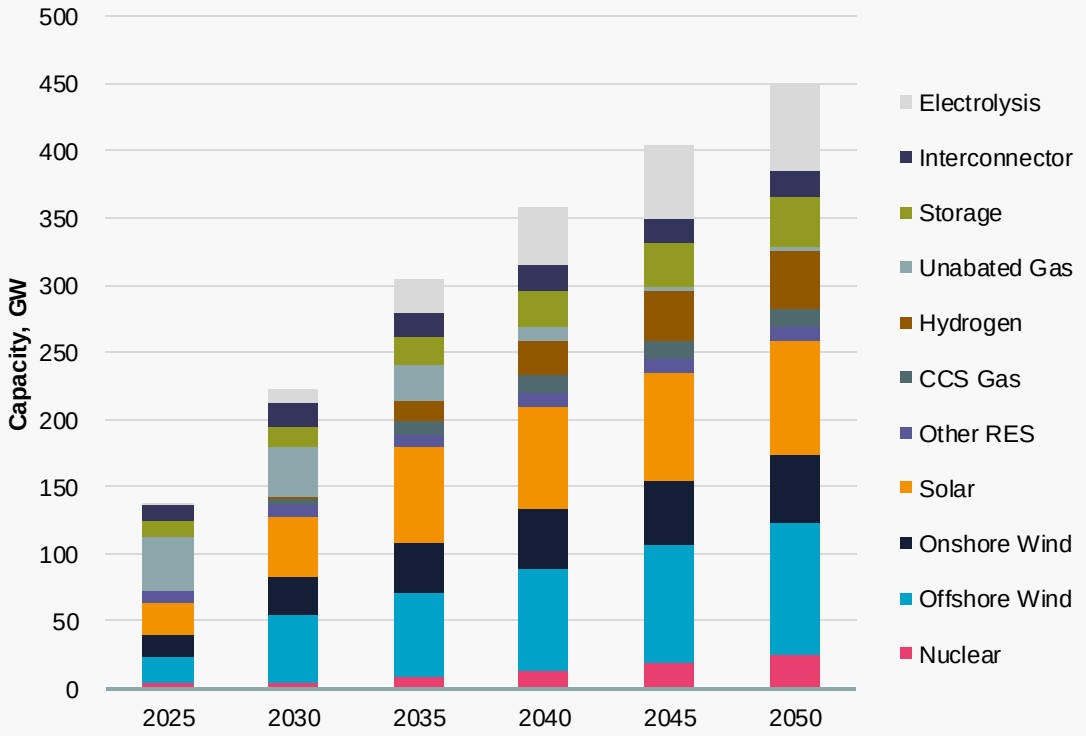
- Offshore wind increases by 3.5x to reach the 50GW ambition in 2030
- Solar increases fivefold to meet the 70GW ambition in 2035
- Nuclear capacity meets the 24GW ambition in 2050
- Interconnector capacity reaches 18GW in 2030

These technologies continue to see their capacity increase through to 2050 to meet net zero while electricity demand increases.

In addition, LCP Delta analysis shows the following technology capacities are needed to deliver a low-cost, reliable power system that meets decarbonisation targets:

- Onshore wind capacity doubles by 2035 to 30GW and reaches 40GW in 2050.
- CCS capacity increases to 10GW by 2035 to ensure the fully decarbonised ambition is met
- Hydrogen capacity becomes the main back-up technology with 45GW added by 2050

Current Ambition scenario Capacity Mix



The Current Ambition scenario

Delivering a potential pathway for the power sector that meets government commitments

To meet the twin challenges of increasing demand and decarbonisation, total renewable generation more than doubles between 2022 and 2035, increasing from 125TWh to over 400TWh. The share of domestic generation that is renewable increases from 42% in 2022 to 82% in 2035.

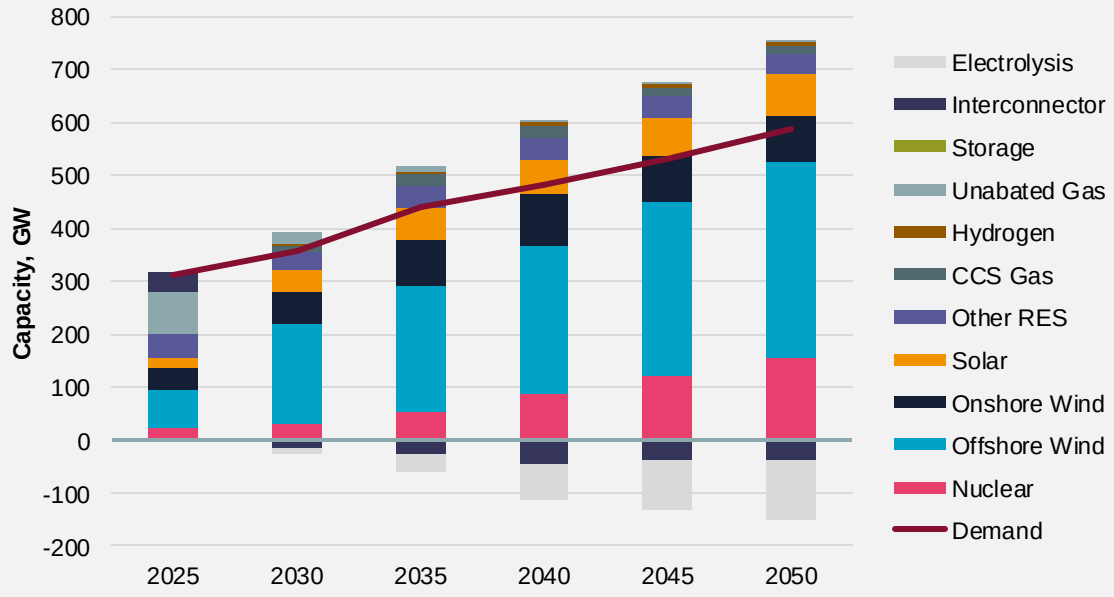
In 2035, 99% of generation is low carbon, meeting the fully decarbonised commitment. In 2022, unabated gas accounted for 40% of domestic generation but this decreases to <1% by 2035.

Emissions intensity in the power sector drops significantly from 140gCO2/kWh in 2024 to 35gCO2/kWh in 2030. This is consistent with emissions reduction required to reach the UK's NDC.

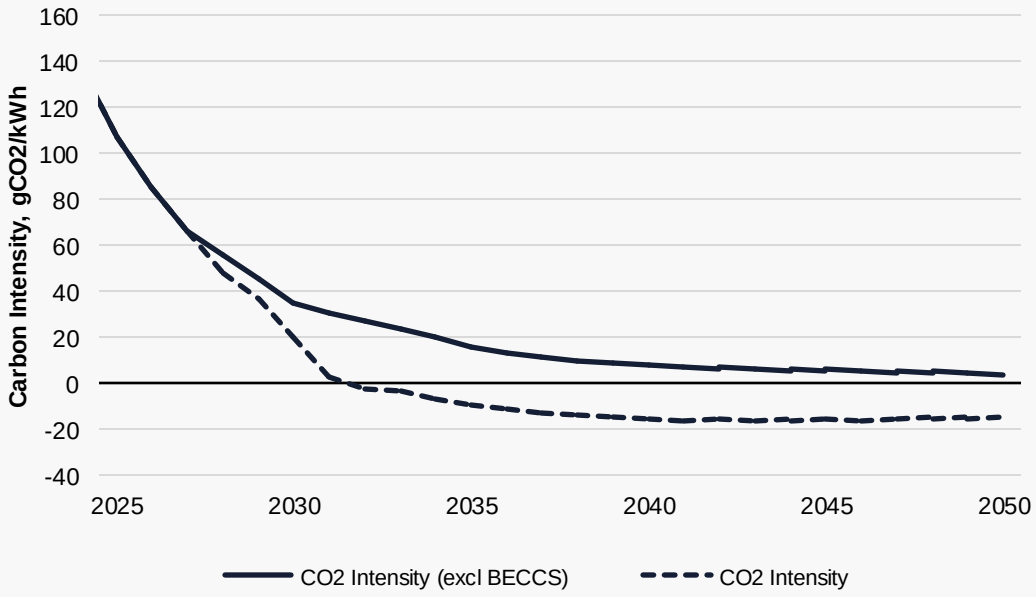
By 2035, this drops to 16gCO2/kWh which is consistent with levels required to meet CB6. And in 2050 emissions intensity is below 5gCO2/kWh consistent with levels needed for net zero.

If BECCS emissions are included within the power sector (which the government does not) then a net zero power sector is reached in 2032 with emissions net negative after this point.

Current Ambition scenario Generation



Current Ambition scenario Emissions Intensity



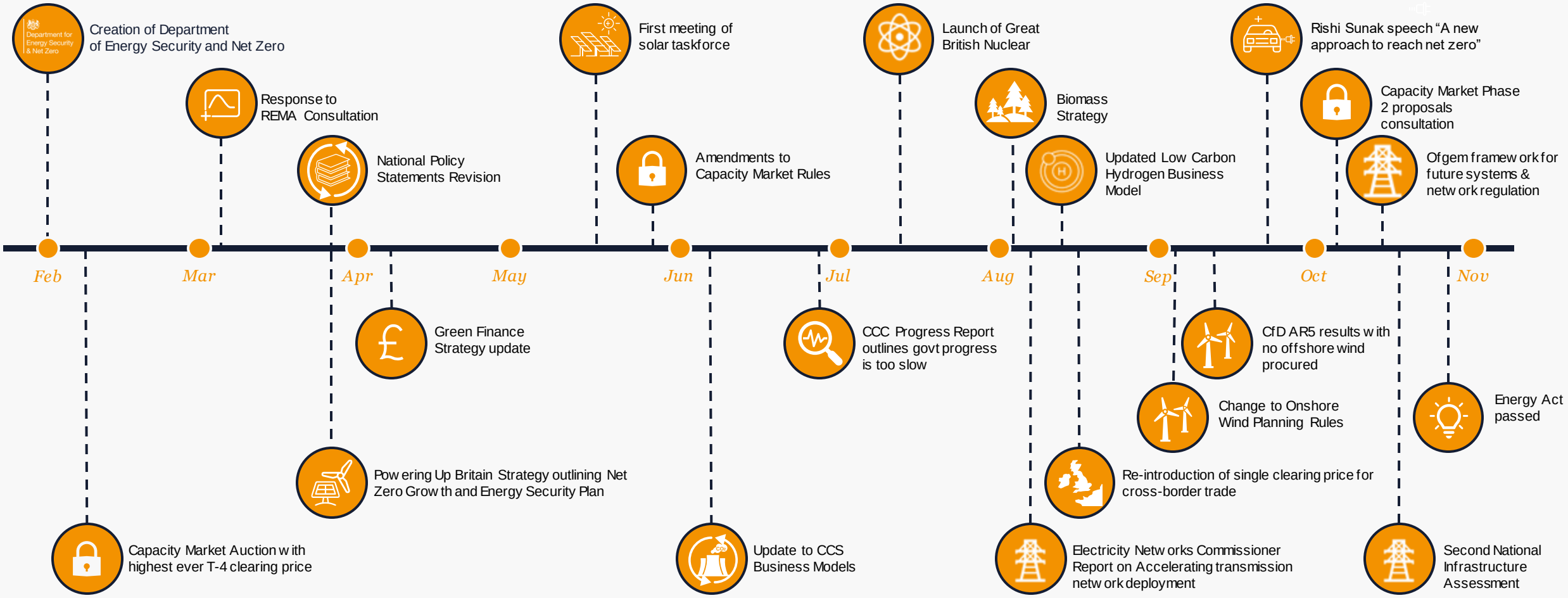
LCP Delta

Is the government on track to meet the Current Ambition scenario?

Assessing progress in 2022/23

Summary of key announcements in 2023

Since the creation of the Department of Energy Security and Net Zero, the government have made many announcements that relate to the power sector



New capacity added to the system in 2022

Last year some new capacity was added to the system, but the rate of build is below the average yearly rate required to meet decarbonisation ambitions

Offshore wind increased by 2.6GW (24%) from 2021 to 2022 to a total installed capacity of 13.9GW. This is still below the average of 4.5GW per year rate needed to reach 50GW by 2030.

Onshore wind increased by 0.3GW (3%) to a total installed capacity of 13.4GW in 2022. This is significantly below the rate needed in the current ambition scenario to reach 30GW by 2030.

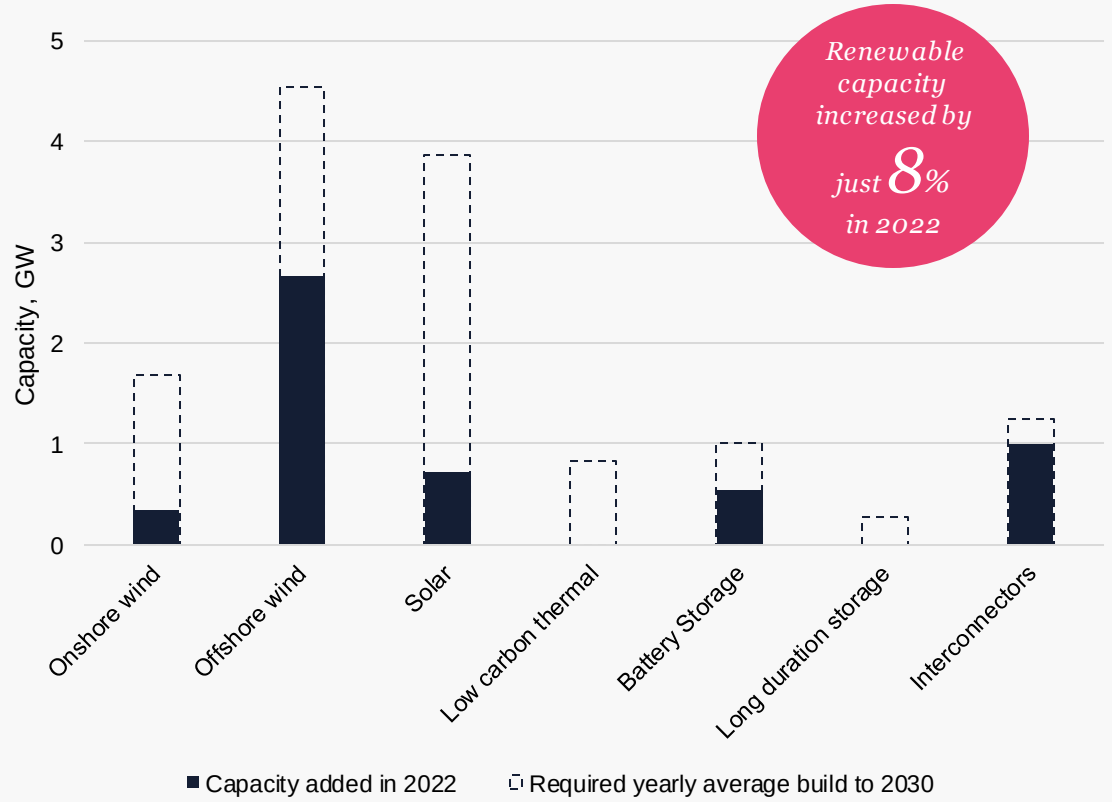
Solar increases by 0.7GW (5%) to 14.2GW in 2022. This is below the 4GW per year rate needed to reach 70GW by 2035 and significantly below 2-4GW a year growth seen from 2014-16.

Interconnection increased by 1GW to a total of 8.4GW in 2022 with the addition of the Eleclink interconnector. This is roughly in line with the required rate to reach 18GW by 2030.

Battery storage increased by 0.5GW in 2022 to reach a total of 1.9GW. We expect this to significantly increase to reach 3GW by the end of 2023 putting battery storage on track to meet 2030 levels needed.

Unabated gas capacity increased by 0.7GW to reach a total of 34.9GW. This is to partly offset decreases in coal and nuclear capacity, which decreased by 1.1GW and 2GW respectively. However, gas capacity will need to decrease in future years to reach the current ambition scenario.

GB capacity change 2021 to 2022 vs required yearly average build to 2030



*Taken from government DUKES publication – data for 2023 not yet available

Summary of progress on government published commitments

While many announcements and strategies were released this year, not enough was achieved to keep government on course to achieve its own power sector ambitions across various technology areas

Area	Offshore Wind	Solar	Nuclear	Interconnectors	Networks
Government Commitment	Ambition to deliver up to 50GW of offshore wind by 2030	Ambition to reach 70GW solar capacity by 2035	Ambition to deploy up to 24GW of nuclear power capacity by 2050	Aiming for at least 18GW of interconnection capacity by 2030	Halve the time it takes to build new Transmission Network infrastructure
Assessment of 2022/23 progress	**Limited progress**	**Some progress**	**Some progress**	**Good progress**	**Moderate progress**
Summary of 2022/23 progress	With only a small amount of offshore wind built in 22/23 and no offshore wind procured in AR5, very limited progress has been made since the 50GW ambition was announced.	A small amount of capacity was added in 22/23 significantly below the rate needed. Meanwhile, 1.9GW solar was procured in AR5 showing some progress. The formation of the Solar Taskforce is also a positive step.	Additional funding for Sizewell C has been provided and the creation of Great British Nuclear is seen as a positive step. No nuclear projects beyond Sizewell C or Hinkley Point C have seen progress.	With the addition of the ElecLink interconnector in 2022, total capacity increased by 1GW to 8GW. The Viking interconnector with Denmark is also due to open at the end of year while the reintroduction of a single clearing price for cross border trade will enable better trading across interconnectors.	Nick Winser's (the UK's Electricity Networks Commissioner) report into accelerating transmission network deployment is a positive step; but only if the recommendations are taken onboard. Publications of key frameworks by ESO and Ofgem have included actions to speed up build and connection dates for new assets.
Achievability of commitment	**Significant risk**	**Some risk**	**Too early to tell**	**On track**	**Too early to tell**
Summary of achievability	There is technically enough capacity with connection agreements to build the extra 25GW needed to achieve the 50GW ambition but with only 7GW having the required planning consent and only up to 3 CfD auctions left to procure pre-2030 offshore wind, time is running out to achieve this ambition.	While the CfD is procuring solar capacity, this is still below the rate needed to reach 70GW by 2035. Other policies and reforms are needed from the Solar Taskforce to make this ambition achievable.	It is too early to tell if this ambition is achievable, but with only 2 nuclear plants in the works (HPC and SZC), more projects need to be bought forward if 24GW is to become a reality.	There is a healthy pipeline of interconnector projects that could come online by 2030 meaning this target is achievable. However, many of these still need approval for Ofgem before build starts. At the current rate the 18GW target is achievable.	It is unclear at this time if this commitment can be met but changes need to be made quickly to accelerate network build to avoid significant constraint issues across the country.

Steps required outside formal targets

LCP Delta's Current Ambition scenario requires significant progress on other technologies to fully decarbonise and ensure a reliable low-cost power system. Limited progress was made on these technologies in 2023.

Area	Onshore Wind	Low carbon thermal	Short Duration Storage	Long Duration Electricity Storage
LCP Delta Recommended level	Double capacity by 2035 to reach 30GW	Need for at least 30GW of new low carbon thermal (hydrogen and / or gas CCS) by 2035 to ensure security of supply	15GW by 2035 with varying levels of duration	At least 5GW additional LDES by 2035
Assessment of 2022/23 progress	**Moderate Progress**	**Some Progress**	**Good Progress**	**Limited Progress**
Summary of 2022/23 progress	Only 0.3GW of onshore wind was added to the system during 2022 taking the total to 13.4GW. However, 1.4GW of onshore wind won a contract in AR5, 0.5GW higher than in AR4. Moderate changes to planning rules for onshore wind in England were also made although it is questionable how much difference these will make to build levels in England.	Business models for both gas CCS and hydrogen to power have been updated in 2023, which gives more certainty to investors in these technologies. However, no project of either CCS or hydrogen has yet reached FID.	Build of short duration storage continues to progress with over 3GW now online and a number of new projects in the pipeline.	Despite the government's commitment to develop an appropriate policy to enable investment in LDES by 2024, nothing has been announced on LDES since the August 2022 response to the LDES Call for Evidence.
Achievability of commitment	**Some risk**	**Significant risk**	**On track**	**Significant risk**
Summary of achievability	At this stage, reaching 30GW of onshore wind by 2035 does seem possible given the success in the last two CfD auction rounds. If onshore wind continues to win contracts at the rate seen in AR5 then it is likely to reach this level by 2035. However, it's uncertain if the changes to planning rules in England announced in September 2023 will be effective to enable the required level of build, as not all capacity can be located in Scotland if this goal is to be achieved.	At least 5GW of gas CCS/hydrogen to power is needed by 2030 to reduce generation from unabated gas. The pipeline of projects to 2030 currently means reaching the level of low carbon thermal technologies required to begin phasing out unabated gas currently seems a long way off. Progress on these technologies will need to speed up if the required build level is to be reached.	With a healthy pipeline of batteries on the horizon then reaching 15GW by 2035 appears to be on track, however with revenues decreasing for batteries in 2023 compared to 2021 and 2022, operators need to develop more sophisticated strategies to be competitive, as outlined in our 2023 Battery investment landscape report.	While there is still time to develop a policy for LDES, this needs to be done quickly to give investors the confidence that is needed to invest in these technologies and reach the level of LDES that is required.

Summary of progress towards power sector decarbonisation targets

Progress across 2023 in the power sector means meeting the power sectors contribution to the 2030 NDC target and the fully decarbonised by 2035 target are now at risk

Decarbonisation period	2030 Nationally Determined Contribution	2035 Carbon Budget 6
Power sector decarbonisation required	The power sector needs to decrease emissions from 54MTCO2 in 2023 to 14-17MTCO2 in 2030 to meet the international NDC commitment of 68% reduction in domestic emissions from 1990 levels.	Fully decarbonise the power sector, subject to security to supply (with 99% of generation from low carbon sources)
Achievability of power sector decarbonisation commitment	**Significant risk**	**Some risk**
Summary of achievability	Meeting the level needed for many technologies to reach the 68-74% emissions reduction required for NDC in 2030 is looking increasingly unlikely. Offshore wind, solar and low carbon thermal are currently not on track to meet required 2030 levels and there is limited optionality for other technologies to fill the gap, meaning this level of emissions reduction in the power sector appears unlikely. Given that the ambition has been reduced in many other sectors (such as the phasing out of internal combustion engine vehicles) by recent government policies, it is even more unlikely that other sectors will be able to reduce their emissions by higher amounts than outlined in the Net Zero Strategy, putting the overall NDC target, not just the power sector contribution, at significant risk.	Enough time remains to achieve this target, but government needs to act quickly to get key technologies back on track to ensure they can reach the levels required to meet the 2035 fully decarbonised target.

LCPDelta

Getting back on track

What is needed to increase chances of reaching decarbonisation targets for the power sector?

Getting back on track

LCP Delta have identified 4 key areas that need immediate focus from the government to get the GB power sector back on track to meet the 2035 target.

At the current rate of change, reaching the fully decarbonised target for 2035 is challenging - but not unachievable.

To ensure that this target can be achieved, new policy and investment is needed from the government to give investors the right signals to enable the build of the key low carbon technologies that are needed.

Based on our assessment on progress in 2023 towards the Current Ambition scenario, the following four areas have been identified as needing additional focus from the government over the next 6 months to improve the chances of reaching decarbonisation targets. These are explored in more detail across the rest of this section, with recommendations provided for each area to get the development of these areas back on track.

Offshore Wind & the CfD

After the offshore wind failure in AR5, changes are needed for the next auction to enable the procurement needed to reach targets.

Low Carbon Thermal

Firm low carbon thermal generation will be needed alongside renewables to ensure the system is balanced without significant use of unabated gas. More progress is needed in this area if this is to be achieved.

Long Duration Electricity Storage

GB has an acute need for long duration electricity storage, but there is currently no government policy to support the development of these technologies.

Changing Investment Landscape

The UK will need large amounts of investment to achieve its power sector commitments. The investment landscape has changed substantially over the last year, and government policy needs to reflect this.

Offshore wind and the CfD

There are enough projects in the pipeline for the 50GW target to remain technically feasible…
…but government planning reforms and CfD auctions must be effective to bring this capacity forward

GB currently has 14GW of offshore wind on the system. An additional 13GW already has a CfD agreement; leaving a gap of 23GW to reach the 50GW ambition (excluding the recent suspension of Norfolk Boreas).

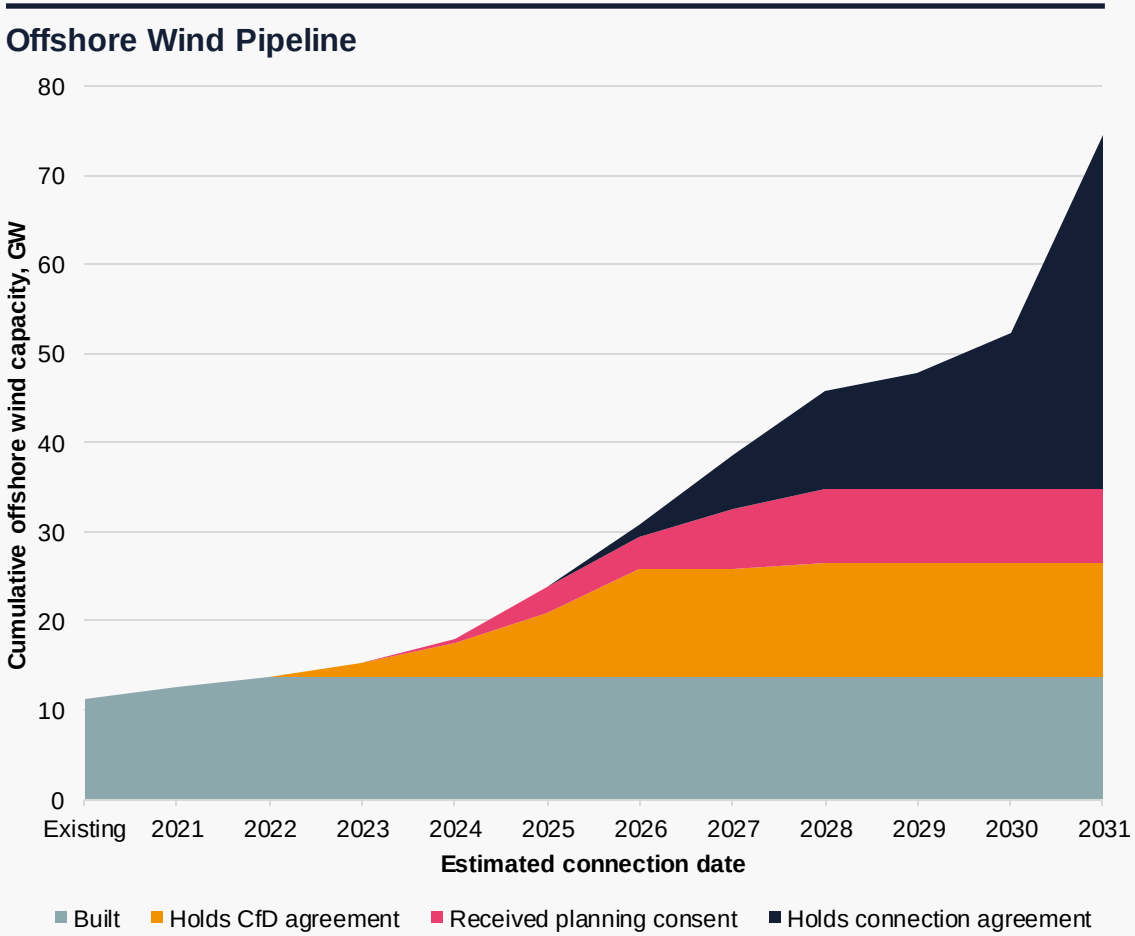
LCP Delta analysis of the Transmission Entry Capacity (TEC) register shows 26GW of new offshore wind projects (that don't already have a CfD agreement) hold a connection agreement at or before 2030. This means there are enough projects in the current pipeline to make the government's ambition technically feasible.

However, cross referencing this data with the Renewable Energy Planning Database (REPD) shows that only 7GW currently have planning consent. This leaves about 19GW still to obtain planning consent before they can even bid into the CfD auctions.

Analysis of planning data over the past 5 years shows an average of 2.9GW of offshore wind capacity has received planning consent annually. As building a new project takes 2-4 years, this planning consent average would mean that 4-10GW of capacity would not obtain planning permission in time to be able to bid into the final CfD auction that would enable them to build by 2030.

To meet 50GW by 2030, government announced planning reforms need to be effective in bringing down planning timelines by at least 2 years to ensure we bring forward all available sites where appropriate.

Once planning is obtained, the next 2 (maybe 3) CfD auctions that can procure capacity at or before 2030 need to be effective to bring the required capacity forward. This will likely require some reform and changes to key assumptions for setting parameters.



Note: The recently suspended 1.3GW Norfolk Boreas project is included in the category of projects with a CfD agreement.

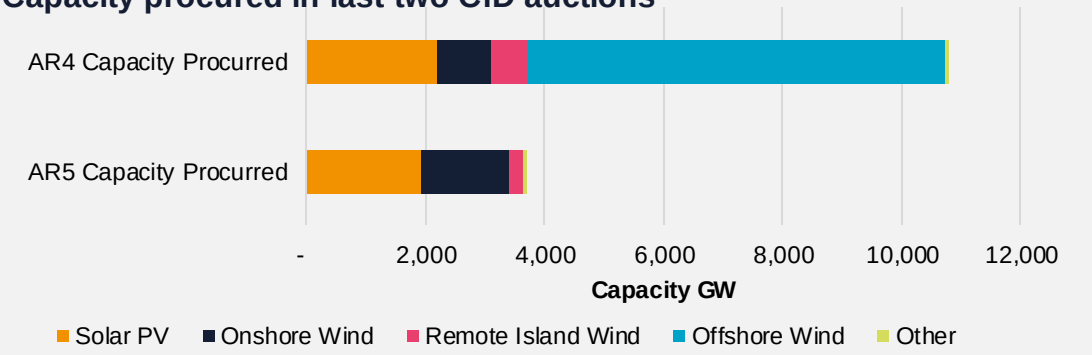
Offshore wind and the CfD

The failure of AR5 to procure any offshore wind was primarily driven by changes to offshore wind costs not being accounted for by government when setting the Administrative Strike Price

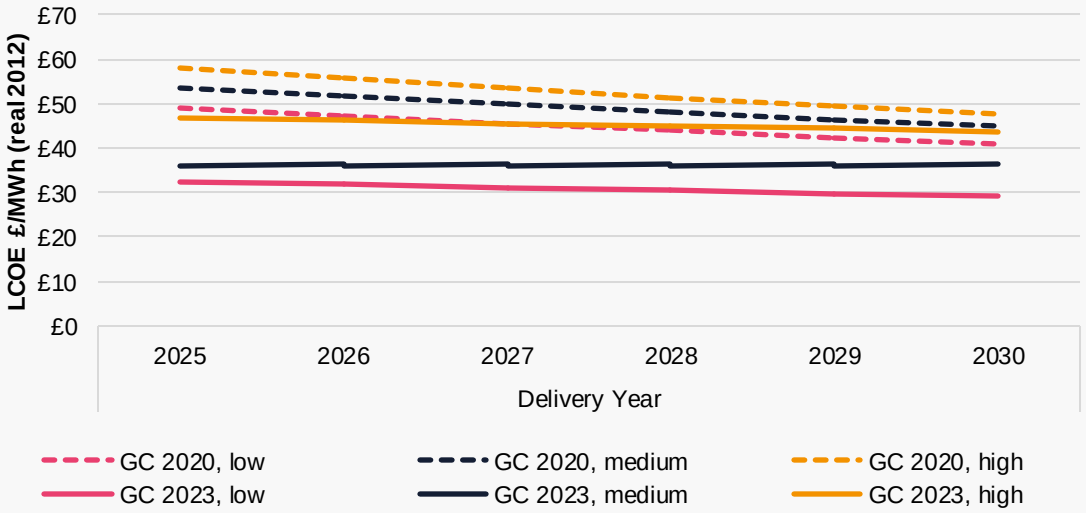
The recent AR5 CfD auction procured 1.9GW of solar PV (13% less than AR4) and 1.4GW of onshore wind capacity (twice as much as in AR4). However, no offshore wind projects (including floating projects) were successful, compared to 7GW in AR4.

The failure of AR5 to procure any offshore wind, despite over 4.5GW of eligible capacity, was largely driven by the Administrative Strike Prices (ASP) being set too low at £44/MWh (2012 prices).

Capacity procured in last two CfD auctions



DESNZ Levelised Cost of Energy estimates for Offshore Wind in GB



LCP Delta analysis undertaken in advance of AR5 showed that offshore wind projects were unlikely to be able to win a CfD contract due to a combination of costs rising at a faster rate than inflation and higher interest rates leading to increased cost of capital.

Neither of these issues appear to be included in the government's own forecasts of offshore wind costs as published in the Generation Cost report, with the Levelised Cost of Energy (LCOE) in the 2023 version (released shortly before AR5) decreasing compared to the 2020 version.

LCOEs are only one part of setting the ASPs, with typical PPAs and projected post-contract income, as well as pipeline specific information also feeding into the process. However, these costs are significant part of the calculation and the fact that they were too low is a key contributor to the failure of AR5 in procuring no offshore wind.

Offshore wind and the CfD

Offshore wind projects are facing increasing costs that need to be reflected in a future CfD

There are increasing cost pressures for offshore wind developers which is putting pressure on achievable CfD prices. DESNZ need to update their assumptions around a number of key variables to provide a more realistic estimate of current offshore wind costs for setting the Administrative Strike Price in future CfD auctions. We highlight below the key issues facing industry:

1. ***Manufacturing costs rising faster than inflation***

   Offshore wind costs have increased at rates higher than the CPI (the inflation rate used in the CfD). This includes change in costs of key materials such as steel and the cost of manufacturing.

   The Input Producer Price Index (PPI) highlights the change in costs of manufacturing. Since 2020, input producer prices have risen by 35% compared to 19% for CPI which illustrates the challenges facing offshore wind developers.

2. ***Cost of Capital increases***

   Increases in base interest rates combined with increasing future market uncertainty have led to increases in cost of capital.

   This will lead to hurdle rates for offshore wind increasing, which would increase overall financing costs across the CfD period.

3. ***Supply chain tightness***

   Evidence suggests that the supply chain for offshore wind is becoming increasingly tight. The Global Wind Energy council suggest that spare capacity in wind energy manufacturing is likely to disappear by 2026.

   This increased tightness will likely increase capital costs for offshore wind due to increased competition and potentially cause delays to projects.

4. ***TNUoS charge increases***

   The 10-year TNUoS charge forecast recently published by National Grid ESO shows a significant increase in TNUoS charges compared to previous forecasts.

   This will directly impact offshore wind strike price bids for plants located in certain areas.

The government should publish updated cost estimates for offshore wind.

It should ensure updated assumptions for key variables to better reflect the true cost in advance of publishing parameters for the next auctions.

Offshore wind and the CfD

Government should also consider various options to change the CfD for offshore wind if the 50GW ambition is to be met, whether in the upcoming or in future auctions

Setting budgets to target an average of 12GW in the next two CfD auctions

Given long planning times for offshore wind, it is likely that at most there are only two (or possibly three) CfD auctions left in order to deploy the 25GW of wind to reach 50GW by 2030.

LCP Delta analysis of the offshore wind pipeline suggests that there is 7GW of offshore wind with the required planning consents currently eligible for the next auction. All this capacity and more will need to be procured in AR6 to stand a chance of reaching that target. Both the budget and the ASP needs to be set accordingly to reach that level.

Move offshore wind back to its own pot for the AR6 and AR7 auctions

For AR5, offshore wind was moved from its own pot to Pot 1 for established technologies. This meant that offshore wind was competing directly with onshore wind and solar.

Forcing offshore wind to compete with other renewable technologies appears to directly conflict with having an offshore wind target.

To maximise the likelihood of delivering on the offshore wind ambition, government should consider reinstating the offshore wind-specific pot.

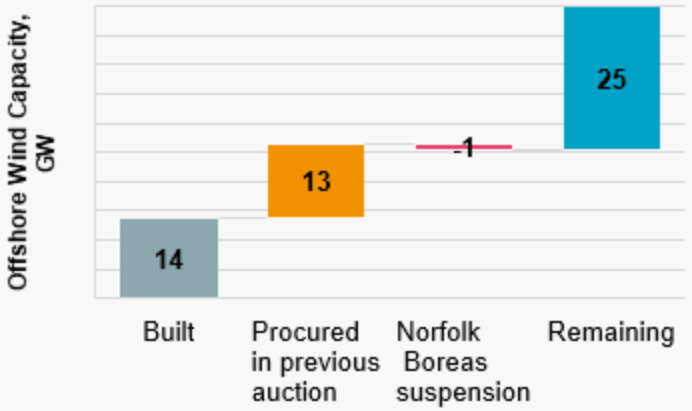
Extending the CfD contract length from 15 to 20/25 years

Government should consider extending the CfD contract length from 15 years to 20 or 25 years to give investors more certainty over revenues for a longer period.

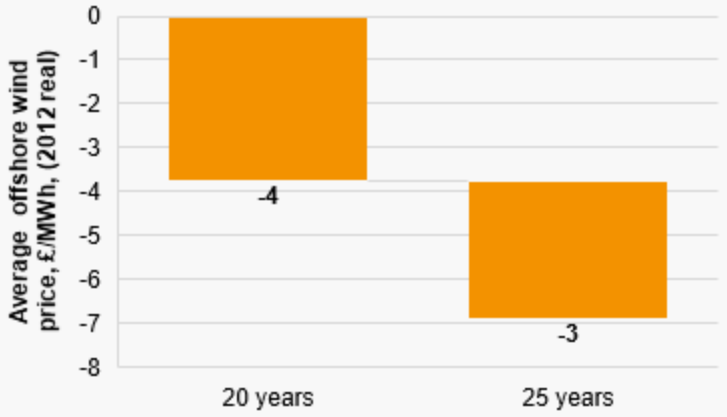
This would decrease the significant merchant tail risk of offshore wind plants and decrease the average bid prices made by generators.

LCP Delta analysis shows that extending the contract length to 20 years could reduce the ASP by £4/MWh and to 25 years could reduce it by £7/MWh.

Offshore wind capacity remaining to hit 50GW



Changes to average bid price with longer CfD contracts



Need for Long Duration Electricity Storage

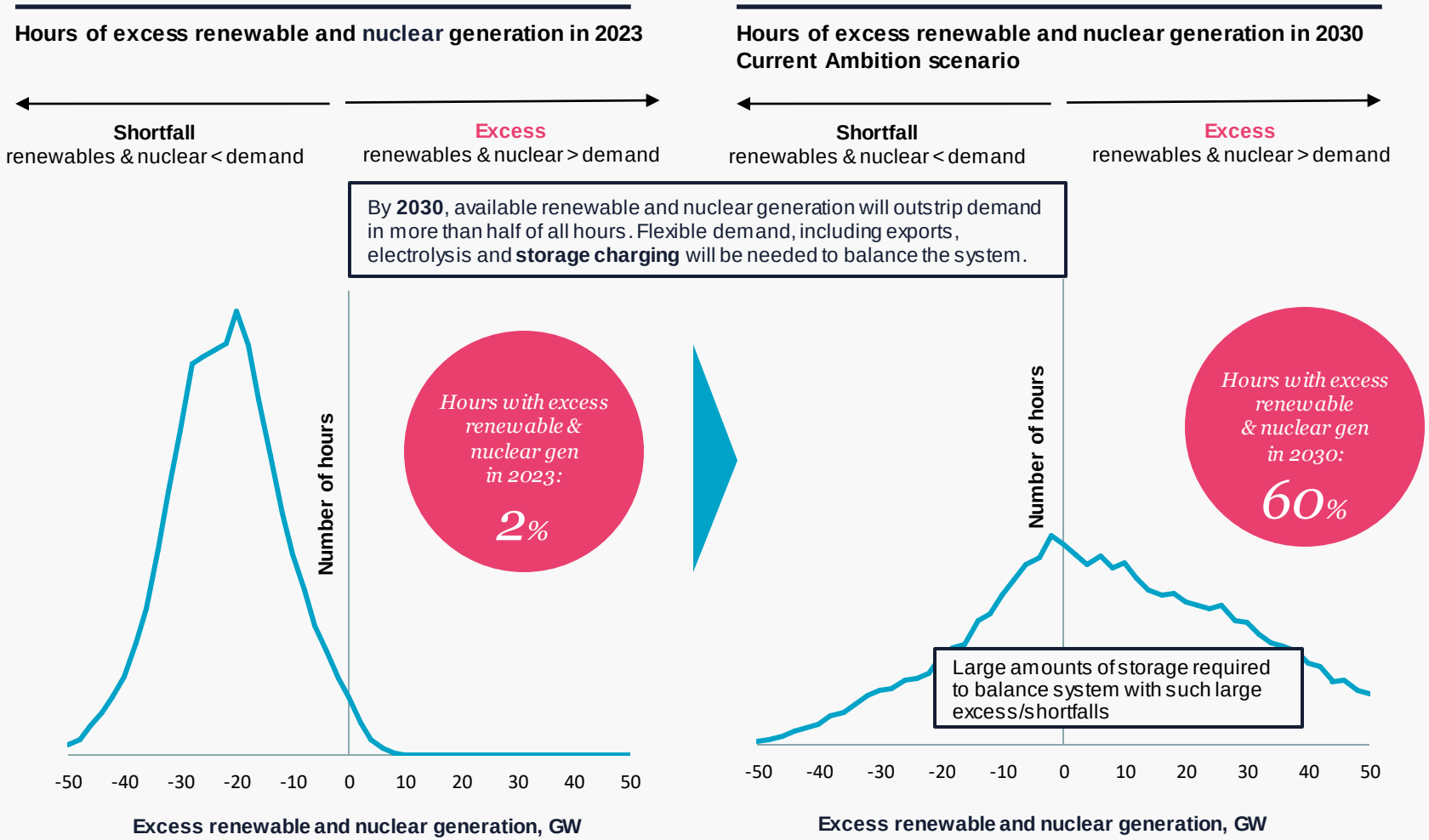
Rapid transformation of GB system means flexibility needs to be deployed at large scale to balance the system in 2030

To facilitate the growth in renewables generation on the GB system, corresponding levels of flexibility are needed to balance the system and maximise the potential of this renewable generation.

This flexibility is needed on both the demand and supply sides.

This can be seen by looking at the proportion of hours across the year that there will be excess renewable (and nuclear) generation on the system. In 2023, only 2% of hours have excess renewables; by 2030 this increases significantly to 60% of hours.

During periods where there is not an excess of renewable generation, flexibility can be provided by a variety of sources including low carbon thermal generation, storage discharging, demand reduction and interconnector imports. When there is an excess, the flexibility can come from storage charging, demand turn up, interconnector exports and electrolysis.



Need for Long Duration Electricity Storage

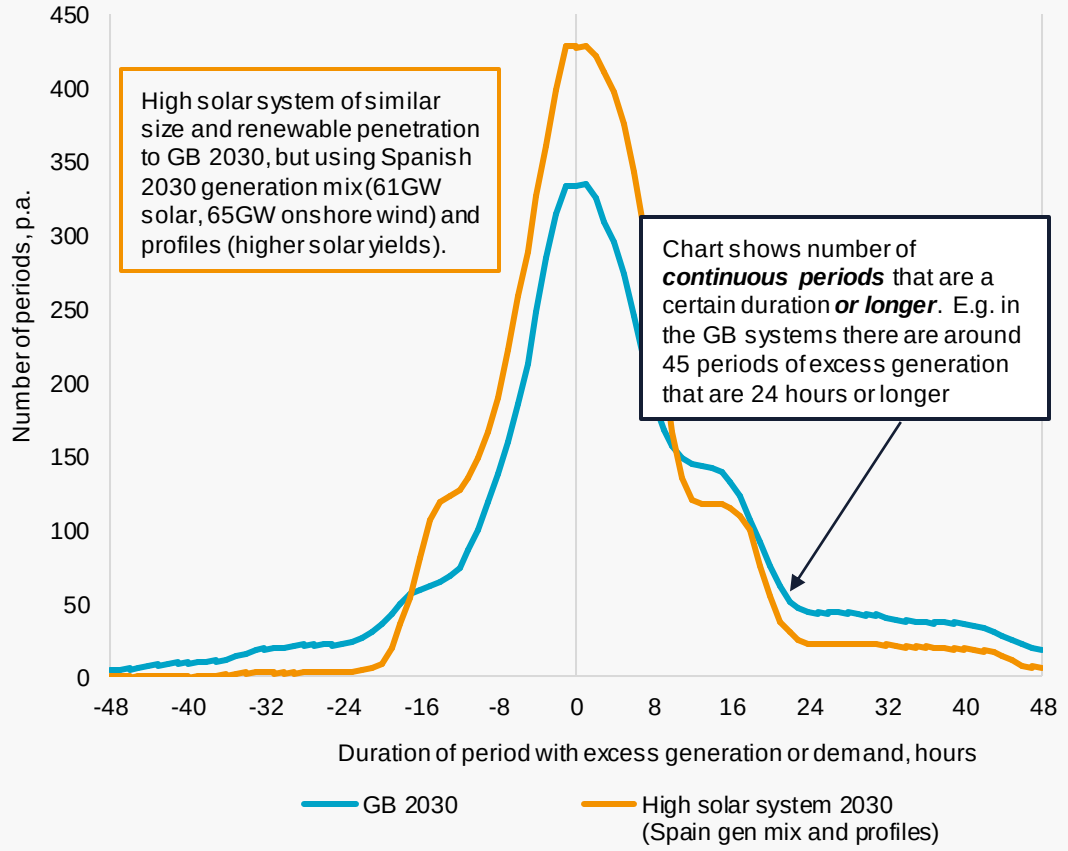
The domination of offshore wind means the need for long duration is particularly acute in GB

Comparing GB to an equivalent high solar system (based on Spanish 2030 generation mix) highlights that the domination of wind in GB will drive longer periods of excess or shortfall of renewable generation compared to other countries and emphasises the need for Long Duration Storage.

A similar size high solar system (with higher solar yield) like Spain in 2030 rarely has continuous periods of excess renewable generation or demand that last longer than 24 hours; as the solar profile is cyclical within a 24-hour period. This type of system will largely require short duration storage technologies to deal with this issue.

In comparison, the GB system in 2030 based on the Current Ambition scenario has continuous periods of excess generation/demand that are 24 hours, or even 48 hours. This cannot be resolved with short duration storage alone and means that GB has an acute need for longer duration storage technologies.

Duration of periods requiring gen/demand flexibility: GB system in 2030 vs High solar system



Need for Long Duration Electricity Storage

Adding more LDES to the system in the Current Ambition scenario can reduce both emissions and system costs

The impact that LDES can have on the system can be demonstrated by modelling increases to LDES capacity in the Current Ambition scenario.

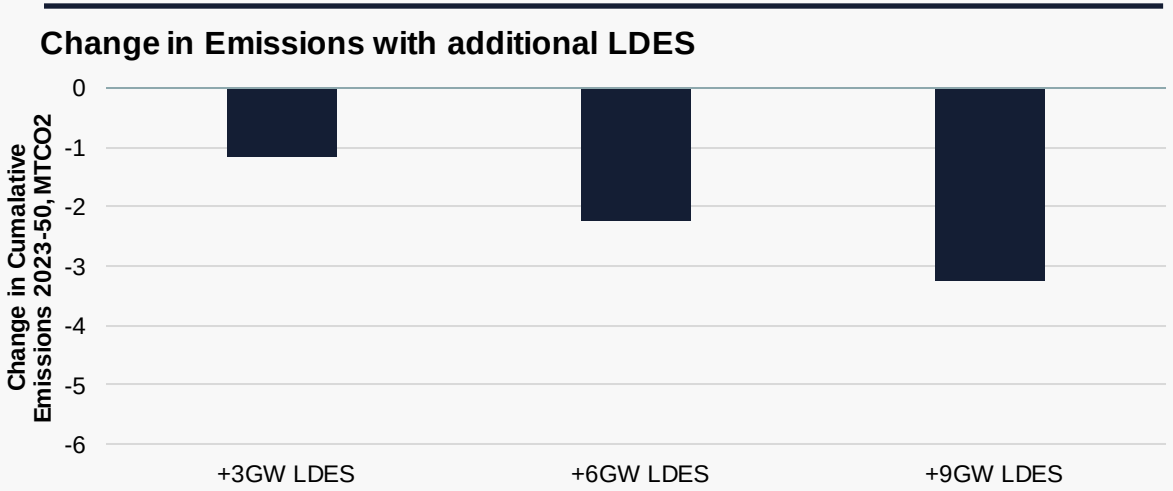
Three scenarios of 3GW, 6GW and 9GW additional LDES are modelled with a mix of LDES technologies (ranging in duration from 8-32 hours). The LDES is added such that half the capacity is added by 2035 and the full capacity added by 2050. This is in addition to the 5GW by 2050 already included in the Current Ambition scenario. The LDES replaces some peaking capacity as less is now needed on the system to ensure security of supply, but no other changes are made to the Current Ambition scenario.

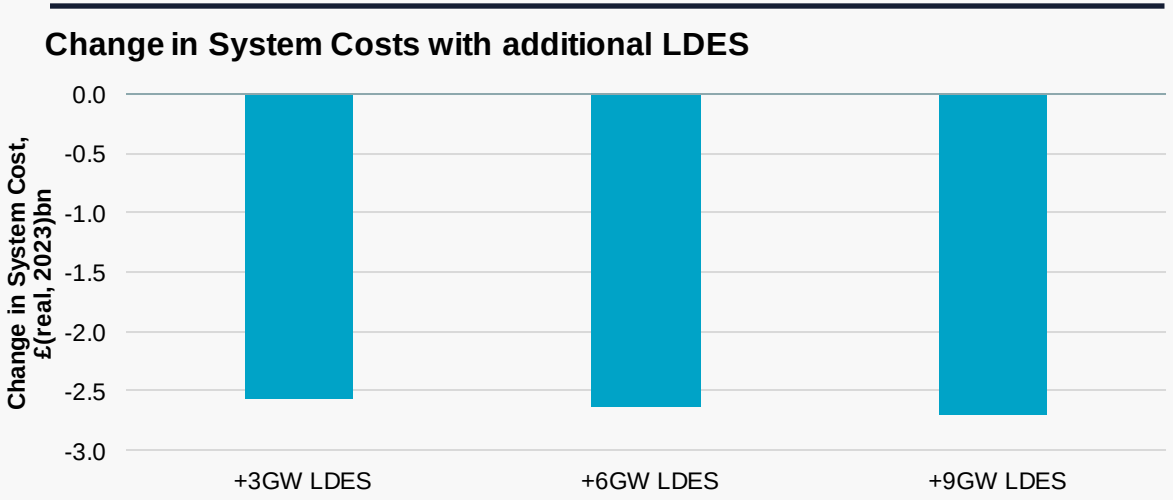
This analysis shows that adding LDES to the system can have a positive impact on both emissions and system costs. Cumulative emissions across the period modelled (2023-50) drop by 1.5-3MT while system costs decrease by £8.5-10bn.

GB has a system need for LDES and government should support these technologies to ensure they can deliver this.

Given the need for LDES, government must release details of a support mechanism, most likely a cap and floor mechanism, as soon as possible to ensure that investment decisions can be made on LDES technologies by the end of 2024 (as per government's commitment).

The parameters for this support mechanism need to be set at a realistic level to make projects investable so that they can contribute to 2030/35 decarbonisation targets.





The importance of low carbon thermal generation

Alternatives to unabated gas generators will be needed to ensure security of supply without increasing emissions

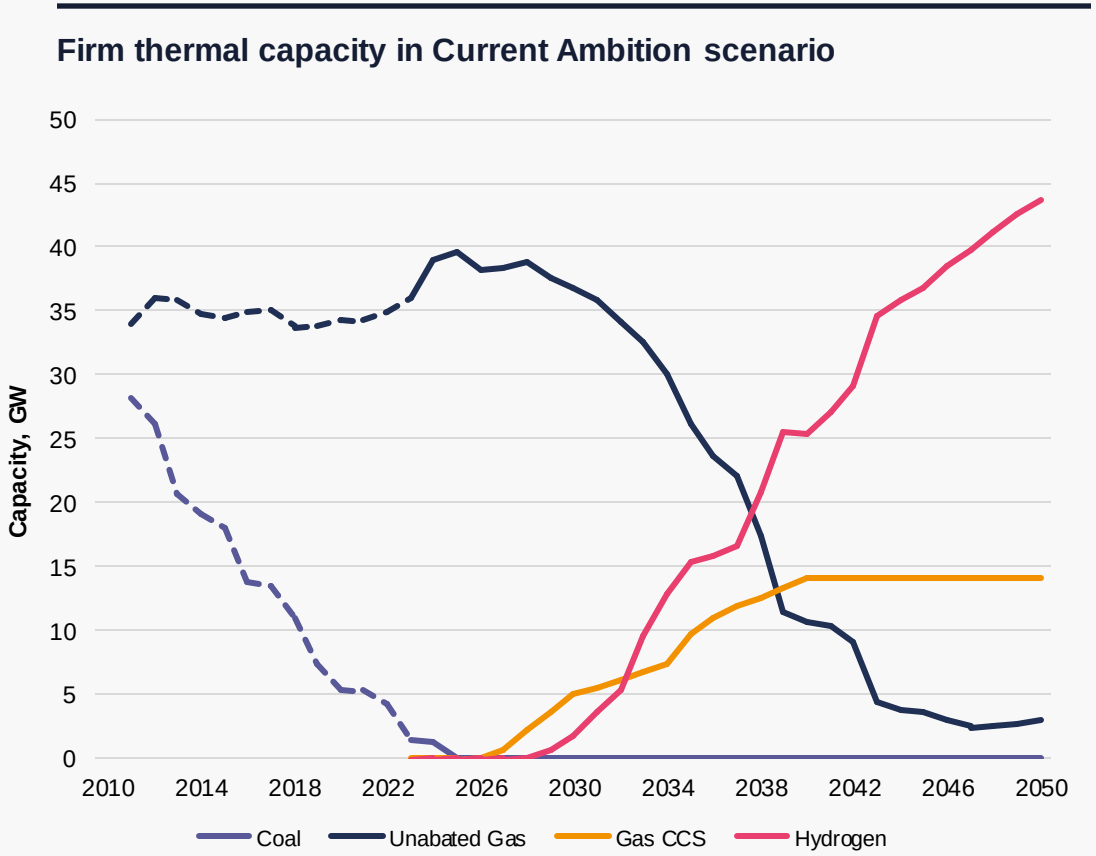
While renewable and nuclear generation will be sufficient to meet demand in the majority of hours across the year, there will be a large number of periods where the wind is not blowing, or the sun is not shining. In the Current Ambition scenario, despite renewable build out rates, there will be insufficient renewable generation to meet demand in 40% of all periods across the year in 2030.

Generation from other technologies will be needed to fill the gap during these periods. Currently, this requirement is met with unabated gas, but, as the system decarbonises, use of unabated gas will need to significantly reduce. Technologies like storage and interconnection can help fulfil this role but firm low carbon generation, such as hydrogen and gas CCS, will also be needed to deliver an efficient low carbon power system.

With demand also set to increase by 50% by 2035 and double by 2050, as other sectors such as heat and transport decarbonise through electrification, this also increases the requirement for back-up capacity to ensure security of supply.

As hydrogen and gas CCS can offer reliable, firm capacity, they are likely to be two of the main technologies to ensure future security of supply, replacing the role unabated gas plays in the market today.

To ensure security of supply and provide generation during periods of renewables shortfall, the Current Ambition scenario sees gas capacity increase to 2030 as limited options for gas CCS and hydrogen is available to replace it. This then declines after 2030 as more gas CCS and hydrogen come online.



The importance of low carbon thermal generation

Deploying 7GW of Gas CCS by 2030 would be optimal to reduce both system costs and emission levels

The Current Ambition scenario sets an ambitious level of renewable deployment to 2030; any higher levels by 2030 would unlikely be possible. With new nuclear and hydrogen power plants unlikely to be built before 2030, there are limited options to build additional low carbon technologies by this point.

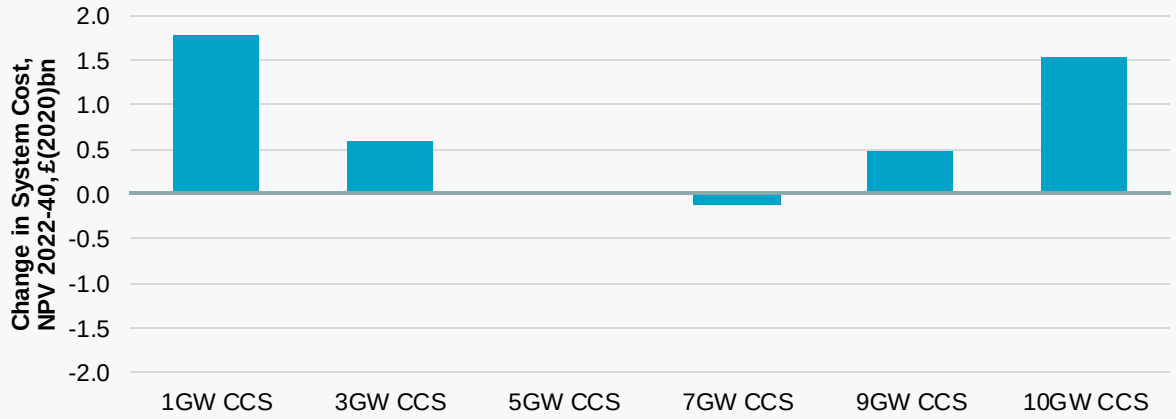
With the current ambition scenario assuming 5GW of gas CCS by 2030 to help meet decarbonisation objectives whilst ensuring security of supply, gas CCS is one of the few technologies where additional deployment by 2030 could be feasible.

The level of gas CCS in 2030 can be increased from the 5GW in the Current Ambition scenario to provide system cost benefits and reduce emissions intensity:

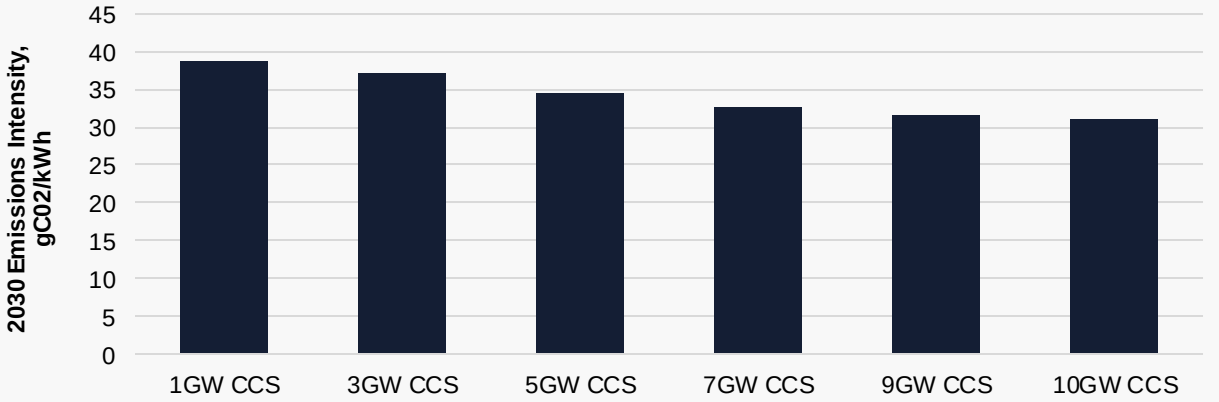
- Increasing gas CCS capacity by a further 4GW, to mean 9GW on the system, can reduce emissions by around 3gCO2/kWh compared to the Current Ambition scenario and would reduce emissions intensity to below 30gCO2/kWh in 2030.
- 7GW of gas CCS provides the lowest system costs across the different levels tested and is likely to be low regrets and can support the deployment of carbon and hydrogen infrastructure in industrial clusters around the UK's ports.
- However, the availability of CO2 transport and storage infrastructure will be a limitation on the amount of CCS that is deliverable by 2030.

Aiming to deploy gas CCS, and indeed all technologies to maximum 2030 levels can also bring benefits in terms of reducing delivery risk. With such high levels of low carbon capacity needing to be deployed to reach decarbonisation targets, additional gas CCS can mitigate against non-delivery of renewables or nuclear.

Change in system costs with different levels of CCS compared to Current Ambition scenario (5GW CCS)



2030 emissions intensity for Current Ambition scenario with different CCS levels



The changing investment landscape

The Inflation Reduction Act in the US has changed the direction of green investment across the world

The total capital investment (excluding financing costs) required for the construction of new power sector generation and supply-side flexibility assets is significant, with an estimated £430bn of investment required between 2023 to 2050.

These technology cost estimates are based on the DESNZ 2023 generation cost report. Recent evidence suggests that these costs are likely to be an underestimate with costs rising above inflation. This would increase the required investment in the power sector to even higher levels.

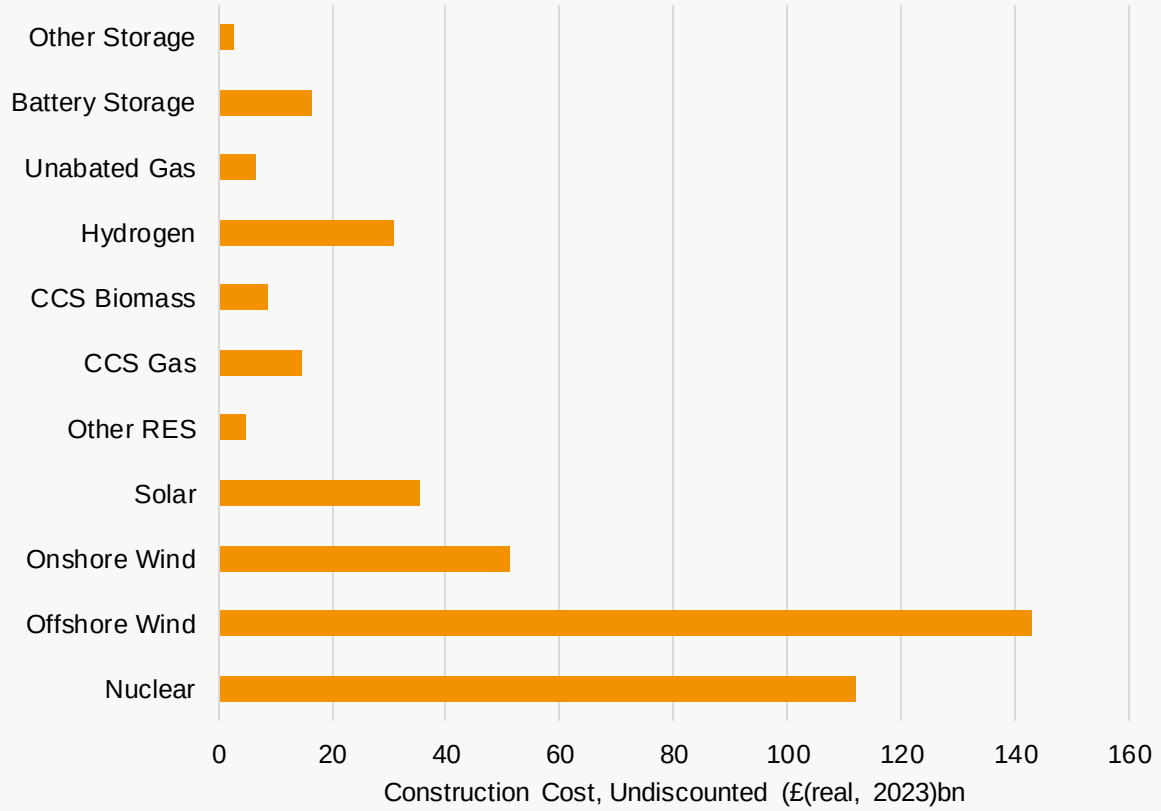
Offshore wind has the highest investment as it has the largest increase in capacity. Nuclear has second highest investment due to the high capex cost associated with this technology.

In previous years, the UK and Europe have led the way (outside of China) in attracting investment in clean energy technologies. However, with the introduction of the Inflation Reduction Act in the US, this is starting to change. Since its introduction in August 2022, $271bn of investments in 185GW of US domestic clean energy assets have been announced, surpassing the total investment between 2015-22*.

The EU has responded to this through the Green Deal Industrial Plan that aims to create a more supportive environment for scaling up the EU's manufacturing capacity for the net-zero technologies and products required to meet Europe's ambitious climate targets.

The UK is yet to introduce any equivalent policy meaning it is at risk of being left behind with investment diverting away from the UK to other parts of the world.

Capex investment in Current Ambition scenario (2023-2050), excluding financing costs



*Statistics taken from the American Clean Power Association

The changing investment landscape

Uncertainty around the future of decarbonisation and the power sector market could lead to increases in cost of capital

A stable and predictable investment environment has benefitted the UK in recent years. This is important as it has the benefit of reducing the cost of capital of a project, thanks to a lower level of risk being considered.

Recent developments such as the September 2022 fiscal announcement, uncertainty around market reform and Rishi Sunak's Net Zero speech in September 2023 increases investor uncertainty.

Reforms that increase volatility or uncertainty for investors will likely raise the cost of financing new projects and risk jeopardising the investment in low carbon generation needed to achieve net zero.

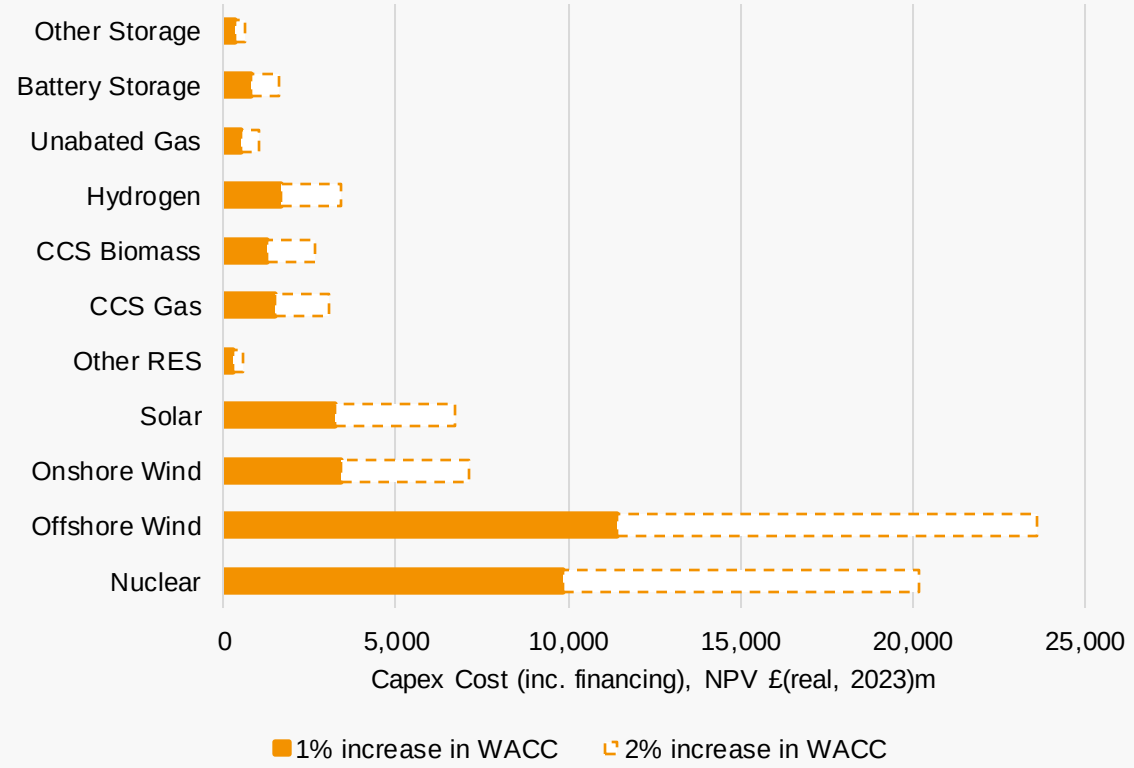
Even with the same level of new build, higher cost of capital would ultimately increase costs for consumers as this would increase CfD strike prices and clearing prices in the Capacity Market for example.

An increase in Weighted Average Cost of Capital (WACC) for new projects of 1 percentage point (pp) could increase capex costs by £35bn and a 2pp increase by £75bn to 2050 in the Current Ambition scenario.

This means significant changes to electricity market design (such as Locational Marginal Pricing) and other policies should be considered in the context of the significant levels of new investment that is required over the next decade to reach net zero and keep costs down.

Delays in key decisions, for example around the Review of Electricity Market Arrangements (REMA) could see cost of capital increase in the UK in the short to medium term putting investment needed to reach 2030 and 2035 targets at risk.

Change in capex financing costs 2023-50 due to increased WACC



Key takeaways and recommendations

Changes are needed to get the UK back on track to meet power sector decarbonisation objectives

Assessment of power sector decarbonisation progress

- Progress in the power sector across 2022/23 has been limited. Across the 9 different technologies assessed only 2 are on track to reach the levels needed by 2030/35, with a number at significant risk including offshore wind, long duration electricity storage and low carbon thermal.
- This means that the reduction in power sector emissions needed to reach the international 2030 NDC target are unlikely to be met, despite the UK strengthening these commitments when it hosted COP26 in Glasgow in 2021.
- Enough time remains to achieve the target of a fully decarbonised power sector by 2035, but government needs to act quickly to get key technologies back on track.

Recommendations to get back to track:

1. Reaching 50GW offshore wind by 2030 is still technically achievable but auction parameters need to be set to procure 25GW offshore wind across the next two CfD auctions to meet this ambition.
2. Planning reforms need to be effective in reducing timelines by at least 2 years to ensure we bring forward all available offshore wind sites where appropriate.
3. Urgently review and publish updated offshore wind cost estimates to enable setting of appropriate Administrative Strike Prices (ASPs) in the next CfD auctions.
4. Consider reforms including pot changes and the lengthening of CfD contracts to attract the required bidding for offshore wind projects.
5. Quickly establish a competitive cap and floor support mechanism for Long Duration Electricity Storage (LDES) given the acute need for LDES in GB.
6. Recognise the importance of low carbon thermal technologies by aiming to deploy 7GW of CCS by 2030 that can reduce system costs and carbon emissions.
7. Key policy decisions need to be made in a timely manner to reduce market uncertainty and avoid delays in investment.
8. Decisions on market reform must account for the impacts that rising cost of capital could have on consumers and the investment required to decarbonise.

Top picks from LCP Delta

Net zero power without breaking the bank

In advance of COP26, LCP Delta were commissioned by SSE to assess the most efficient ways to decarbonise whilst keeping costs down and the lights on.

Market Roadmap Assessment

LCP Delta provided an assessment on how ESO is delivering against market design objectives of efficient design, efficient dispatch and value for money.

The 2023 battery investment landscape

This report explores the future of GB battery storage. It provides insights to navigate the evolving landscape and future investment challenge for the battery storage market.

Enact

Performance benchmarking, leaderboards and real time trading support for the UK market.

Training

LCP Delta offer a range of training courses to help you navigate the energy transition

STOREcast

Bespoke battery storage modelling and revenue forecasting at your fingertips

Follow us on:

lcp-energy

LCP_Delta

Talking New Energy, an LCP Delta podcast

Contact Us

Chris Matson
Partner
+44 (0)274 320 674
chris.matson@lcp.uk.com

Sam Hollister
Head of Economics and Finance
+44 (0) 20 7432 3780
sam.hollister@lcp.uk.com

George Martin
Senior Consultant
+44 (0) 20 7432 3061
george.martin@lcp.uk.com

About LCP Delta

LCP Delta is a trading name of Delta Energy & Environment Limited and Lane Clark & Peacock LLP. References in this document to LCP Delta may mean Delta Energy & Environment Limited, or Lane Clark & Peacock LLP, or both, as the context shall require.

Delta Energy & Environment Limited is a company registered in Scotland with registered number SC259964 and with its registered office at Argyle House, Lady Lawson Street, Edinburgh, EH3 9DR, UK.

Lane Clark & Peacock LLP is a limited liability partnership registered in England and Wales with registered number OC301436. All partners are members of Lane Clark & Peacock LLP. A list of members' names is available for inspection at 95 Wigmore Street, London, W1U 1DQ, the firm's principal place of business and registered office. Lane Clark & Peacock LLP is authorised and regulated by the Financial Conduct Authority and is licensed by the Institute and Faculty of Actuaries for a range of investment business activities.

LCP and LCP Delta are registered trademarks in the UK and in the EU. Locations in Cambridge, Edinburgh, London, Paris, Winchester and Ireland.

https://www.lcp.uk.com/emails-important-information contains important information about this communication from LCP Delta, including limitations as to its use.

Disclaimer and use of our work

Where this report contains projections, these are based on assumptions that are subject to uncertainties and contingencies. Because of the subjective judgements and inherent uncertainties of projections, and because events frequently do not occur as expected, there can be no assurance that the projections contained in this report will be realised and actual events may be difference from projected results. The projections supplied are not to be regarded as firm predictions of the future, but rather as illustrations of what might happen. Parties are advised to base their actions on an awareness of the range of such projections, and to note that the range necessarily broadens in the latter years of the projections