LCP Delta

The Power Market Outlook 2024

The route to Clean Power 2030

Sponsored by SSE

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Contents

Foreword

The new government's commitment for a 'Clean Power' system by 2030 is a bold and welcome ambition for the GB power sector but will require significant investment and government action to achieve

Welcome to the second edition of LCP Delta's "Power Market Outlook", sponsored by SSE, providing an independent assessment of the journey to a decarbonised power sector in Great Britain.

Last year, the report focussed on the ambitious deployment targets of the UK government, led by the Conservative Party and found that "limited progress had been made since COP26 and that the UK's 2030 Nationally Determined Contribution (NDC) and the fully decarbonised GB power sector target for 2035 were both at risk."

Since then, a new government has been formed and has made even stronger commitments to decarbonise the power system, aiming for Clean Power by 2030 (CP2030). The definition of 'Clean Power' is currently unclear and the route to achieving such a target is unknown, but the ambition and commitment is undoubted.

The report provides insights and recommendations to government for its action plan for CP2030 due to be published before the end of the year. The report also aims to help investors and developers understand the opportunities of CP2030 and how to maximise value from the energy transition.

Using LCP Delta's modelling expertise, this report provides an expert view of the requirements for a clean power system. We assess the progress to date of decarbonising the GB power and provide insights into the key challenges post 2030.

*Our analysis shows that there is limited optionality for Clean Power 2030. Given the scale of investment, the potential for delivery risk and delays, and the potential for higher demand from greater electrification, our overriding recommendation is to deploy **all** key low carbon technologies to their maximum feasible level in order to achieve a Clean Power system within 5 years.*

George Martin
Senior Consultant

In a rush… this is what you need to know:

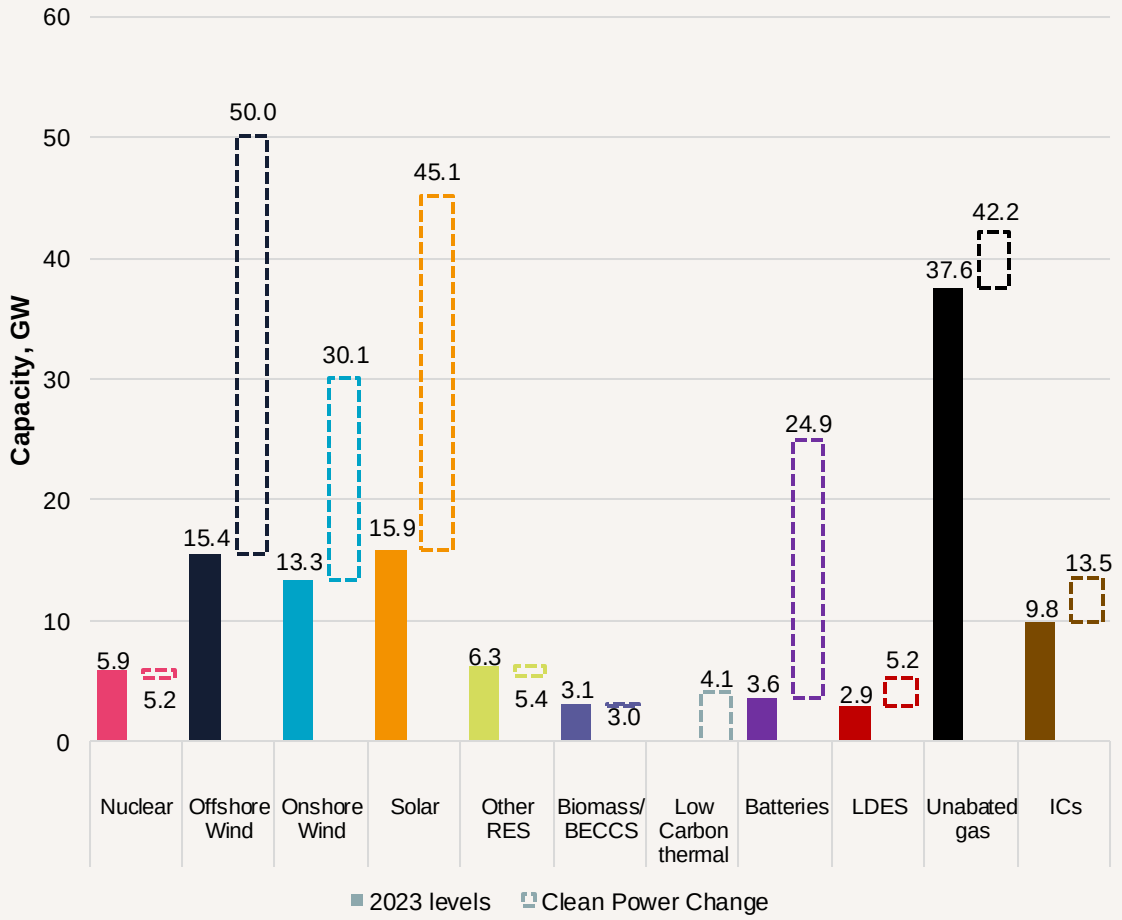
- LCP Delta have undertaken analysis to find a 2030 capacity mix consistent with meeting the Clean Power 2030 target. To achieve this, the analysis shows that all key low carbon technologies need to be delivered at or close to maximum feasible levels.
- This includes tripling offshore wind to 50GW, doubling onshore wind to 30GW and tripling solar to 45GW. Renewables cannot deliver CP2030 alone however with 4GW low carbon thermal capacity needed, existing nuclear and biomass remaining online for longer and large levels of flexibility, such as storage, interconnectors and Demand Side Response.
- LCP Delta recommend setting a low carbon generation % target of above 95% as the one metric for measuring CP2030. In our Clean Power scenario unabated gas (including CHP) is still used in 33% of hours across the year in 2030 compared to 52% in the Previous Government scenario.
- Renewable capacity increased by just 3GW in 2023 compared to 11.3GW build rate required to meet Clean Power by 2030. Based on current timelines to bring projects online, next year's AR7 and the following AR8 auction would each need to procure 10GW of offshore wind in each auction.
- To deliver Clean Power 2030, £120bn capex investment is needed (excluding financing costs) by 2030, with the majority in Offshore Wind. A further £235bn of investment is needed out to 2050.
- Reaching Clean Power by 2030 is not the end point for the power sector in its contribution to Net Zero. Post 2030, electricity demand is set to increase significantly; meaning further investment and policy change is needed

A blueprint for Clean Power

Clean Power 2030 is technically achievable, but significant build and investment is needed to reach such a challenging target

- LCP Delta have undertaken analysis to find a 2030 capacity mix consistent with meeting the Clean Power 2030 (CP 2030) target. This provides a blueprint for reaching Clean Power that the government can use to inform its action plan due to be published before the end year.
- The analysis shows that CP2030 is technically achievable but over £120bn in investment is required in generation and flexibility technologies to reach a system where >95% of generation is low carbon.
- All major technologies need to be delivered at or near maximum feasible levels and build rates need to be scaled up way above the disappointing levels seen in 2022/23:
  - All renewables need to increase significantly with offshore wind more than tripling from 2023 levels to 50GW, onshore wind doubling to 30GW and solar tripling to reach 45GW.
  - Flexibility will be key in helping to balance the system. Short duration storage capacity needs to significantly increase to 25GW while new long duration storage (LDES) needs to delivered under the government's new cap and floor scheme.
  - 4GW of Low Carbon Thermal (Gas CCS and Hydrogen to Power) is needed to provide firm low carbon energy during low wind and high demand periods.
  - The first unit of Hinkley Point C needs to be delivered on time and 2 plants from the current nuclear fleet need to remain online to 2030 (as announced by EDF).
  - The existing biomass plants needs to be online in some form, either as biomass or BECCS, and they need support to ensure they generate ahead of unabated gas.
- The low carbon build required for CP2030 needs to be supported by key system enablers, such as planning, connection agreements and network build. Network build needs to be massively scaled up as without this build constraint costs could be up to £7bn higher and gas generation output could increase by 13TWh to deal with network constraints making CP2030 unachievable.
- However, it is important to note that while CP2030 is an excellent ambition for the power sector, it is not the end point. More investment and reform will be needed post 2030 to deliver an electricity system that is consistent with meeting Net Zero by 2050.

Capacity mix in LCP Delta Clean Power 2030 scenario compared to 2023



Batteries are short duration storage at 4 hours duration or below while LDES refers to any storage with 6 hours duration or above

Key recommendations for Clean Power 2030

Reform and action are needed immediately by the government if CP2030 is going to be reached

Clean power is achievable, but requires pace and investment in low carbon generation

Apart from interconnectors, none of the technologies required for CP2030 were built at the required rate in 2023. Increased action is needed across all techs with £120bn of investment needed in generation and flexibility to reach CP2030.

LCP Delta recommends that government:

1. **Maximum deployment:** Build all technologies to maximum feasible levels given the limited optionality for CP2030.
2. **Offshore Wind**: Procure 20GW of offshore wind across the next two CfD auctions, each requiring a budget of at least £1.8bn, a 64% increase on AR6**.**
3. **Onshore Wind and Solar**: Increase procurement of onshore wind and solar in the CfD more than doubling the AR6 budget (to at least £400m).
4. **Long Duration Electricity Storage**: Dramatically speed up Ofgem's current proposed timetable for the Cap & Floor scheme with the first window complete in 2025.
5. **Low Carbon Thermal:** Put in place delivery plans to procure at least 4GW of gas Carbon Capture and Storage (CCS) and Hydrogen to Power (H2P).

The investment in low carbon generation could be wasted without reform to system enablers:

Network build, planning and connections are currently major barriers to reaching CP2030. Reform needs to be prioritised in these areas to ensure that projects can get online by 2030 and transport energy to where it is needed.

LCP Delta recommends that government:

1. **Network build:** Prioritise the reforms to network and planning that is needed to deliver the 88 network projects identified by NESO. Without reforms, network constraints will lead to 13TWh of additional gas generation – making CP2030 unachievable.
2. **Planning and connections:** Speed up the planning and grid connection regimes. As existing bottlenecks are addressed, new ones will become clear. This means government will need to remain vigilant and implement additional changes quickly to ensure low carbon capacity delivery.

Remember that Clean Power 2030 is not the end point for power sector decarbonisation:

Further low carbon build will be needed post 2030 to reach a Net Zero consistent system. Demand growth is expected to rapidly accelerate after 2030, necessitating a further £235bn of investment over the 2030-50 period and new challenges to overcome.

LCP Delta recommends that government:

1. **Decarb ready CCS/H2P**: Recognise CCS and H2P technologies are key to ensuring security of supply in the 2030s. Whilst the required infrastructure to support these plants is built, they may need to run as efficient unabated gas for a short period. This requires a change in the government's current proposed business models to give investors certainty to invest now.
2. **Investment environment**: Make faster decisions on the REMA programme to provide investors with more certainty. Uncertainty around market reforms is leading to increased risk for investors which could put CP2030 in doubt.

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Increasing Ambition: Clean Power 2030

Clean Power 2030

The new government has increased ambition for decarbonisation of the GB power by aiming to deliver a 'Clean Power' system by 2030

- The new Labour government have set an ambition to deliver a clean power system by 2030 (CP2030), forming one of its 5 key 'Missions of government'.
- A new Mission Control centre led by Chris Stark has been set up to deliver this with the aim to produce and then deliver a plan 'to provide Britain with cheaper and clean power by 2030'.
- This effectively brings forward the previous government's plans for a 'fully decarbonised' power system by 5 years, from 2035 to 2030.
- As a first step, the government commissioned the National Energy System Operator (NESO) to provide independent 'practical advice on achieving clean power by 2030'.
- This advice was published on the 5th November and covers the generation and demand mix, network requirements and locations of infrastructure needed for a clean power system. It also provides an assessment of the costs, benefits, challenges and risks as well as the actions that need to be taken to ensure delivery.
- The government aims to publish an 'action plan' for CP2030 before the end of the year that will outline key government actions and plans for reaching clean power. This will incorporate the NESO advice as evidence alongside other sources. This report, sponsored by SSE, is designed to provide evidence to support this action plan.
- The Labour manifesto included a number of other ambitions for 2030 that would support this target, including higher levels of offshore wind, onshore wind and solar deployment.

	Previous government key commitments	New government statements*
Decarbonisation	**Fully decarbonise the power sector,** subject to security of supply, by 2035.	A Clean GB power system by 2030
Offshore Wind	Ambition to deliver up to **50GW of offshore wind by 2030**, with up to 5GW from floating offshore wind by 2030.	Quadruple offshore wind with an ambition of 55 GW by 2030" "Pioneer floating offshore wind, by fast-tracking at least 5 GW
Onshore Wind	Develop partnerships for onshore wind projects for supportive communities. Planning regulations still limited.	"More than double our onshore wind capacity to 35 GW"
Solar	Ambition for a **fivefold increase in solar capacity by 2035** to reach 70GW of ground and rooftop capacity together.	"More than triple solar power to 50 GW" by 2030
Hydrogen	**2030 low carbon hydrogen production target of 10GW**, with electrolysers contributing at least 50% (5GW) of this.	"Double the government's target on green hydrogen [from electrolysis], with 10 GW of production" by 2030

*Taken from "5 Missions for a Better Britain", Labour.

Defining Clean Power 2030

A key first step for Clean Power 2030 is to define a simple and understandable metric with a clear target that progress can be tracked against

- The previous government never defined a metric for a 'fully decarbonised' power system by 2035. This made it challenging to objectively and independently track the government's progress and understand what their plan was to ensure the target was met.
- By setting up the mission control centre and commissioning advice from NESO, the new government have already made improved progress in making the new clean power target more tangible and having a defined plan.
- To track progress, define a plan and gain confidence of the energy industry, the government needs to produce one metric that defines what 'clean power' means.
- There are a range of options as shown in the graphic opposite. NESO have used both % low carbon generation metric and the % of demand met by low carbon as two metrics for clean power. Having dual metrics could cause confusion and uncertainty so government should use a sole metric for CP2030 in its action plan.
- Any metric for CP2030 should meet the following criteria:
  1. **Simple** – the metric needs to simple to explain with a clear definition and limited exceptions so that is understandable to the public and non-experts.
  2. **Measurable** – the metric should be easy to measure and tracked in government statistics to allow for easy reporting.
  3. **Achievable** – the target level for the metric needs to be set so that it is a target that can realistically be reached by 2030.
  4. **Ambitious –** the target needs to be achievable but also stretching to ensure real change in power sector decarbonisation.

Possible metrics for Clean Power 2030

% Low Carbon generation

The percentage of GB generation coming from low carbon sources (renewables, nuclear, gas CCS etc.). This is one of the metrics being considered by NESO.

The CCC recommended a 98% level for the 2035 target, and this metric was included in the 2021 Net Zero strategy.

% Zero Carbon generation

The percentage of GB generation coming from zero carbon sources (renewables, nuclear etc.).

Generation from zero carbon sources is often mentioned in government announcements but there will be several emitting technologies still on the system by 2050.

% of demand met by low carbon

The percentage of GB demand that is being met from low carbon sources (renewables, nuclear, gas CCS etc.). This is one of the metrics being considered by NESO.

Given GB may become a net exporter of electricity then this metric could exceed 100% by 2030.

Net Emissions

A target for net zero emissions in the power sector. Any remaining emissions are offset by greenhouse gas removals.

The previous 2035 target was often misinterpreted as this but in government carbon accounting, negative emissions from BECCS are not counted in power sector

Emissions Intensity

A target based on reaching a defined level of emissions intensity (emissions/domestic generation) for the power sector. This is one of the metrics being considered by NESO.

This measure has been used by CCC and government for previous measurement of power sector decarbonisation.

Defining Clean Power 2030

The clean power target should be set based on the percentage of generation coming from low carbon sources

- The table opposite provides a RAG rating for each metric against the 4 criteria: Simple, Measurable, Achievable and Ambitious.
- This assessment shows that the low carbon generation % and emissions intensity successfully meet most criteria according to our assessment.
- LCP Delta recommend using the % low carbon generation metric. It is easier to communicate success on this metric compared to emissions intensity and outperforms other metrics according to our assessment.
- However, setting an ambitious yet achievable target for low carbon generation % will be challenging. The CCC previously advised that 98% from low carbon sources was consistent with meeting the previous governments 'fully decarbonised' ambition.
- Hitting 98% by 2030 is likely to be unachievable given the timescales, however, a target below 95% is likely to not be ambitious enough. As such, LCP Delta would recommend setting a low carbon generation % target of >95% as the definition of Clean Power 2030.
- NESO are endorsing this as the metric for the power system although their definition of low carbon power may be slightly different to those currently used in government statistics.
- Specifically, it is unclear how NESO propose to count generation from Gas Combined Heat and Power (CHP) power plants within the metric, with the proposed definition excluding 'power produced as a by-product from heat'. While some power from CHP plants is a by-product of using the plant for heating, some CHPs do participate directly in the market producing power for power purposes, so this generation at least should not be counted as low carbon. LCP Delta recommend using the same definition of low carbon power as government statistics and account for Gas CHP generation in the same way as unabated gas.

*A more detailed explanation of the reasoning for the RAG ratings for each metric can be found in the Annex.

LCP Delta Assessment* of possible metrics for Clean Power 2030

Metric	Simple	Measurable	Achievable	Ambitious
% of low carbon generation				
% of zero carbon generation				
% of demand met by low carbon				
Emissions Intensity				
Net Emissions				

Key takeaway

A clear definition of CP2030 is needed with just one metric used that is simple that is simple, measurable, achievable and ambitious.

LCP Delta recommend >95% of generation from low carbon sources as the target for CP2030

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What does a Clean Power system look like?

Modelling what is needed to reach a clean power system and its impact on system and consumer costs

Reaching a Clean Power System

LCP Delta have carried out a detailed assessment of the required capacity mix needed to reach CP2030

- To assess the impacts and requirements of a clean power 2030 system, LCP Delta has undertaken analysis using our EnVision modelling framework to build a 2030 capacity mix consistent with >95% generation coming from low carbon sources.
- Detailed analysis has been undertaken on the pipeline of projects across all key low carbon technologies to understand technically feasible levels that can be reached. This includes renewables (wind and solar), other low carbon (nuclear, biomass gas ccs and hydrogen) and flexibility (short duration storage, long duration storage and interconnectors). The changes needed in unabated gas capacity are also assessed
- Four scenarios have been run to give an understanding of the requirements and impacts of meeting CP2030. The analysis builds on a scenario consistent with previous government plans to provide an understanding as to the additional investment and build required to meet clean power 2030. The LCP Delta Clean Power scenario is then built up from this point adding and removing capacity from different technologies as needed. The four scenarios are:
- The 'Previous Government scenario' is consistent with the British Energy Security Strategy published in 2022 and with meeting the previous government's ambition of a 'fully decarbonised' power system by 2035, subject to security of supply. This includes reaching the previous 50GW offshore wind target.

1. Previous Government Scenario

The 'Previous Government scenario' is consistent with the British Energy Security Strategy published in 2022 and with meeting the previous government's ambition of a 'fully decarbonised' power system by 2035, subject to security of supply. This includes reaching 50GW offshore wind.

2. Labour Manifesto Scenario

The Labour manifesto scenario adds the increases renewable ambition outlined in their manifesto and Mission report to the previous government scenario. This includes, by 2030, increasing the offshore wind ambition to 55GW, a new solar ambition of 50GW and a new onshore wind ambition of 35GW.

3. Clean power inc. Labour Manifesto Scenario

The Clean Power inc. Labour manifesto builds on the Labour manifesto scenario by adding other low carbon (nuclear, biomass gas ccs and hydrogen) and flexibility capacity (short and long duration storage) to reach a capacity mix consistent with meeting CP2030.

4. LCP Delta Clean Power Scenario

The LCP Delta Clean Power scenario is the end-point analysis and gives our recommended capacity mix for Clean Power 2030. This builds on the previous scenario by scaling down the renewable capacity slightly from the levels in the Labour Manifesto

1. Previous government scenario

Previous government plans are not enough to reach CP2030

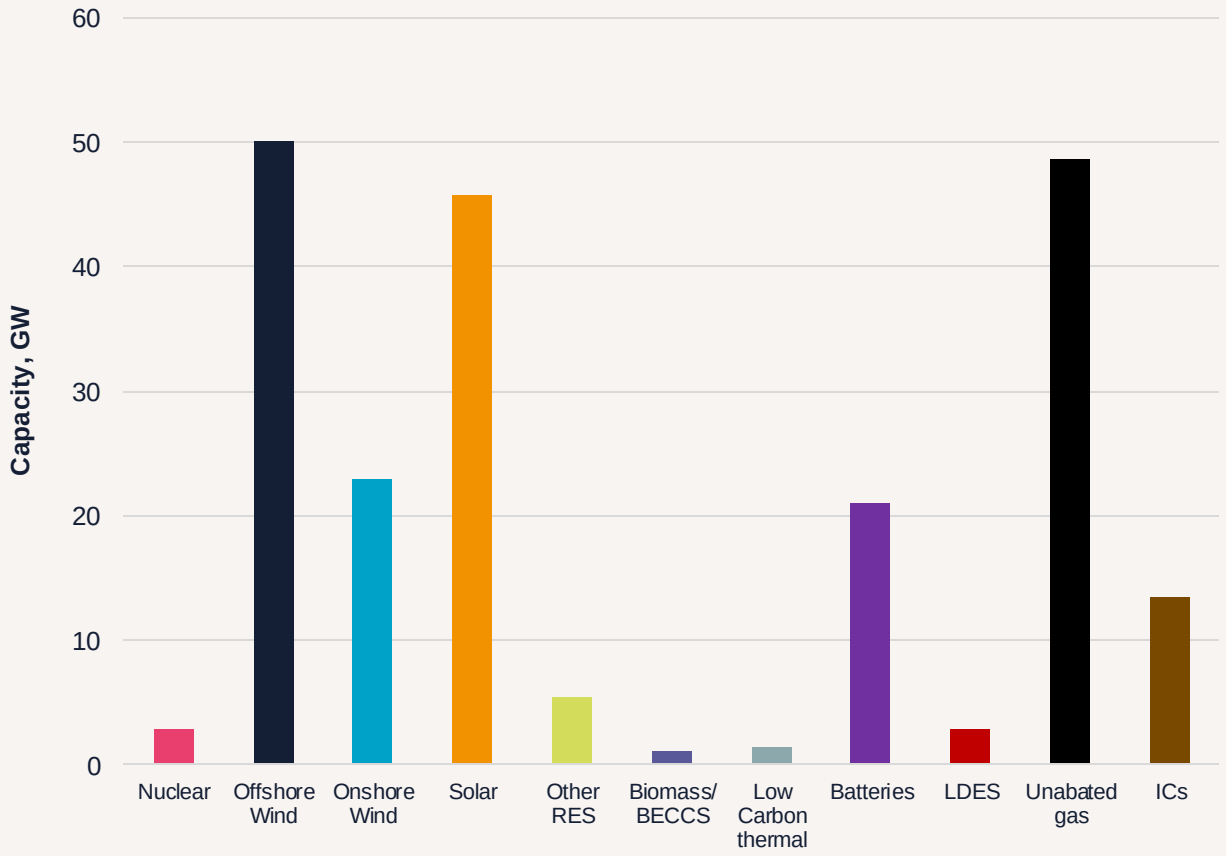
- The 'Previous Government scenario' is consistent with the British Energy Security Strategy published in 2022 and the previous government's ambition of a 'fully decarbonised' power system by 2035, subject to security of supply.
- Based on LCP Delta's assessment of previous government commitments and the expected pipeline of projects, in 2030 this scenario includes:
  - Meeting 50GW offshore wind target and but limited increases in onshore wind capacity given the de-facto ban on building onshore wind in England. Solar capacity increases to 45GW in line with ambition 70GW solar by 2035
  - Closure of much of the existing biomass plants (as RO support ends) and Nuclear fleet (except Sizewell B). Delivery of the 1st unit of Hinkley Point C (HPC)
  - Delivery of 1 Gas CCS project by 2030 and no hydrogen to power
  - Increase in short duration storage capacity in line with the expected pipeline but no new LDES given the cap and floor scheme is not yet implemented. Interconnector capacity increase in line with expected new projects.
- Under this capacity mix, 88% of domestic generation comes from low carbon sources meaning 12% of domestic generation is still coming from unabated gas.
- Gas is also still operating in the majority of hours across the year by generating (and likely setting the price) in 52% of hours across the year.

Key takeaway

Under the 'Previous government Scenario, 88% of generation comes from low carbon sources with gas generation still making up 12% of domestic generation.

To reach CP2030, a significant scale up in low carbon capacity is needed on previous government plans.

Previous government scenario – Capacity Mix in 2030



2. Labour manifesto scenario

Increasing renewable capacity alone is not enough to reach a clean power system

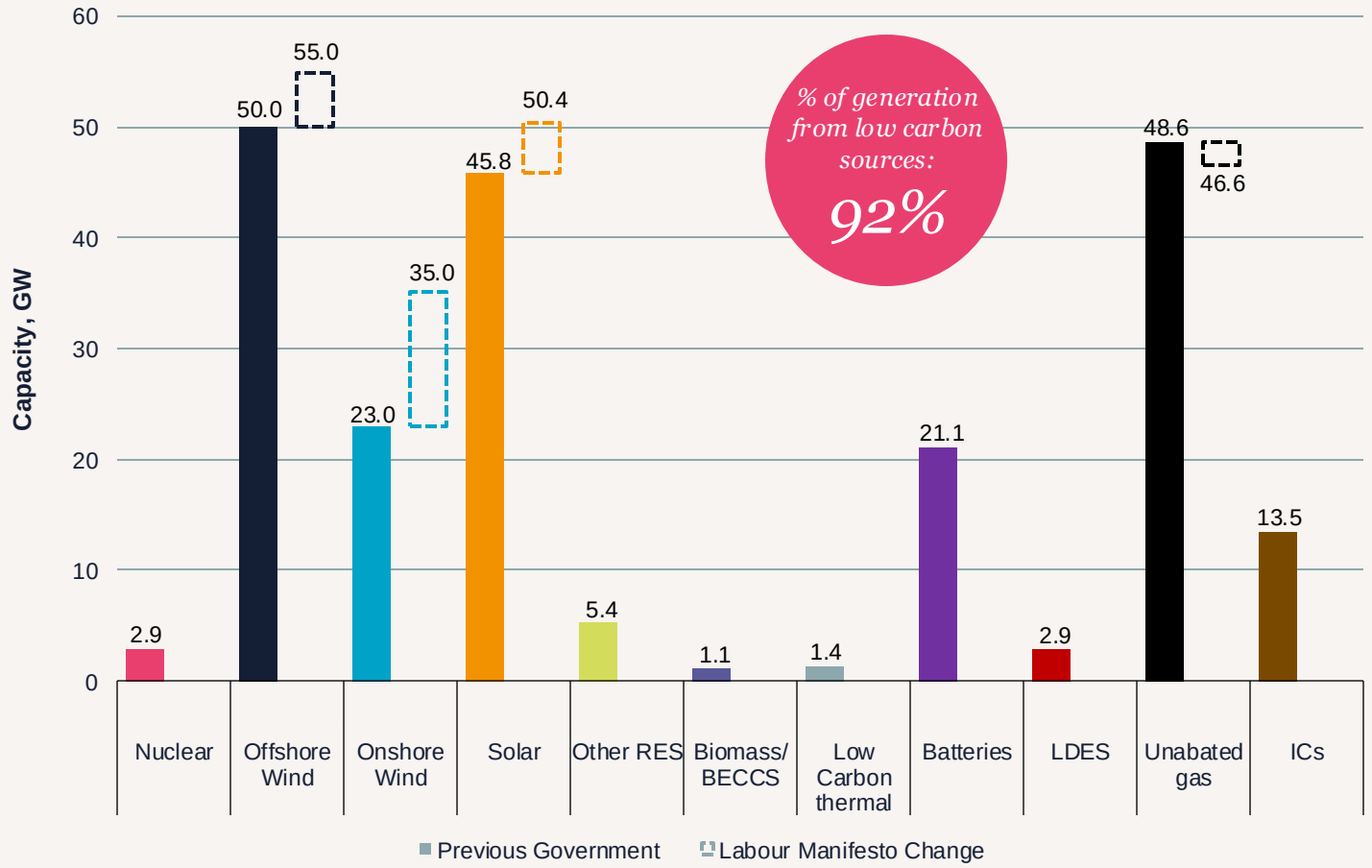
- Labour's manifesto and Mission report outlined ambitions to increase renewables build by 2030 increasing the offshore wind ambition to 55GW, a new solar ambition of 50GW and a new onshore wind ambition of 35GW.
- Adding this capacity to the previous government scenario to give a 'Labour Manifesto' scenario increases generation from low carbon sources to 92%.
- This is still below the >95% required to be consistent with meeting Clean Power in 2030 with unabated gas still provides 8% of domestic generation and generates in 42% of hours across the year.
- Increases in renewable capacity alone are not enough to reach a clean power system as there will still be a number of periods where the wind/solar output is low that will need to be filled by unabated gas.

Key takeaway

Increasing renewable capacity in line with Labour manifesto is not enough to reach CP2030 alone with this scenario only reaching 92% of generation from low carbon sources

Therefore, additional capacity in other areas is needed, particularly in flexible technologies and low carbon thermal, to fill the gap

Labour Manifesto scenario – Capacity Mix in 2030 compared to Previous Government scenario



3. Clean Power inc. Labour Manifesto Scenario

Additional flexibility and firm low carbon power is needed to reach Clean Power in addition to renewables

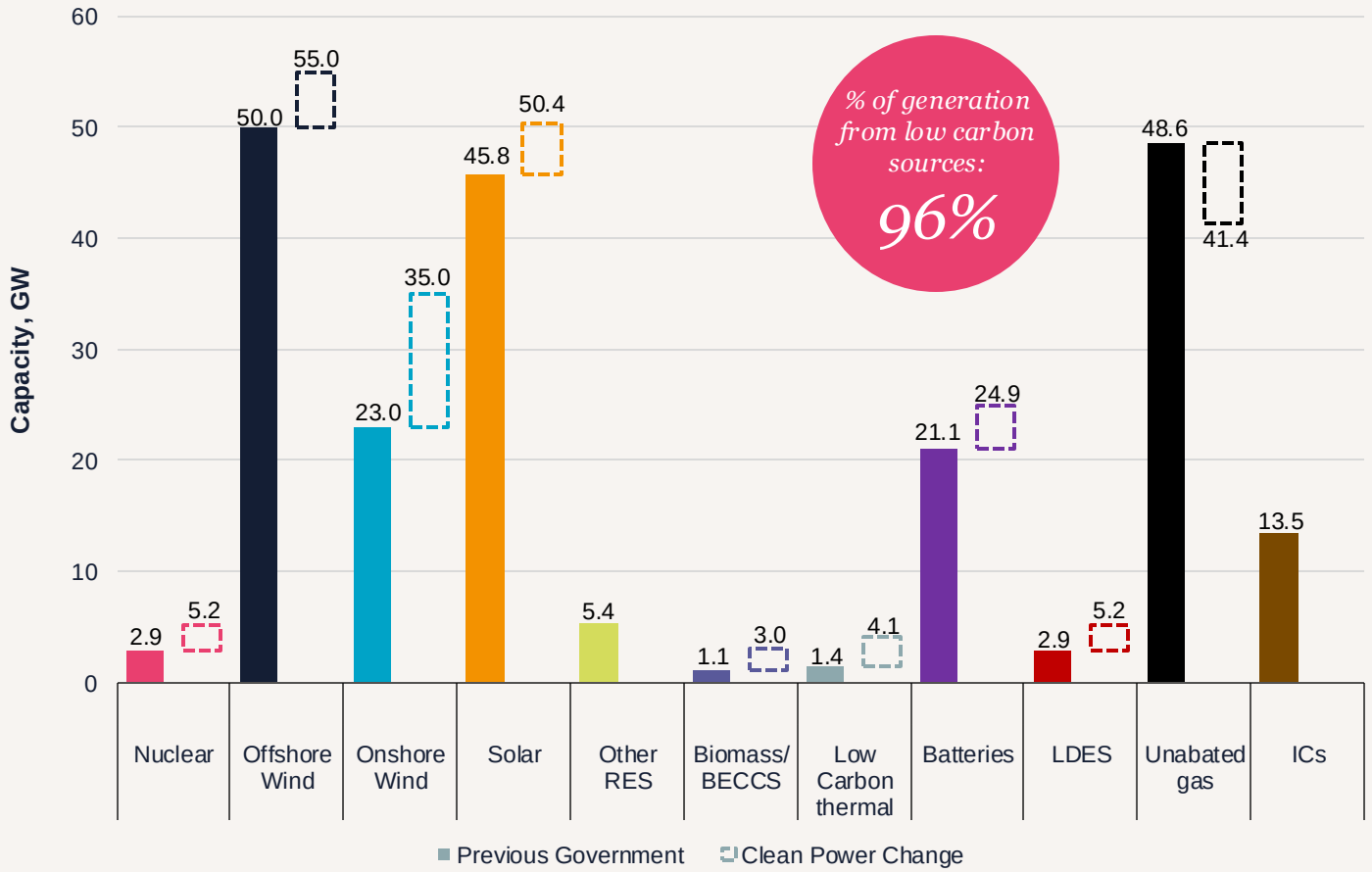
- LCP Delta have assessed the pipeline of different technologies to gain an understanding of what other technology types could increase their capacity by 2030, in addition to wind and solar (in line with Labour Manifesto.
- This analysis has shown that there are limited options in growth of other technologies beyond a scenario consistent with previous government plans. All technologies essentially need to deliver to near maximum levels for CP2030 to be reached.
- This scenario shows growth in storage (short and long) and low carbon thermal (Gas CCS and hydrogen) beyond the previous government levels. However, this will also need to be supported by extensions to the lifetime of existing nuclear and biomass plants.
- Additional demand side response will also play a role reducing the peak demand across the year by around 10GW.
- This scenario increases the % of generation from low carbon sources to 96% with unabated gas provided just 4% of generation and generating in 30% of hours across the year.

Key takeaway

The 'Clean Power inc. Labour Manifesto scenario' sees the % of generation from low carbon sources increase to 96%.

The deployment of additional firm low carbon and flexible technologies is required for CP2030 to displace unabated gas during low renewable and high demand periods.

Clean Power inc. Labour Manifesto scenario – Capacity mix in 2030 compared to Previous Government scenario



4. LCP Delta Clean Power Scenario

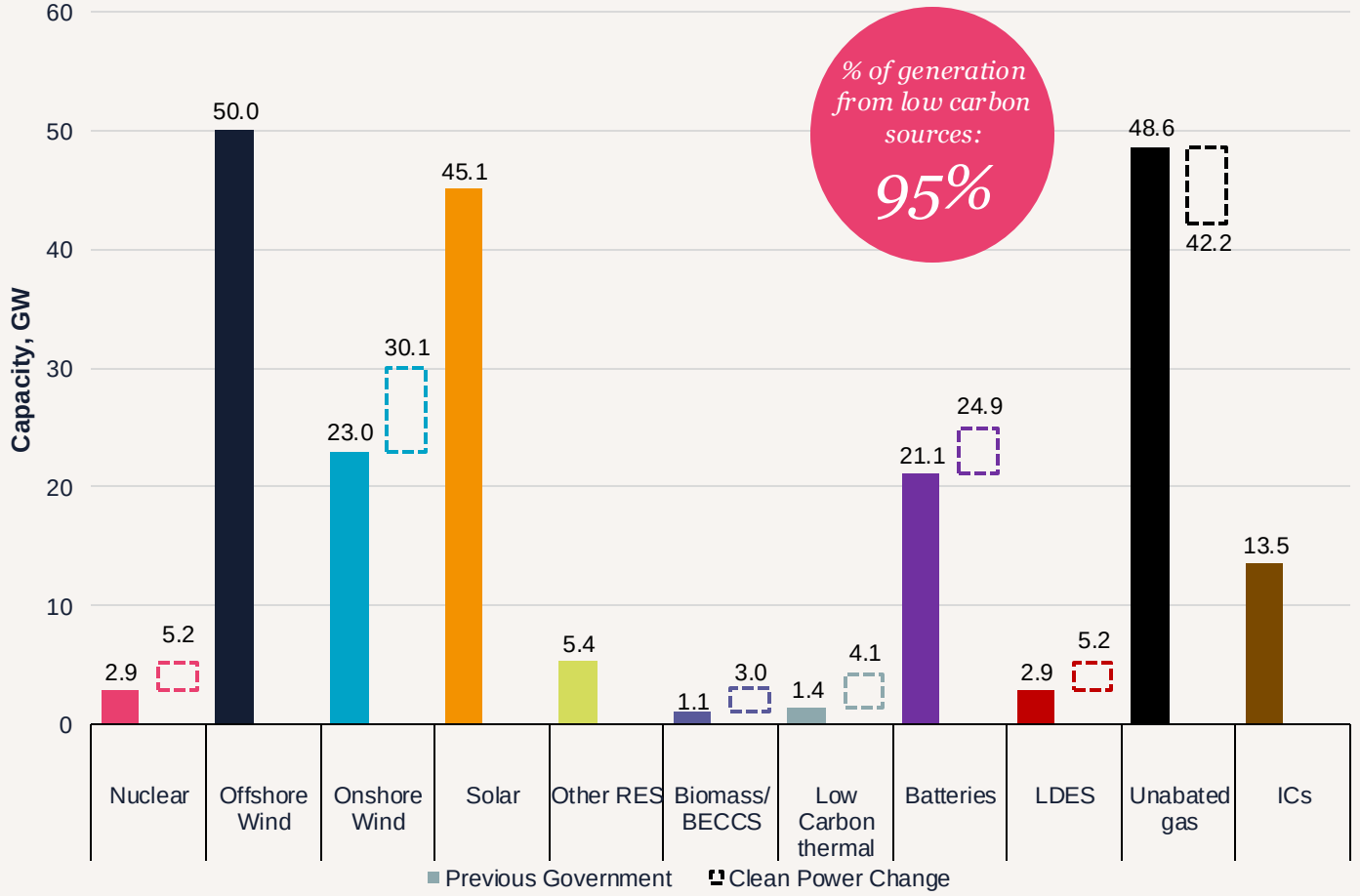
Renewable levels do not need to reach levels set out Labour Manifesto, but significant increases are still needed

- The renewable ambitions set out in the Labour Manifesto can be reduced to slightly lower levels with Clean Power 2030 still being met.
- Offshore Wind can be reduced to 50GW (from 55GW), onshore wind to 30GW (from 35GW) and solar to 45GW (from 50GW). For offshore wind and solar, this reduces these levels back in line with the previous government ambitions.
- This still requires a significant increase in capacity from today's levels but does ease the pressures somewhat on the levels needed.
- On one hand, given the significant delivery risk associated with reaching Clean Power, it may be prudent for the Government to over procure renewable projects to guard against delayed delivery and ensure CP2030 is given the best chance of delivery.
- LCP's Clean Power scenario sees the % of generation from low carbon sources at 95% with unabated gas provided just 5% of generation and generating in 33% of hours across the year.

Key takeaway

LCP Delta's Clean Power scenario shows that Labour's renewable ambitions can be eased back slightly with 95% of generation from low carbon sources. But significant build out by 2030 is still required.

LCP Delta Clean Power scenario – Capacity Mix in 2030 compared to Previous Government scenario



Reaching Clean Power 2030

LCP Delta analysis shows significant build is required across all technologies if CP2030 is to be achieved with most technologies needing to be deployed to maximum feasible levels

Offshore wind sees a 35GW increase on 2023 levels to reach 50GW in 2030. This requires 19GW of new projects to be procured in the next two CfD auctions.

Onshore wind sees a 17GW increase on 2023 levels to reach 30GW in 2030. This requires 13GW of new projects to be procured through CfD auctions.

Solar sees a 30GW increase to reach 45GW in 2030. This requires a build of 4.2GW per year, more than was seen at the height of the FiTS scheme.

Nuclear capacity sees a small decrease from 2023 due to closure of existing plants, however clean power requires more existing plants to stay online beyond 2030 than is currently planned in addition to the first unit of Hinkley Point C.

Low Carbon thermal sees new build of 4GW of capacity comprising of 3GW of Gas CCS and 1GW of Hydrogen to Power

Biomass/BECCS sees no change from 2023 levels. CP2030 requires most current biomass plants to remain online beyond their current RO contracts, either continuing as biomass or converted to BECCS

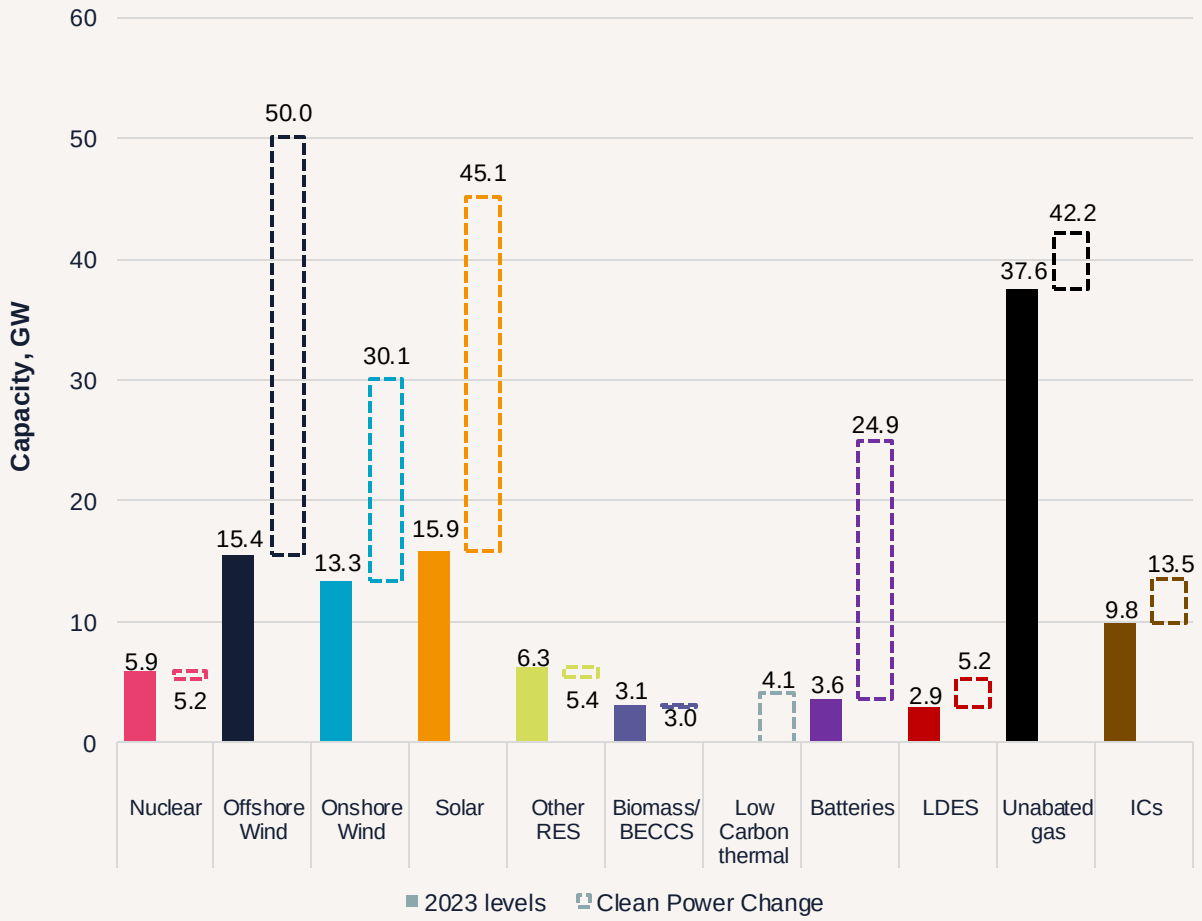
Batteries sees a 21GW increase on 2023 levels to reach 25GW in 2030. Battery capacity increase in line with renewables.

LDES sees a 2.3GW increase on 2023 levels to reach 5GW in 2030. This is a small increase in pumped storage and new technologies, such as liquid air and compressed air, supported by the new Cap and Floor scheme.

Interconnectors see an increase of 4GW to reach 13.5GW by 2030. This increase reflects expected new capacity through the cap and floor scheme.

Unabated gas sees a 4GW increase on 2023 levels. While their use decreases, further capacity is needed to ensure security of supply.

LCP Delta Clean Power scenario capacity mix compared to 2023 levels



Impact on emissions

CP2030 has a limited impact on reducing emissions compared to previous government emissions targets for the power sector, but putting a plan in place means emissions commitments are more likely to be met

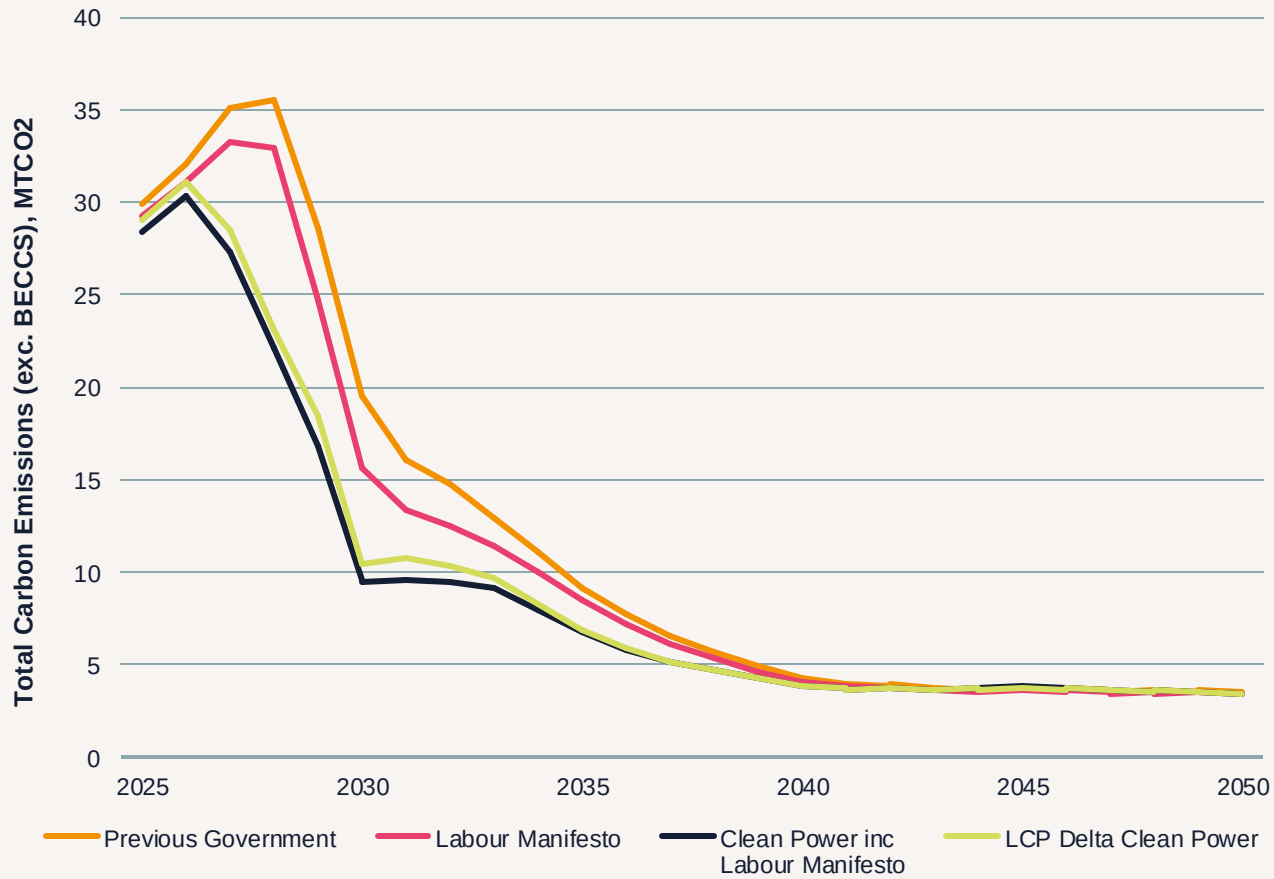
- The previous government had outlined an ambition to reduce power sector emissions by 69-74%* from 2023 levels to reach to 14-17MTCO2 in 2030. This level of power sector emissions is consistent with meeting the UK's 2030 Nationally Determined Contribution (NDC)
- LCP Delta's Previous Government scenario suggests plans were off track to meet that level reaching 19MTCO2 in 2030.
- Compared to the Previous Government scenario, LCP Delta's Clean Power scenario reduces emissions from 19MTCO2 to 10.5MTCO2.
- Overall, reaching a clean power system has limited impact on emissions compared to commitments made by the previous government.
- However, the clean power mission does mean a more detailed plan is being put in place for the power sector which would mean the NDC 2030 commitment and the power sector contribution to Carbon Budget 6 are more likely to be achieved.
- In the longer term, the clean power mission does not change the system we are likely to reach by 2050 but does reduce cumulative emissions across the 2025-50 period by 64MTCO2.

Key takeaway

The emissions impact of CP2030 is limited compared to previous government ambitions only reducing target emissions set out in the 2021 Net Zero Strategy by 3.5-6.5MT.

But having a clear plan in place increases chances of targets being met as well as providing wider benefits, such as international climate leadership

Emissions across scenarios



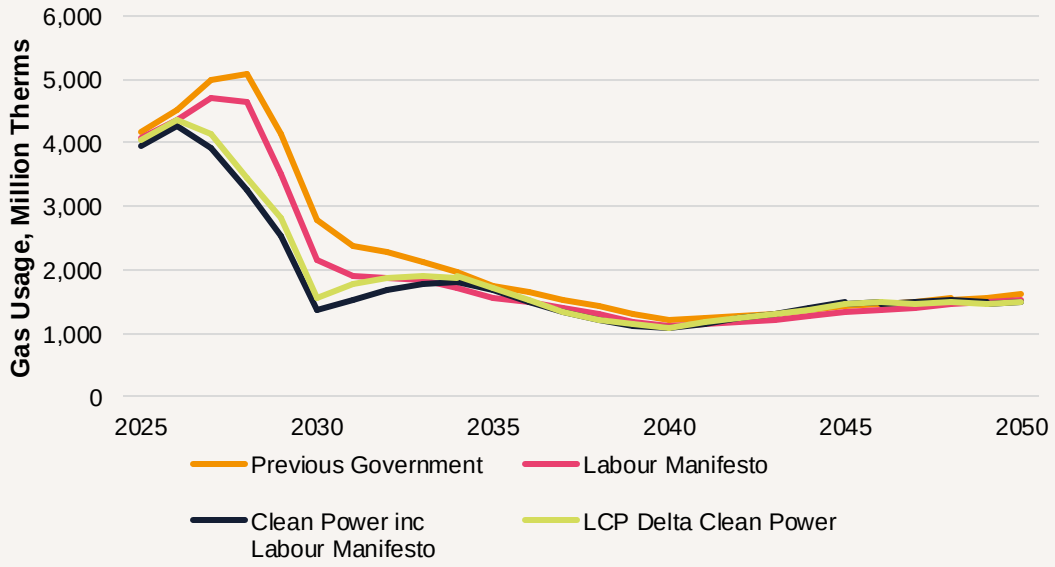
*The Previous government did not have a specific target for the power sector, but the Net Zero Strategy did outline what was needed to reach the NDC. This showed an emissions level of 14-17MT in 2030 for power.

Impact on gas use in the power sector

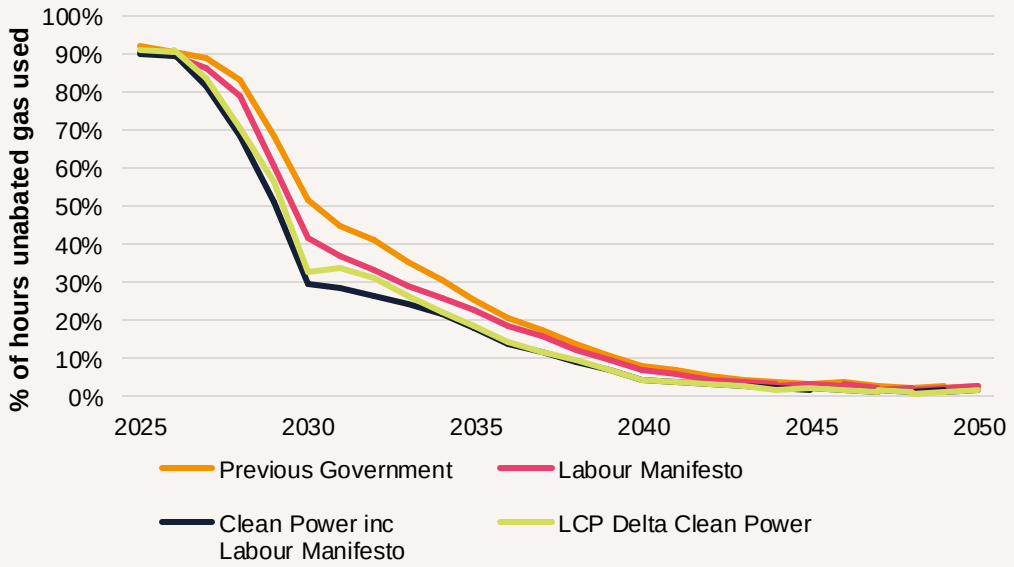
Gas is still likely to play an important role in the system in 2030 but will be used significantly less. This will reduce the impact of any gas price shocks similar to 2022

- Moving to a Clean Power system in 2030 will reduce use of unabated gas across the power system to less than 5% of domestic generation.
- However, unabated gas will still continue to play an important role across the power sector to ensure security of supply during high demand and/or low renewable output periods.
- In LCP Delta's Clean Power scenario, unabated gas (including CHP) is still used in 33% of hours across the year in 2030 compared to 52% in the Previous Government scenario and nearly 100% of hours today*.
- Gas will also still be used in CCS plants in 2030 and beyond with CCS likely to play an important role in the future energy system. However, total gas used in power sector plants (including CCS) is reduced by a cumulative 5 million therms from 2025 to 2030 compared to Previous Government scenario.
- Even though gas is still at the margin on a regular basis, CP2030 means that consumer bills are better insulated from shocks to the gas price (such as the recent energy crisis) as gas is setting the price less often and the increase in CfD renewables as a share of generation means a higher proportion of the bill is predictable in advance.

Gas used in power sector



No. of hours unabated gas generating



*Note that this excludes use of gas for dealing with thermal constraints

Costs of Clean Power

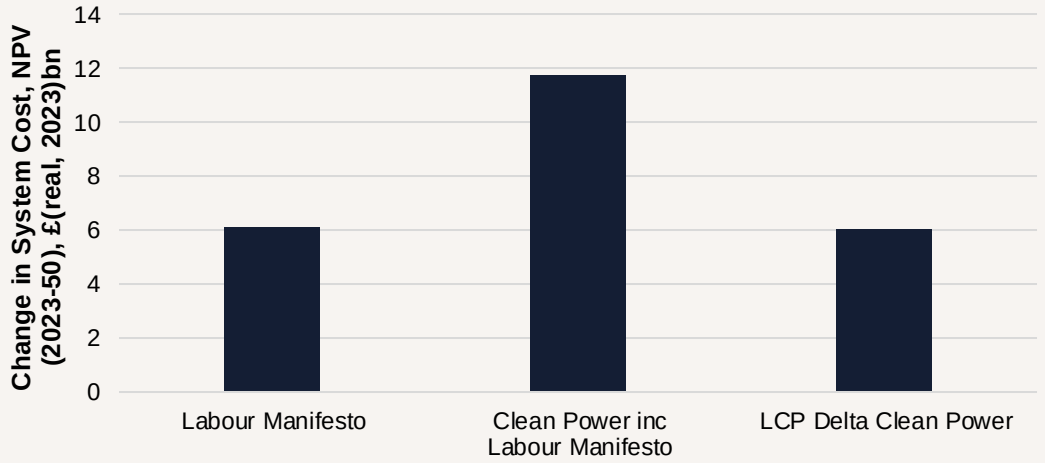
CP2030 will likely lead to an increase in system costs but reduces consumer exposure to volatile fossil fuel prices

- The increased low carbon build required means moving to a CP2030 scenario increases system costs compared to a previous government scenario.
- While generation and carbon costs decrease - as cheaper low carbon technologies are used more - this is offset by the increase in capex needed to build this additional capacity. This results in the LCP Delta Clean Power scenario increasing system costs by £6bn (NPV) over 2025 to 2050 compared to previous government plans. For more detail on system costs and how they calculated, please see the Annex.
- A positive outcome is that by moving to CP2030 then reduces consumers exposure to volatile fossil fuel prices. Even though gas is still at the margin on a regular basis in that time period, CP2030 means that consumer bills are better insulated from shocks to the gas price (such as the recent energy crisis). This is a direct result from gas setting the price less often and the increase in CfD renewables as a share of generation means a higher proportion of the bill is predictable in advance.
- To illustrate, if in 2030 we experienced a gas price shock akin to prices in 2022, then household costs* would be £100 lower in CP2030 compared to the previous government scenario. This is due to CfD generators providing a higher share of generation mix.

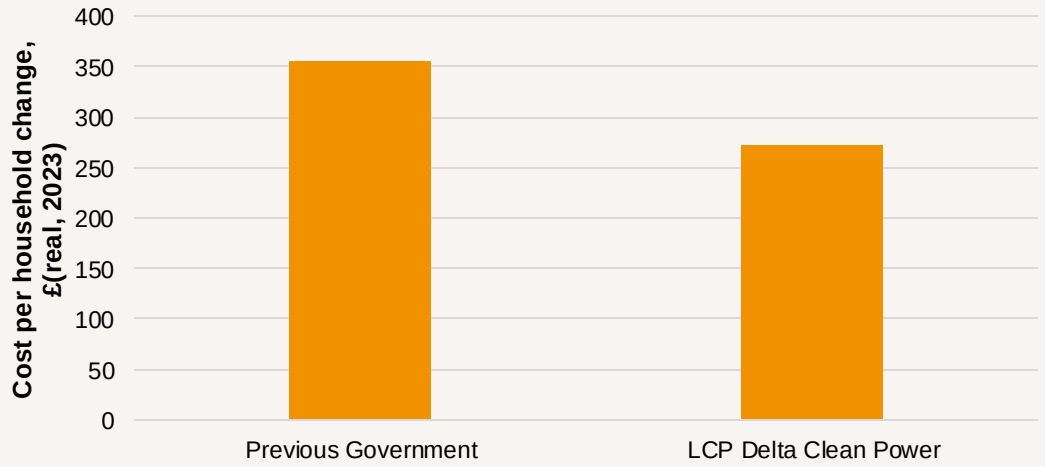
Key takeaway

CP2030 reduces consumer exposure to volatile fossil fuel prices. Under the LCP Delta Clean Power scenario, the rise in bills is £100 less compared to the Previous Government scenario if gas prices were to increase to 2022 levels.

Change in System Costs compared to Previous Government Scenario



Change in consumer cost per household in 2030 with higher gas prices



* Cost per household refers to wholesale and environmental and social policy costs elements of the bill only

Comparison to NESO Clean Power system

LCP Delta's Clean Power scenario shows most technologies aligning with the higher levels across the two NESO scenarios highlighting that the government should aim for the max feasible levels across all technologies

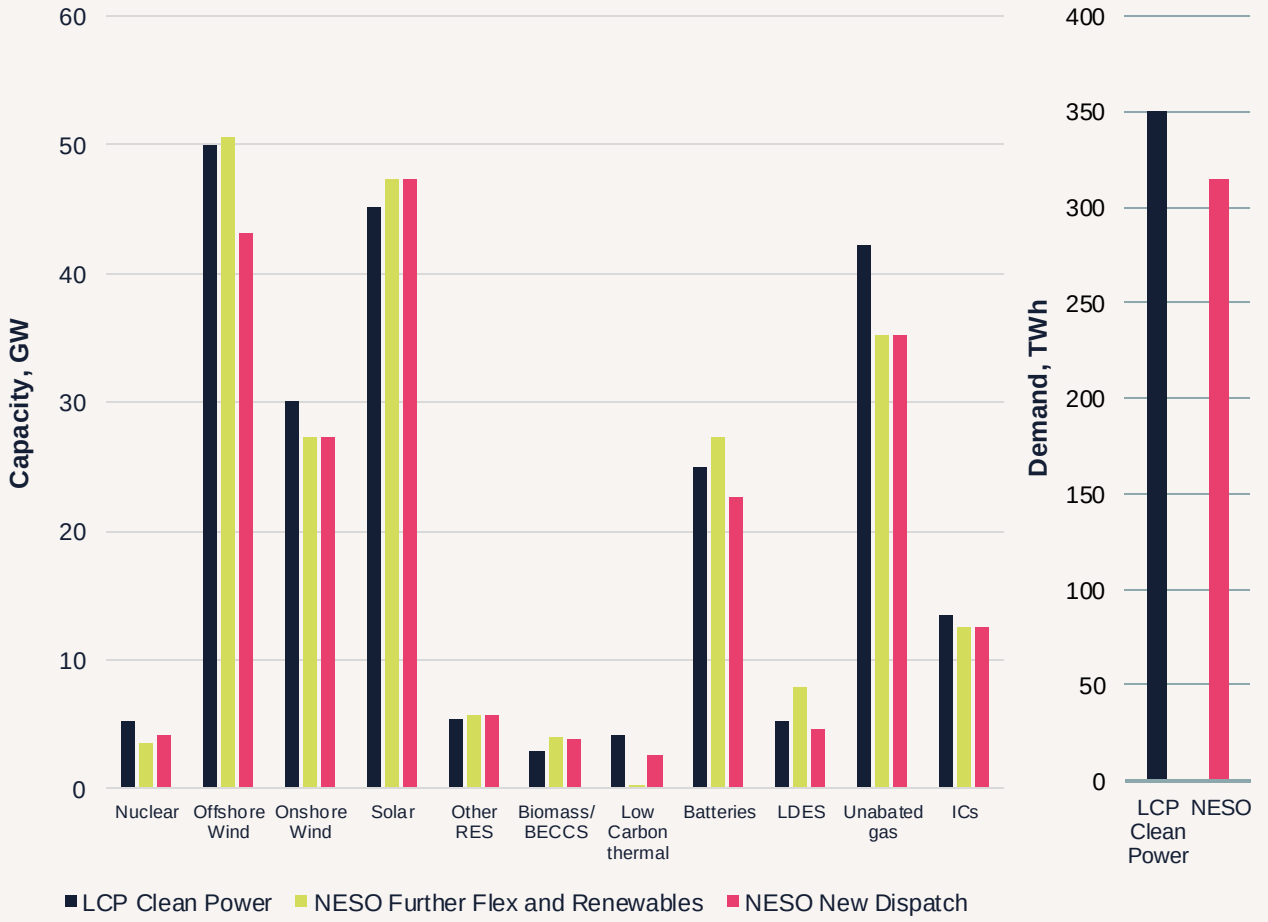
- The government commissioned NESO to provide advice on achieving the CP2030 target. This report was published in November 2024 with NESO showing 2 possible scenarios with different capacity mixes to reach CP2030. This provides a useful comparison to LCP Delta's Clean Power scenario
- LCP Delta scenario shows higher deployment overall compared to the NESO scenarios. This is most likely due to slightly different definition of low carbon generation (including CHP) and higher demand in the LCP scenario. NESO's assumption is based off FES 2024) while the LCP Delta demand assumption aligns with DESNZ published demand levels.
- LCP Delta analysis shows that optionality in reaching CP2030 is more limited compared to NESO analysis. LCP Delta's scenario shows capacity across most technologies needs to be deployed at a similar point to the higher level across NESO's two scenarios.
- LCP Delta largely align with NESO's assessment of what is feasible to build by 2030. The only area where NESO assumptions seem more optimistic is in deployment of LDES in the Further Flex and Renewables scenario. Based on LCP Delta analysis of the pipeline from StoreTRACK, 8GW by 2030 is likely unrealistic given most pumped storage projects will complete after this point as they have long development timelines.

Key takeaway

The government cannot aim for just one of the NESO's scenarios as higher than planned demand and delivery risk on projects could lead to CP2030 not being reached.

To reach CP2030, government must aim to deploy all key low carbon technologies to their maximum feasible level in line with the LCP Delta Clean Power Scenario

Capacity and demand comparison between LCP Delta Clean Power Scenario and NESO Clean Power scenarios



Note it is unclear if NESO's unabated gas figures include Gas CHP so these figures could be higher

LCP Delta

Are we on track to meet Clean Power by 2030?

Assessing progress in 2023/24 and highlighting key actions and recommendations that are needed to reach CP2030

Building more power plants is not easy

The rate of build across 2022/23 was far below the build that is required to reach Clean Power in 2030

With the exception of interconnectors, no technology was built in 2023 at the rate required to reach LCP Delta Clean Power 2030 scenario:

Offshore wind increased by 1.5GW (11%) in 2023 to a total capacity of 15.4GW. This is significantly below the average of 4.7GW per year rate needed to reach 50GW by 2030 and lower than the 2.6GW of build seen in 2021/22.

Onshore wind showed no increase in capacity in 2023 according to government statistics leaving a total capacity of 13.3GW. Growth needs to accelerate to reach the 2.4GW yearly build needed for 30GW by 2030.

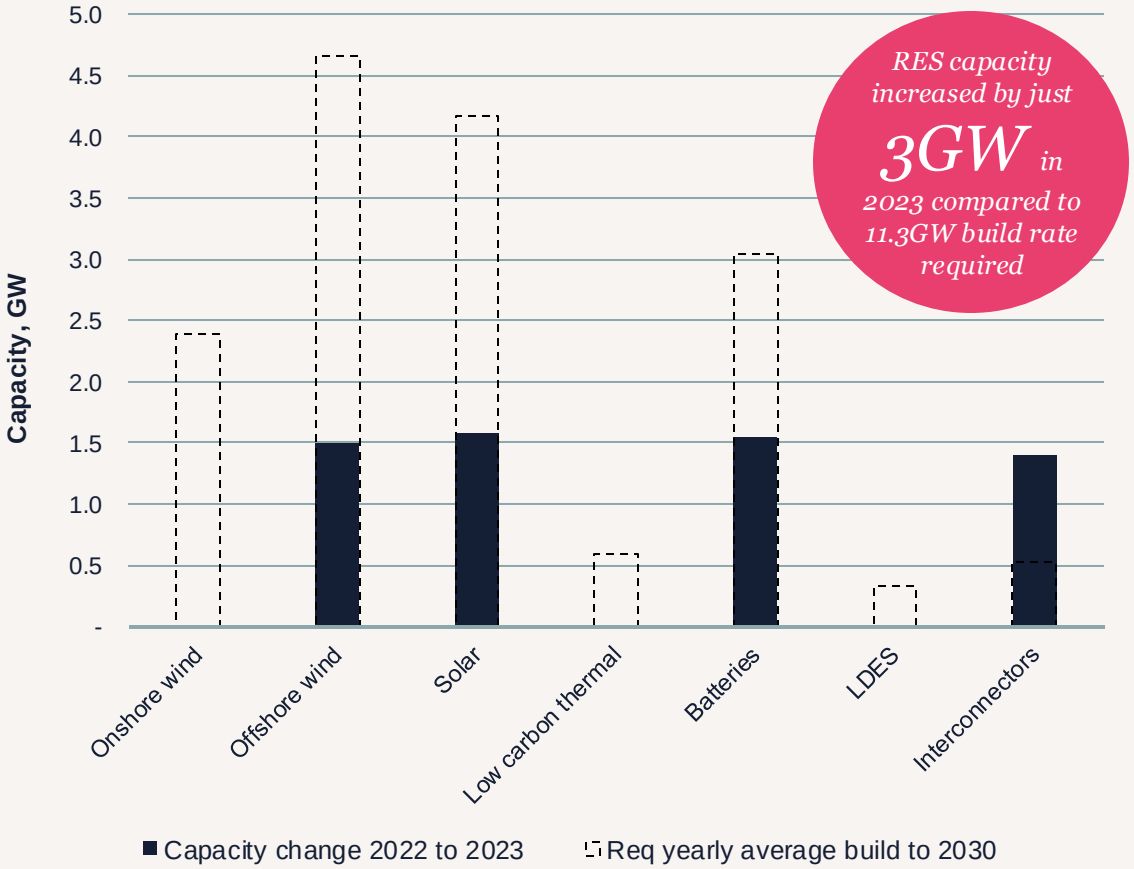
Solar increased by 1.6GW (11%) to 15.8GW in 2023. While this is double the build seen in 2022, this is still below the 4.2GW per year rate needed to reach 45GW by 2030 and below the 2-4GW a year growth seen in 2014-16.

Low Carbon Thermal & LDES saw no additions in 2023. There is currently no Gas CCS or Hydrogen to power on the system and 2.8GW of pumped storage. Neither of these technologies are expected to grow until later in the decade.

Battery storage increased by 1.5GW in 2023 to reach a total of 3.6GW. This is below the 3GW per year build required to reach 25GW in 2030. Batteries have a strong pipeline to reach this level but are held back by connection issues.

Interconnector capacity increased by 1.4GW with the opening of the Viking Link interconnector with Denmark to reach a total of 9.8GW. This is above the build needed to reach 13.5GW by 2030 but the previous government's 18GW target by 2030 now appears impossible to meet.

GB capacity change 2022 to 2023 vs required yearly average build to 2030



Note: Historical data based on DUKES with battery storage from LCP Delta STORETrack. Required yearly average build to 2030 based on LCP Delta Clean Power scenario.

Key takeaway

Build rates need to significantly increase in future years if the capacity required to Clean Power 2030 is to be built. This will require changes in policy by the government and increased investment from industry

Step change in policy and investment

All technologies and enablers need faster development and more revenue certainty

CP2030 is technically achievable but it requires a significant step change in government policy and investment from industry.

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 of what is needed to reach a clean power system and progress made in 2023/24 towards, the following four areas have been identified as needing significant change and focus within the upcoming Clean Power action plan to give the GB system the best chance of reaching CP2030. 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.

Intermittent Renewables

Intermittent renewable technologies will provide the bulk of generation for the Clean Power system. While AR6 was an improvement in capacity procured compared to AR5, changes are needed for the next auctions 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 any deployment of gas CCS or Hydrogen to Power is be achieved by 2030.

Storage

GB has an acute need for both short and long duration electricity storage. While the pipeline of short duration batteries remains strong, not enough progress has been made on the cap and floor scheme to support deployment of long duration storage.

System enablers

CP2030 requires certain challenges to be overcome to ensure parts of the system are enablers and not barriers. Reform is needed to current planning and connection agreement timelines and the transmission network needs to increase in line with increases in capacity if CP2030 is to be reached.

Turbo-charging intermittent renewables

There are enough offshore wind projects in the pipeline for the 50GW needed for clean power…
…but government planning reforms and increased CfD budget are needed to bring this capacity forward

Offshore wind will be the foundation of our future system. GB had 14.9GW of offshore wind on the system in 2023. There is an additional 15.3GW that already has a CfD agreement; leaving a gap of almost 20GW to reach the 50GW needed for CP2030.

The previous CfD auction, AR6, procured 3.4GW of new offshore wind capacity. This was an improvement on the failure of AR5 to procure any offshore wind but was well below the 8GW that was needed to be on track to reach 50GW by 2030.

Analysis of the offshore wind pipeline shows that there are enough projects in the current pipeline to make the 50GW achievable, but that at least 9GW of projects still need to receive planning consent before they can participate in the CfD.

Based on current timelines for projects, next year's AR7 and the following AR8 auction would each need to procure 10GW of offshore wind in each auction. To achieve this, an increase in the budget is needed even if this reduces competitiveness in the auctions. Assuming similar clearing prices to AR6 and no change in the auction parameters or approach to CfD budgets, a budget of at least £1.8bn (in 2012 prices) will be required for the offshore wind pot alone – a 64% increase on AR6's budget of £1.1bn.

Previous analysis by LCP Delta (in last year's outlook) showed that extending CfD contracts to 20 and 25 years could reduce strike prices by £4/MWh and £7/MWh respectively. This reduces the budget needed for AR7 and AR8 by 12-25% to £1.4-1.6bn.

Offshore wind projects often take many years to approve but the Government may be able to speed up the process through changes to the National Planning Policy Framework, or through a fast delivery and implementation of the Planning and Infrastructure bill (due in Parliament in early 2025). This could potentially give another CfD auction to procure more capacity by 2030.

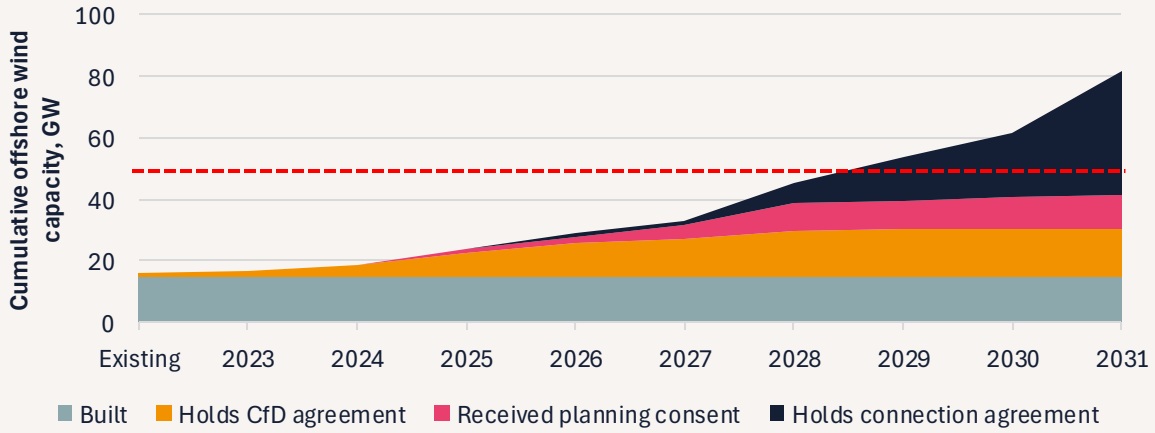
Key takeaway

To reach 50GW of offshore wind needed for CP203, 20GW needs to be procured across the next two CfD auctions. Assuming the same parameters and approach as AR6, this requires a 64% increase in budget to £1.8bn.

Offshore Wind CfD Budget required at different at different capacity levels and strike prices

Budget impact, £m, real 2012	Capacity, MW																	
Strike price, £(real 2012)/MWh	3,000	3,500	4,000	4,500	5,000	5,500	6,000	6,500	7,000	7,500	8,000	8,500	9,000	9,500	10,000	10,500	11,000
32.5	133	155	177	199	222	244	266	288	310	332	355	377	399	421	443	465	488
35	173	201	230	259	288	317	345	374	403	432	460	489	518	547	576	604	633
37.5	212	248	283	319	354	389	425	460	496	531	566	602	637	673	708	743	779
40	252	294	336	378	420	462	504	546	588	630	672	714	756	798	840	882	924
42.5	292	340	389	438	486	535	584	632	681	730	778	827	876	924	973	1,021	1,070
45	332	387	442	497	553	608	663	718	774	829	884	939	995	1,050	1,105	1,160	1,216
47.5	371	433	495	557	619	681	743	804	866	928	990	1,052	1,114	1,176	1,238	1,299	1,361
50	411	479	548	616	685	753	822	890	959	1,027	1,096	1,164	1,233	1,301	1,370	1,438	1,507
52.5	451	526	601	676	751	826	901	977	1,052	1,127	1,202	1,277	1,352	1,427	1,502	1,577	1,653
55	490	572	654	736	817	899	981	1,063	1,144	1,226	1,308	1,390	1,471	1,553	1,635	1,716	1,798
57.5	530	618	707	795	884	972	1,060	1,149	1,237	1,325	1,414	1,502	1,590	1,679	1,767	1,855	1,944
60	570	665	760	855	950	1,045	1,140	1,235	1,330	1,425	1,520	1,615	1,710	1,805	1,899	1,994	2,089
62.5	610	711	813	914	1,016	1,118	1,219	1,321	1,422	1,524	1,626	1,727	1,829	1,930	2,032	2,133	2,235
65	649	757	866	974	1,082	1,190	1,299	1,407	1,515	1,623	1,731	1,840	1,948	2,056	2,164	2,272	2,381
67.5	689	804	919	1,033	1,148	1,263	1,378	1,493	1,608	1,722	1,837	1,952	2,067	2,182	2,297	2,411	2,526
70	729	850	972	1,093	1,215	1,336	1,457	1,579	1,700	1,822	1,943	2,065	2,186	2,308	2,429	2,551	2,672
72.5	768	897	1,025	1,153	1,281	1,409	1,537	1,665	1,793	1,921	2,049	2,177	2,305	2,433	2,561	2,690	2,818

Offshore Wind Pipeline



Note: Offshore Wind Pipeline based on REPD and TEC Register data.

Turbo-charging intermittent renewables

Onshore wind build also needs to significantly ramp up to reach levels required for Clean Power with planning changes needed to bring forward more projects

GB had 13.3GW of onshore wind on the system in 2023. There is an additional 4.5GW of onshore and remote island wind that already has a CfD agreement, and an additional 0.7GW under construction without a CfD agreement; leaving a gap of 11.5GW to reach the 30GW needed for CP2030.

Analysis of the onshore wind pipeline shows that there is currently less capacity eligible for AR7 than how much is needed to hit CP2030 targets, but there is 8.3GW waiting for approval.

With onshore wind having shorter delivery timelines than offshore wind, the new government ending the de facto ban on projects in England and prospective reforms to planning, there should be enough time for more projects to come through. This is also important to ensure adequate competition in the CfD auction. However, action is still needed by the government to improve planning timelines and avoid delays.

Based on current timelines to bring projects online, there is likely to be 3 CfD auctions remaining that can procure onshore wind projects to deliver by 2030, meaning an average of 3.8GW per auction (assuming all delivered through the CfD). This is nearly double the onshore wind capacity that was procured in AR5 (largest auction for onshore wind to date) and three times the capacity procured in AR6.

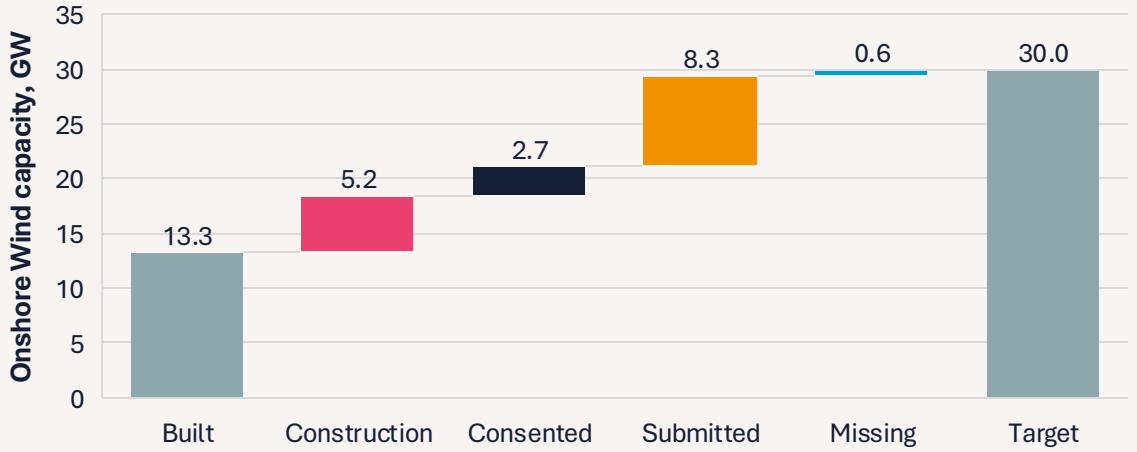
Assuming similar clearing prices to AR6 and no change in the auction parameters, a budget of at least £400m (in 2012 prices) will be required in Pot 1 for onshore wind alone, a 110% increase compared to AR6's budget. Pot 1 also has solar projects participating and therefore the ultimate size of the budget needs to be even higher.

Key takeaway

Based on the current pipeline, more onshore wind projects need to come forward and obtain planning permissions for 30GW by 2030 to be reached.

Budgets in the CfD for onshore wind will need to more than double compared to AR6 budget for onshore wind and solar to get this capacity online.

GB Onshore Wind Pipeline



Onshore Wind CfD Budget required at different at different capacity levels and strike prices

Budget impact, £m, real 2012		Capacity, MW				
		1,000	2,000	3,000	4,000	5,000
Strike price, £(real 2012)/MWh	40	60	120	180	240	300
	42.5	71	141	212	282	353
	45	81	162	243	325	406
	47.5	92	183	275	367	458
	50	102	205	307	409	511
	52.5	113	226	339	451	564
	55	123	247	370	494	617
	57.5	134	268	402	536	670
	60	145	289	434	578	723
	62.5	155	310	465	620	776

Turbo-charging intermittent renewables

Solar build needs to ramp to levels not seen since 2015 with CfD solar and rooftop solar build required to increase to meet CP2030

GB had 15.8GW of solar on the system in 2023. There is an additional 7.3GW of solar that already has a CfD agreement; leaving a gap of 21.9GW to reach the 45GW needed for Clean Power 2030.

While solar build has been steadily increasing year on year since 2020, the level of build is still significantly below the average 4.2GW required per year to reach 45GW and below the 4GW of build in 2015 during the height of the FiTS scheme. To reach 45GW by 2030 will require build to ramp up both through the CfD and increased deployment of residential and commercial solar.

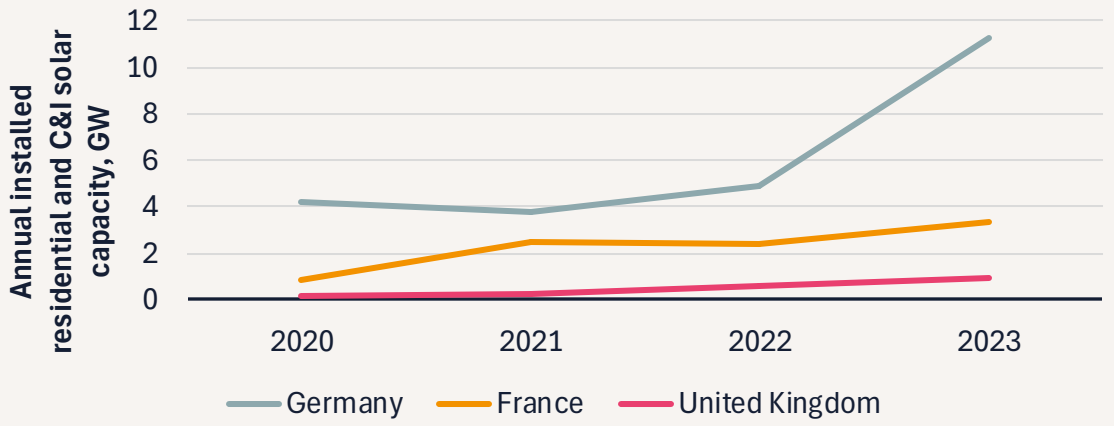
GB has seen much lower deployment of small-scale solar PV when compared to Germany and France, which both ramped up their deployment rates in recent years. Both countries use a simplified registration scheme, paired with building regulation requiring new-built or substantially renovating homes to install solar PV in certain cases. The government needs to do more to ramp up residential small-scale solar PV build and should consider implementing similar policies to France and Germany. For example, mandatory solar for new build properties in the residential sector.

Grid-scale solar projects continue to face planning barriers. Only 4 of the 93 projects successful in AR6 were above 50MW, with 20 schemes just below 50MW. Many projects are reluctant to build over 50MW due to the more complex planning application process, as well as the requirement to hold an energy generation licence. While the new Government has proposed increasing the threshold for planning applications, it is now also time to review the energy licence exemption threshold, to boost smaller solar farms.

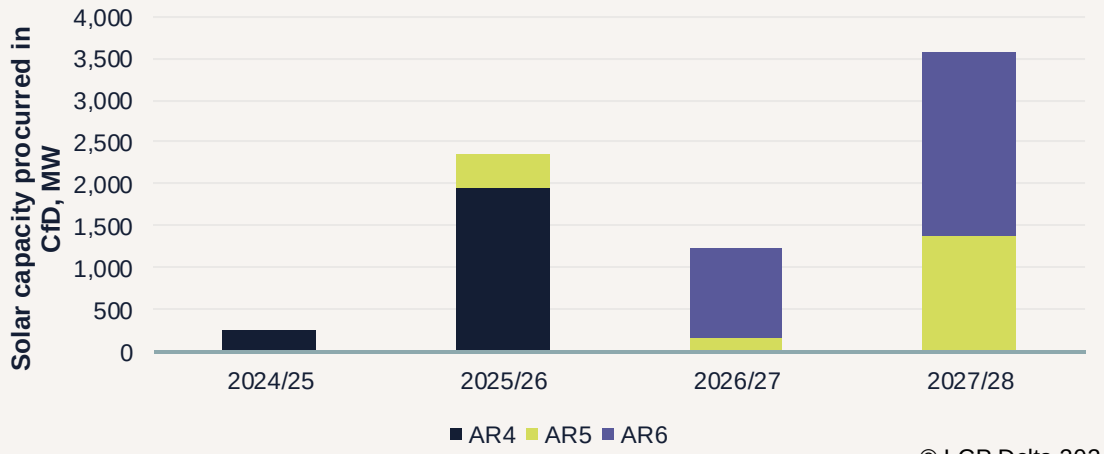
Key takeaway

Solar build needs to increase to 4.2GW compared to 1.6GW built in 2023. Larger solar projects currently face barriers on planning and energy generation licence requirements that need to be overcome while more needs to be done to support small scale solar build to reach levels seen in France and Germany.

GB residential and C&I solar build vs other countries



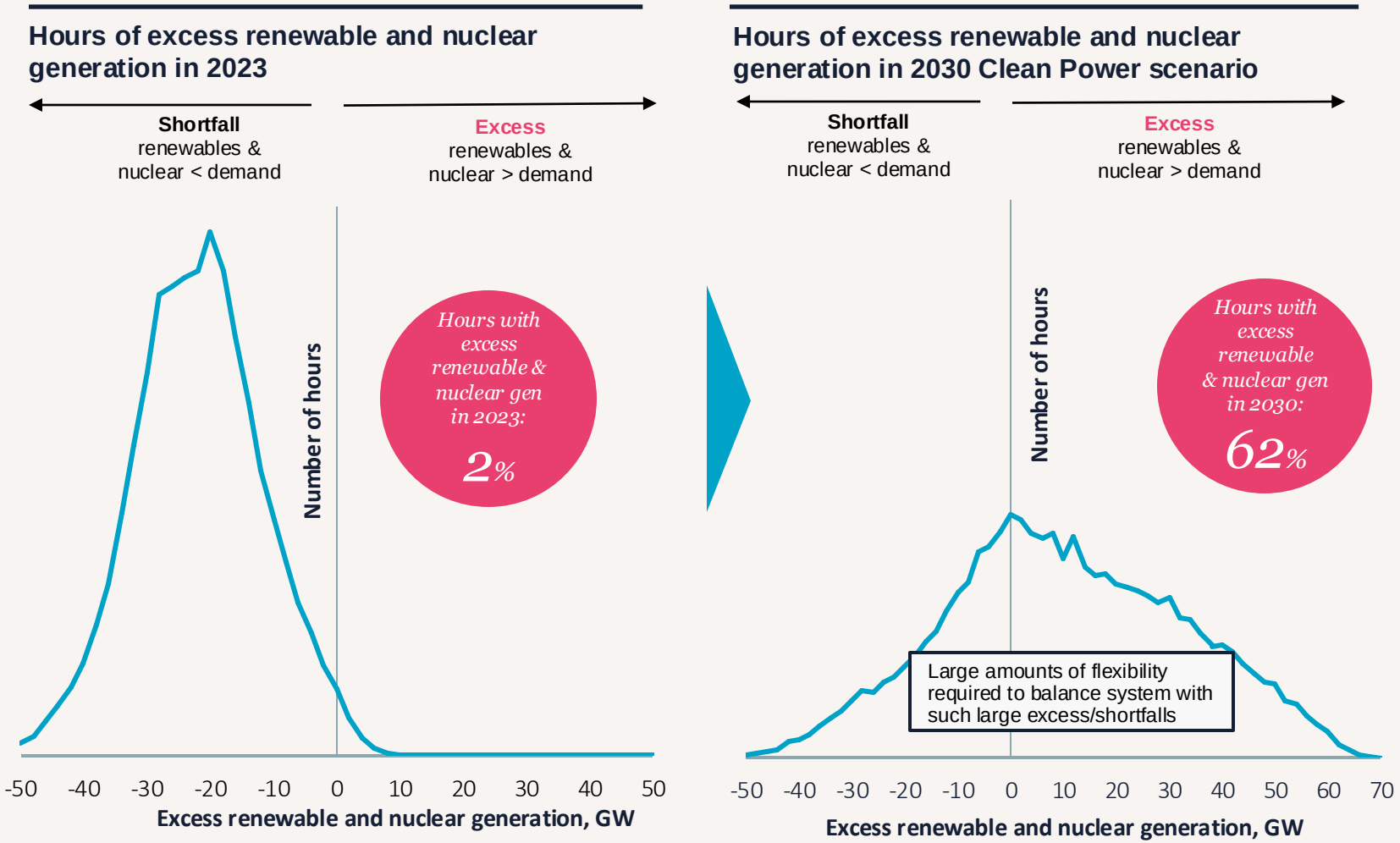
Solar capacity procured in the CfD by delivery year



Storing power for a rainy day

It's not rain we need to worry about, CP2030 means flexibility needs to be deployed at large scale to balance the system in 2030 when wind and solar output is low

- Flexibility (including storage) must be ramped up to aid system operability, stability and balancing in the face of intermittent generation from renewables which will provide low-cost bulk energy.
- The number of periods across the year where renewable and nuclear generation is in excess of demand (before any flexibility is used) will increase from 2% in 2023 to over 60% in 2030 under a Clean Power scenario. Flexible demand, including exports, electrolysis and storage charging will be needed to balance the system.
- Storage will enable electricity to be effectively moved from periods with excess renewable and nuclear generation to periods of shortfall helping to balance the system and avoid use of more expensive and higher emissions thermal generation to make-up the shortfall.



Storing power for a rainy day

The domination of offshore wind means the need for LDES is particularly acute in GB, but support for LDES is still lacking

The domination of wind in GB will drive longer periods of excess or shortfall of renewable generation. While there are many shorter duration periods of excess generation/demand that can be resolved with short duration storage, CP2030 will see many continuous periods of excess generation/demand that are 24 hours, or even 48 hours. This means that GB has an acute need for longer duration storage technologies.

LCP Delta's report for DESNZ published alongside the first Cap and Floor consultation earlier this year showed that deployment of LDES leads to a cheaper and more decarbonised power system. The analysis showed that adding 12GW of LDES to the system could lead to 28% reduction in emissions by 2035, and by deploying 20GW of LDES by 2050 can save up to £24bn in power sector system costs (NPV 2030-50).

While there is a strong pipeline of short duration battery storage and a clear investment case, the same is not true of LDES (including longer duration battery storage). The government's plans to progress with a Cap and Floor scheme for LDES is a positive step. However, the responses to the consultation, released in October, and a recent webinar from Ofgem outlining their current plans for implementing the scheme still leaves investors in LDES with a number of questions.

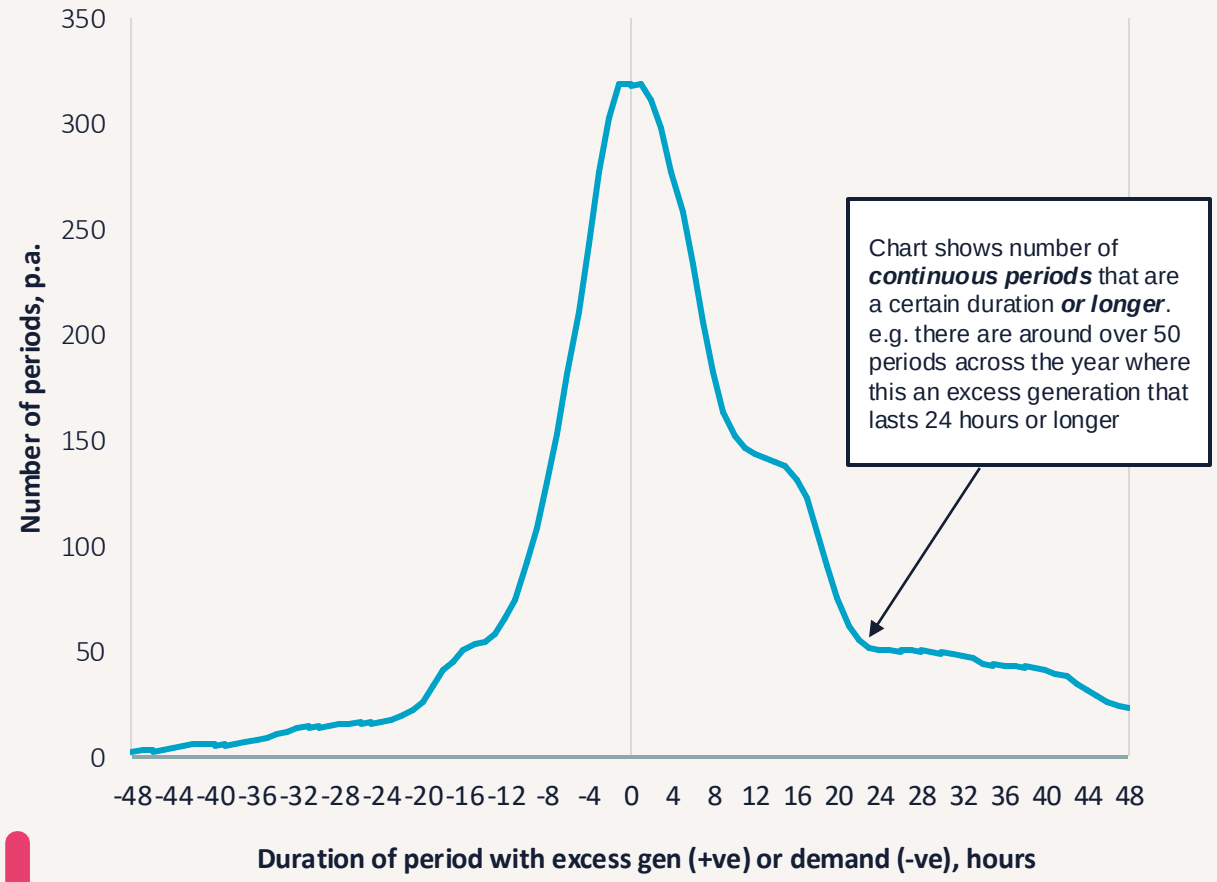
Ofgem's current proposed timetable for the scheme is to open applications for the first cap and floor window in mid-2025 but not award the first contracts until mid-2026. If LDES is going to make a positive contribution to CP2030, then the scheme timelines need to sped up dramatically to give projects contracts in 2025. For many LDES projects with a longer development timeline, such as pumped storage, this will already come too late to build by 2030, but there are projects in the pipeline that can deliver by 2030 if they can get a contract quickly.

Key takeaway

There is a clear need for LDES on the GB power system and 3.5GW of new projects are needed to reach CP2030.

These projects will need a Cap & Floor agreement but proposed timelines by Ofgem are far too slow creating a major risk to building the capacity needed.

Duration of periods requiring gen/demand flexibility: GB power system in 2030



The importance of firm low carbon power

Alternative to unabated gas generators will be needed to ensure security of supply and reach Clean Power

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 Clean Power scenario, despite renewable build out rates, there will be insufficient renewable and nuclear generation to meet demand in 38% of all periods in 2030.

While storage and flexible technologies can help fill this gap, generation from firm power sources will also be needed. Currently, this requirement is met with unabated gas, but if CP2030 is to be reached then this requirement will need to be met by low carbon technologies.

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. LCP Delta analysis shows that at least 4GW of these technologies (3GW Gas CCS and 1 GW Hydrogen to Power) is needed to replace enough unabated gas to meet CP2030.

In the past year, progress has been made on these technologies with the new government's announcement of £22bn in funding for CCS projects and more detail released on Hydrogen to Power business models. However, investors and project developers still need more clarity on how they will be supported by government if 4GW is to be delivered by 2030.

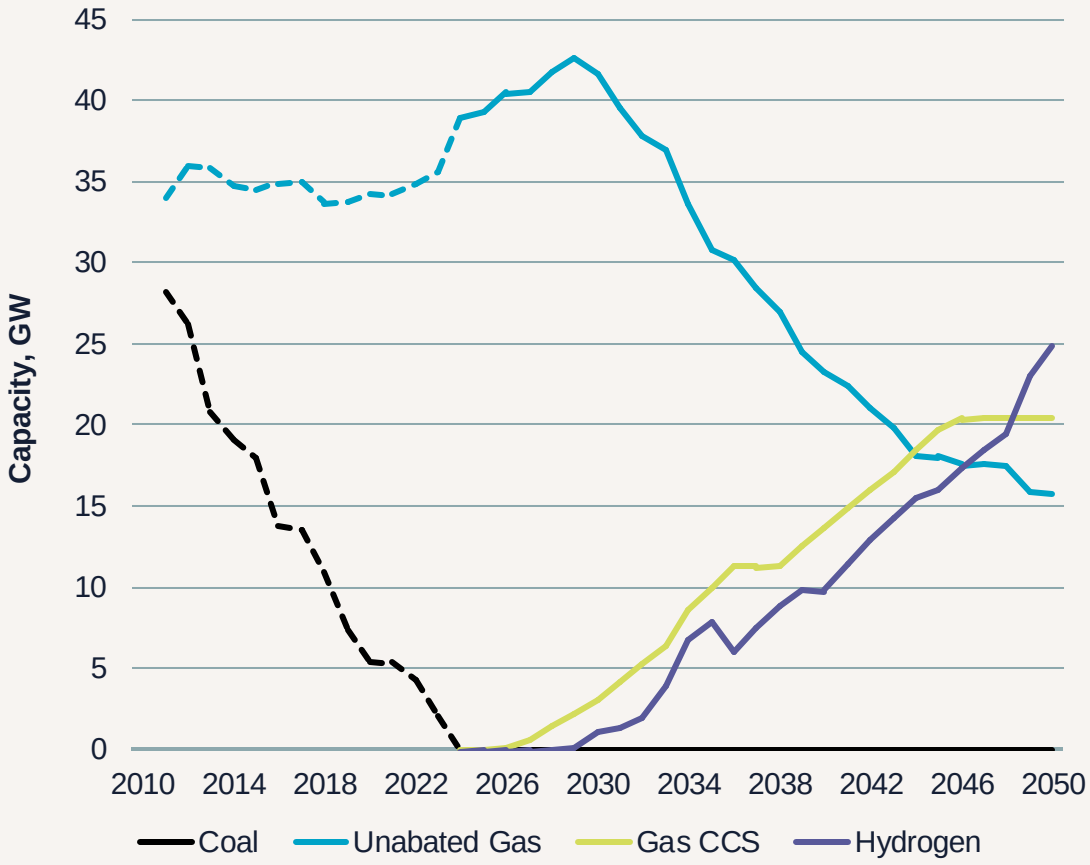
More detail is also needed on transport and storage arrangements for the carbon captured in gas CCS plants and how hydrogen will be supplied to Hydrogen to Power plants.

Key takeaway

Gas CCS and Hydrogen to Power are key to providing a low carbon option for security of supply and to replace unabated gas during higher demand/low renewable periods.

4GW of Gas CCS and Hydrogen to power are needed for CP2030.

Firm Thermal Capacity in LCP Delta Clean Power scenario



Prioritising system enablers

The transmission network needs to increase in line with increases in capacity to ensure low carbon power can meet demand

Building of the network has not kept pace with capacity deployment in recent years which has increased constraints on the network. This often means that renewable power generated in certain parts of the country (e.g. Scotland) cannot be transported to demand centres (e.g. in the South of England). This results in renewable power being turned down and gas generation being turned up to ensure that demand is met. This is paid for by consumers through constraint costs.

With CP2030 requiring more build of renewables which will be located away from demand centres and demand increasing, the network capacity needs to increase to reduce periods where gas is turned up. NESO's report identifies 88 network projects that are needed for CP2030 and to reduce constraints, with only 9 of these projects already built. It is vital that these projects are completed by 2030 to reduce gas turn ups and constraint costs for consumers.

LCP Delta analysis shows that if network capacity were to remain at current levels the constraint costs could be £7bn higher under a Clean Power scenario compared to a scenario where the network is built in line with NESO plans (pre the Clean Power publication). Unabated gas turn ups are also 12TWh higher under a scenario with no network reinforcement which would lead the share of generation that is low carbon dropping to 92% and the CP2030 target no longer being met.

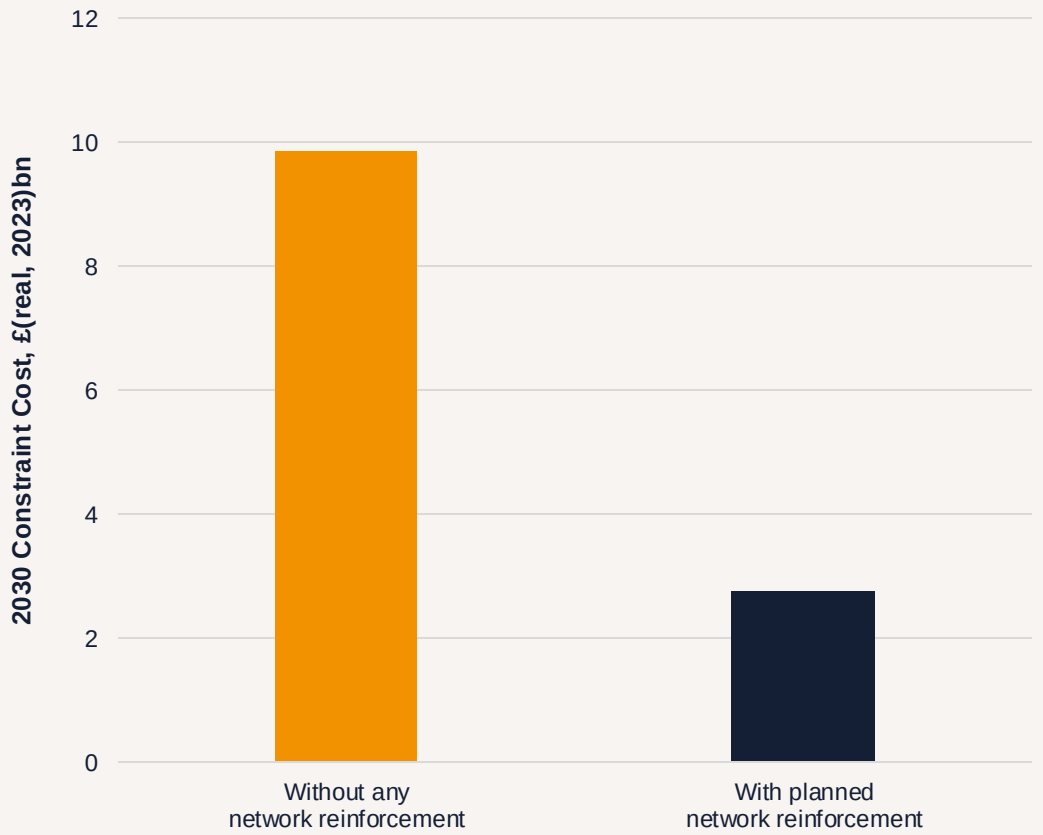
This highlights the critical role that the network will play in enabling CP2030. The level of network build needs to be significantly scaled up from current levels and increase in line with capacity. The government needs to prioritise delivery of network build in the Clean Power action plan making reforms to planning and working closely with industry, NESO and Ofgem to ensure the network is built to required levels.

Key takeaway

Deliver the 88 network projects identified by NESO for CP2030 must be prioritised with reforms needed.

Without reforms, network constraints will lead to 13TWh of additional gas generation – making CP2030 unachievable and increasing costs for consumers.

2030 Constraint Costs with and without network reinforcement under LCP Delta Clean Power scenario*



*Methodology used to calculate constraint costs is the same as that used by NESO as published here.

Prioritising system enablers

CP2030 is not possible with the reforms to planning

Over the next five years, power system capacity will have to more than double to reach CP2030. This rate of growth will not be possible under the existing development framework as projects are facing delays from the planning consent processes.

A major power plant can take up to seven years to build, with new nuclear projects being particularly delayed due to funding uncertainty. These problems have amounted to there being barely enough capacity in the pipeline to hit the governments capacity targets for renewable projects.

A few key chokepoints do exist which, if addressed quickly and efficiently, could be critical in advancing new builds. All new build projects share the same difficulty in getting planning approval. The government have sought to address planning constraints quickly with the introduction of the Planning and Infrastructure Bill, lifting the de-facto ban on onshore wind projects, and support for new solar projects. Changes to planning does need a unified approach across government departments beyond DESNZ, such as in the Treasury and the Ministry of Housing, Communities & Local Government.

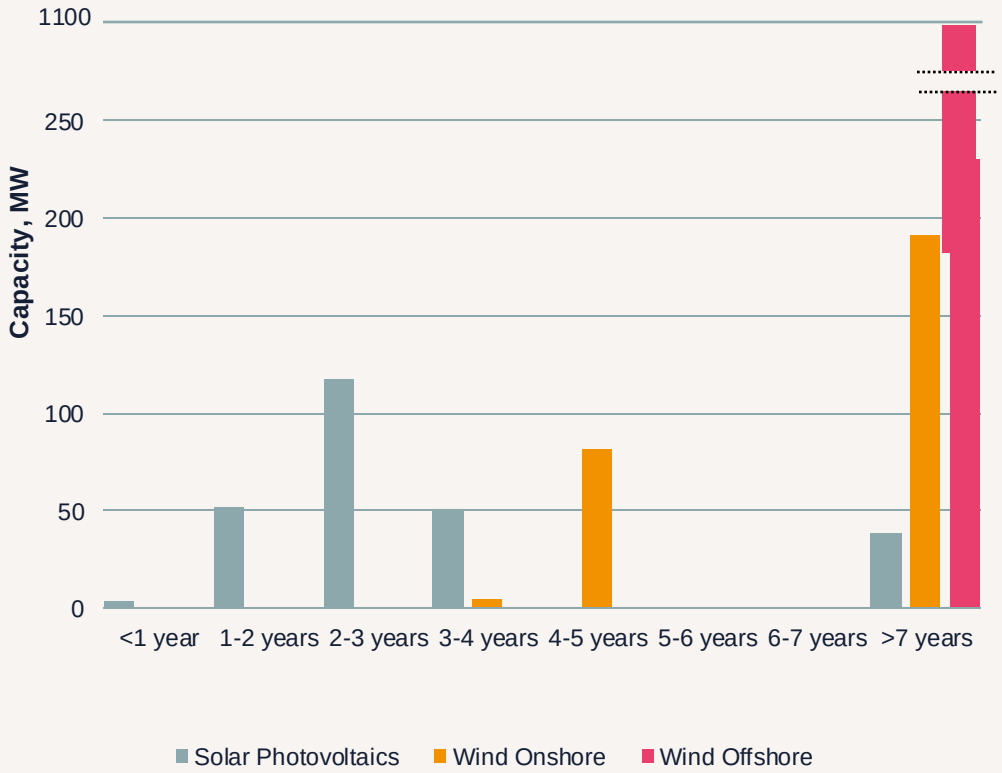
The Planning and Infrastructure Bill will be a critical enabler for new developments. For example, the proposal to reintegrate onshore wind into the Nationally Significant Infrastructure Project (NSIP) regime, increasing the capacity threshold for renewable projects to be classified as NSIPs, and to more heavily weight the benefits of renewable and low carbon generation in the National Planning Policy Framework. Including pre-determined pathways for how communities can get involved in planning decisions would reduce uncertainty and could allow communities feel more engaged in local planning decisions.

Key takeaway

The current planning regime is creating bottlenecks on the system with many projects waiting many years for planning approval .

While some positive steps have already been made, the Planning and Infrastructure Bill is desperately needed to ensure planning becomes an enabler not a barrier to CP2030.

Time from application submission to site being operational, 2023



Note: Based REPD data
Using the Renewable Energy Planning Database, we can see that average time it took from REPD application submission to a site being live.

Prioritising system enablers

Too many projects are waiting for connections

The grid queue has been an escalating predicament for new energy projects. The grid connections queue is greatly inflated, currently holding a capacity of 722GW across transmission and distribution networks. This reduces investor confidence and hinders the most valuable and ready projects from connecting quickly.

Historically, the barriers to enter the connections queue have been very low in GB. This has served the country well when relatively few new projects needed to be connected and therefore no major grid upgrades were necessary. However, the increase in the country's capacity needs, combined with a larger number of small capacity projects, has meant a huge influx of new connections. The grid queue currently holds twice as much capacity than the total installed capacity required in 2050 under Future Energy Scenario pathways.

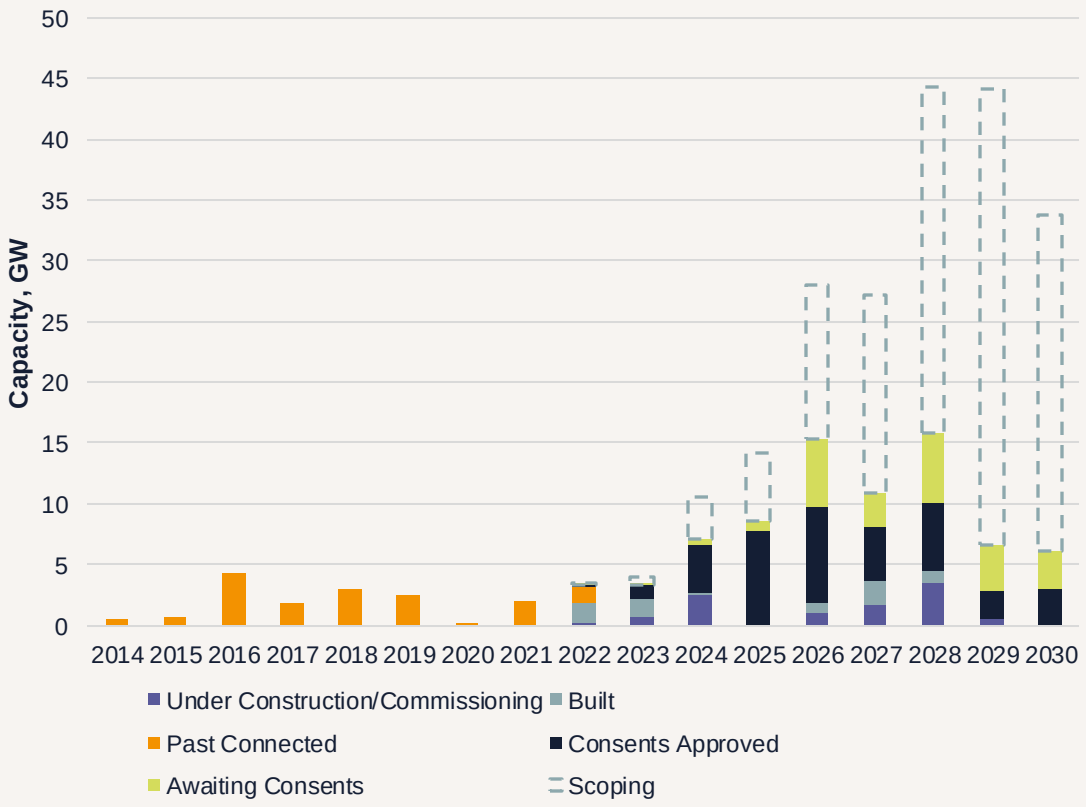
Steps have been taken to address this. Ofgem has been developing a 'First Ready, First Connected' approach (also known as TMO4+) which aims to streamline the connections queue by making queue entry criteria more stringent. Ofgem has recently moved to a 'First Ready *and Needed,* First Connected' approach, as outlined in a letter to industry. Most recent plans highlight the need to reach CP2030 targets and therefore define two fairly rigid boxes for projects to connect pre-2030 and projects to connect between 2030 and 2035.

Projects deemed ready, those with approved consents, under construction, or already built, offer three times the capacity to connect over the next seven years compared to the previous seven. Including scoping and projects awaiting consents increases potential capacity to 207GW by 2030, just under double what our analysis shows is needed for CP2030. Criteria for readiness and necessity must be transparent and industry-led to minimise impacts on investor confidence.

Key Takeaway

The grid connection queue is significantly inflated, with many projects entering before obtaining planning consent. A 'First Ready and Needed' approach is essential to address this backlog and achieve CP2030 targets.

Connections queue: Previously connected annual capacity and those awaiting consent



Note: Based TEC Register and DUKES data
Total connected capacity by year from 2014-2022 compared to the capacity waiting for connection in the current grid queue.

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Beyond CP2030

What are the challenges and opportunities post 2030?

Maintaining a Clean Power System

Further low carbon build will be needed post 2030 to ensure the GB power system continues to be a Clean Power system and is on track to deliver Net Zero by 2050

Reaching Clean Power by 2030 is not the end point for the power sector in its contribution to Net Zero. Post 2030 demand is set to increase significantly which will mean further investment and policy change is needed to ensure >95% of generation is met by low carbon sources. The level of gas use in power will also need to be reduced from 2030 levels by 2050 to ensure a Net Zero consistent power sector

As other parts of the system electrify, such as heat and transport, this increases demand on the power sector. By 2050, demand could double from today's levels with the most significant rise in demand expected between 2030 and 2035 where EV and heat pump adoption ramp up significantly. Demand across 2030 to 2035 increases by 100TWh in our scenario, double the increase seen from now to 2030.

This increase in demand will require further investment in low carbon technologies to ensure the system continues to be a Clean Power system post 2030. This means that the government needs to ensure any policy changes made to meet 2030 can continue to make an impact after this points.

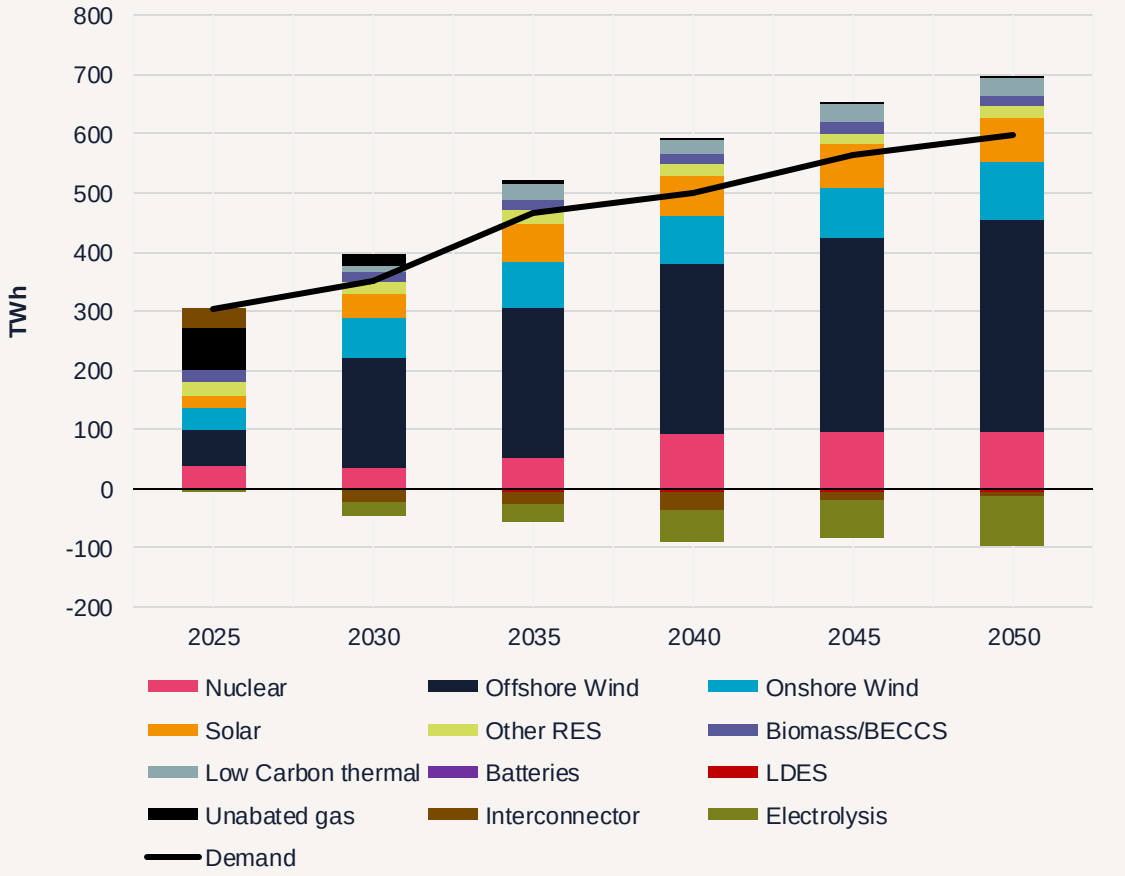
While many of the challenges for the post 2030 system are the same as those needed to reach CP2030, the post 2030 system will also face some different challenges that are likely to require some policy intervention from government and will impact on investors. Our analysis has identified three key areas:

Investment - Large levels of investment are needed in the power sector before and after 2030, but more investment is actually needed over 2030-50 to reach a Net Zero consistent power sector than now to 2030 to reach CP2030

Security of Supply – Rising demand over the 2030 to 2035 could lead to potential issues for security of supply. Changes may be needed to encourage investment in low carbon thermal assets needed to keep our system secure

Flexibility – Further decarbonisation of the system post 2030 creates both opportunities and risks for flexibility assets with renewables setting the price at close to £0 for an increasing number of periods across the year.

Generation mix and demand in LCP Delta Clean Power scenario to 2050



Investment required for Clean Power and beyond

Significant investment is needed for Clean Power 2030, but more investment is needed post 2030 to reach Net Zero

Over £355bn of investment* is needed in generation and flexibility technologies to deliver CP2030 and Net Zero by 2050. This requires significant commitment and fund from both private and public investment to make it a reality.

The Government is currently undertaking a Pensions Investment Review to find ways to increase the proportion of the UK's £2+ trillion of pension assets that is invested within the UK economy. This is an opportunity to incentivise pension schemes to invest in UK energy infrastructure, including through judicious use of GB Energy's seed capital. The key will be to ensure a strong pipeline of financially attractive investments that are aligned with pension schemes' risk and return objectives.

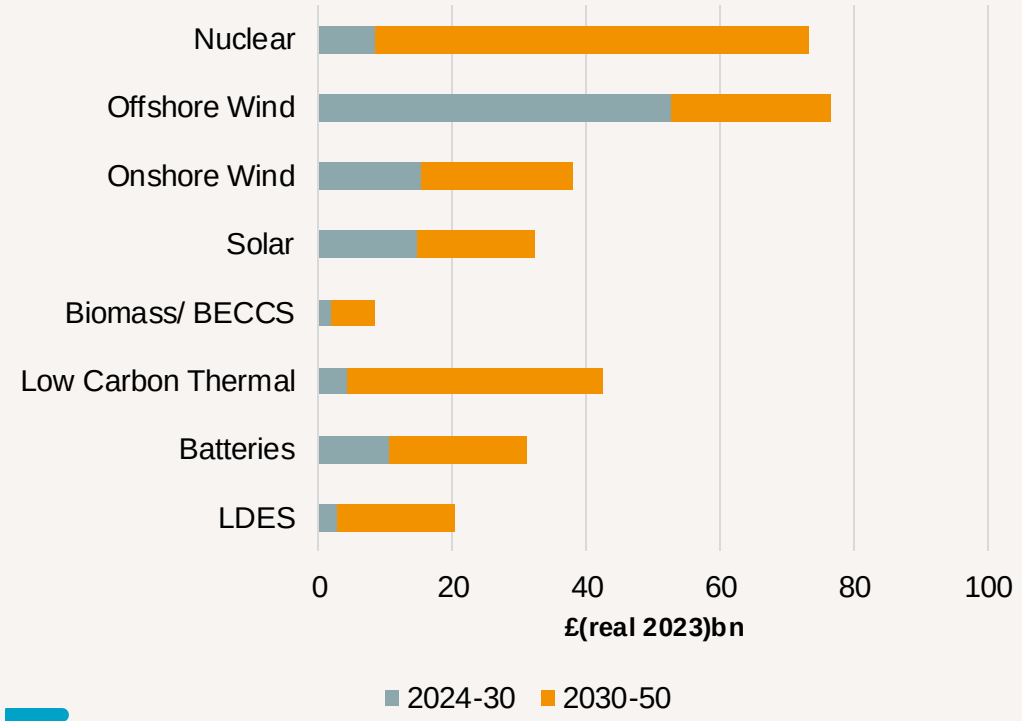
To deliver CP2030, £120bn capex investment is needed (excluding financing costs) by 2030, with the majority in offshore wind. A further £235bn of investment is needed to build the power infrastructure required out to 2050. Outside of offshore wind, every other technology requires greater investment in the 2030-50 period than pre-2030 - highlighting that the final goal of Net Zero consistent power sector in 2050 is just as important as the CP2030 target.

Ensuring a more stable and certain investment environment will be key to this. Current uncertainty around reforms to the system in the REMA programme is leading to increased volatility or uncertainty for investors potentially jeopardising the investment in low carbon generation as well as increasing costs of a net zero power system. If this impacts investment decisions, then an increase in Weighted Average Cost of Capital (WACC) for new projects of 1 percentage point (pp) could increase capex costs (including financing) by £30bn and a 2pp increase by £62bn to 2050 in the LCP Delta Clean Power scenario.

The new government have established GB Energy and the National Wealth Fund to provide public capital to attract further private investment. GB Energy has been allocated £8.3bn over the lifetime of this Parliament to "to own and invest in clean power projects in regions across the UK". The priorities of both these bodies is yet undefined, and when asked through an LCP survey (autumn 2024, 36 respondents), 56% of fund managers active in the energy transition said that GB Energy's priority should be to invest in emerging technologies. Other responses included providing cheap finance (8%), investing in supply chains (8%), investing in supporting infrastructure (14%) and investing in established technologies (14%).

*Note – these are construction costs and therefore doesn't include financing. This is therefore not comparable to investment figures in NESO Clean Power analysis.

Capex investment in LCP Delta Clean Power scenario (2024-2050), excluding financing costs



Key takeaway

Over £355bn of investment is needed in generation and flexibility technologies to deliver CP2030 and Net Zero by 2050.

This creates a big opportunity for investment in GB infrastructure, but a more stable and certain investment environment is needed

Security of supply

Increasing demand in the early 2030s could lead to issues for security of supply

Ensuring security of supply is a key requirement for any power system. Consumers need to be able to use energy when and where they need it even when demand is high, the wind is not blowing, or the sun is not shining.

Many within the industry have highlighted a possible supply crunch in the late 2020s with the existing nuclear fleet going offline, support for biomass ending and peak demand increasing. However, if CP2030 is met then nuclear and biomass will stay online for longer and other technologies capacity will increase negating this issue.

However, the supply crunch could become more apparent in the early 2030s where peak demand will rise significantly as total demand increases. Under LCP Delta's clean power scenario, peak demand rises from 60GW today to 71GW in 2030 and 89GW in 2035.

Assuming all capacity in the LCP Delta Clean Power scenario is built by 2030 and factoring in known changes in nuclear capacity (existing closure + 2nd unit of HPC) then this leaves at least 15GW of additional derated capacity that is needed between 2030 and 2035 to ensure 2035 peak demand is met. This could also increase as it is likely some unabated gas would likely close during this period

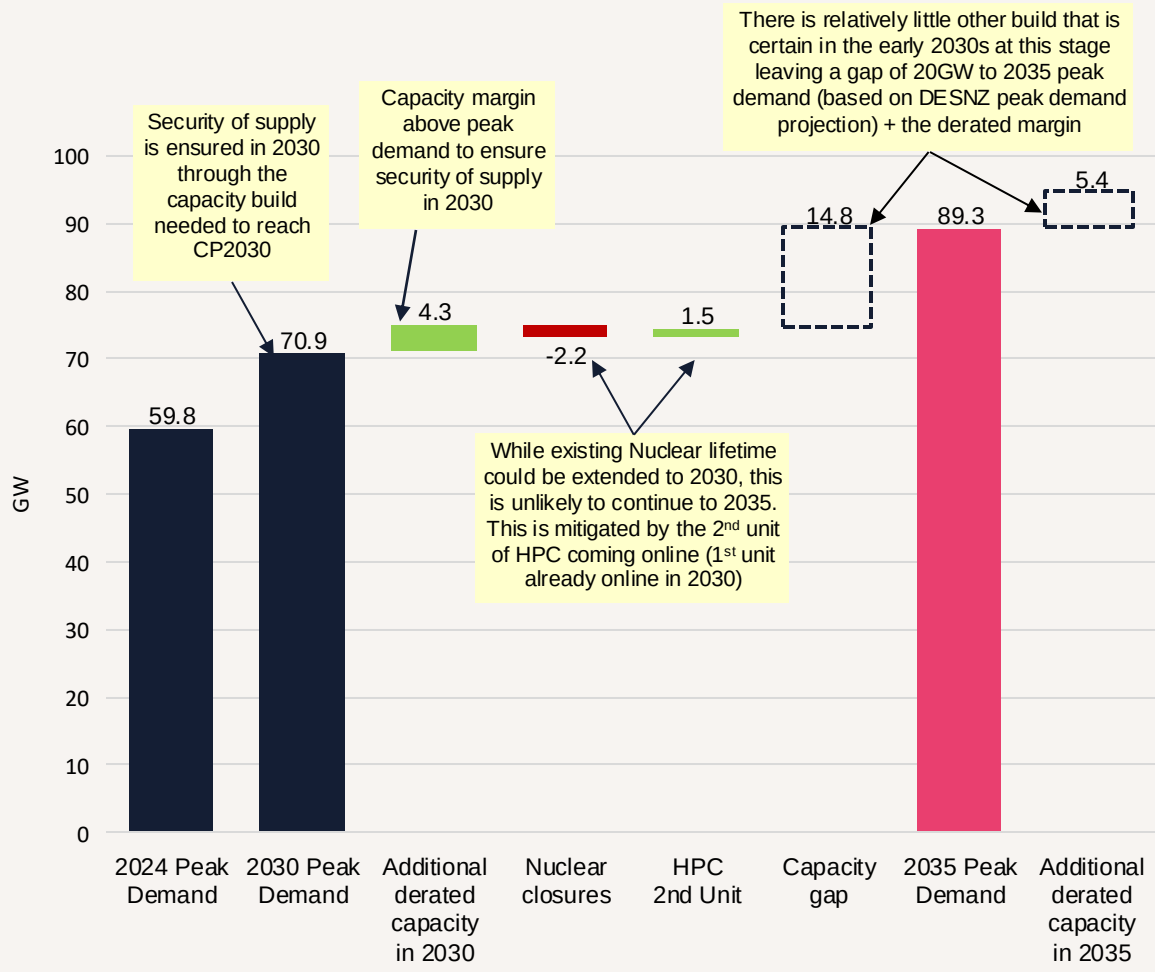
Renewables and short duration storage have low deratings in the Capacity Market and therefore can only provide a limited contribution to security of supply while further new nuclear other than Hinkley Point C is unlikely to deliver before 2035. This leaves low carbon thermal, LDES and interconnectors as the main low carbon options to fill the gap.

Low carbon thermal technologies will be key. As hydrogen to power 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.

Key Takeaway

Increasing demand in the early 2030s combined could lead to a supply crunch with a derated capacity gap of 20GW by 2035. With renewables and short duration storage providing a limited contribution to security of supply, gas CCS and Hydrogen to Power will be key to filling that capacity gap

Additional capacity needed to ensure security of supply in 2035



Security of supply

Low carbon thermal technologies are key to ensuring security of supply in the 2030s but reliance on corresponding infrastructure means they may need to run as efficient unabated gas for a short period

LCP Delta's Clean Power scenario sees Gas CCS reach 10GW in 2035 and hydrogen to power reach 8GW. However, this capacity is reliant on accompanying infrastructure on hydrogen supply and gas CCS transport and storage which are uncertain over this period.

While short term solutions in lieu of hydrogen/CCS infrastructure are likely available to enable delivery of the 4GW of low carbon thermal capacity needed for CP2030, these are unlikely to be sustainable for larger levels of capacity. If solutions are not available for hydrogen supply and gas CCS transport and storage, then these plants are unlikely to be built in the early 2030s.

A potential option to mitigate this issue is to allow these plants to build as genuine CCS/H2P 'Decarb ready' plants but generate as an efficient gas plant until the accompanying infrastructure is available. While this will lead to small increases emissions, it will ensure security of supply and mean a quick conversion to low carbon is possible as soon as the accompanying infrastructure is built. Including this as an option in Hydrogen and CCS business models should be looked at by government.

The alternative would likely be to be build unabated gas that are not truly decarbonisation ready. This leaves the potential for these plants to become stranded assets and need to be replaced by Hydrogen and Gas CCS new build at a later date and/or using inefficient unabated gas plants (OCGT/Recips) during this period.

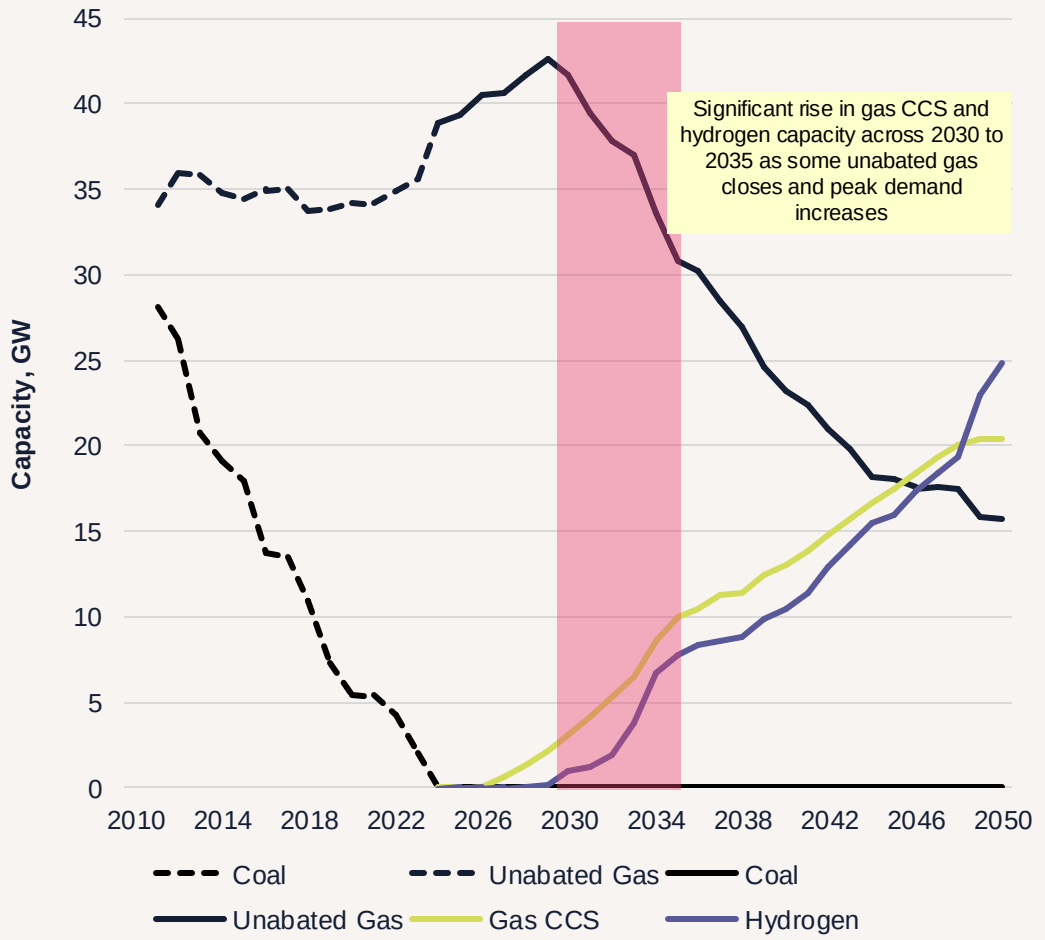
In the event supporting CCUS and hydrogen infrastructure is delayed, having 'Decarb Ready' assets that would end up plugged into CCUS or hydrogen infrastructure when available, would counterintuitively save gas and CO2 emissions through improved efficiencies of new turbines compared to less efficient peakers.

If all hydrogen and gas CCS capacity in the LCP Delta scenario from 2031 to 2035 is built as unabated gas then replaced by new build gas CCS and hydrogen to power, this could increase system costs over 2025-50 by £2bn as a result of wasted capex costs.

Key Takeaway

In the event accompanying CCS and/or hydrogen infrastructure is delayed, allowing these assets to build as true 'Decarb Ready' assets that would plug into CCUS or hydrogen infrastructure when available could reduce use of gas in the power sector and reduce system costs.

Firm Thermal Capacity in LCP Delta Clean Power scenario



Valuing Flexibility

As the system decarbonises, renewables will increasingly set the price bringing both risks and opportunities for flexibility

In the GB electricity system, the marginal plant sets the system price. For many years this has been unabated gas plants but as the system decarbonises, low marginal cost renewable plants will set the price more. We can therefore expect to see an increasing number of near zero price periods. This creates both risks and opportunities for flexible technologies.

Under LCP Delta's Clean Power scenario, by 2030 and then continuing to 2050 there are over 2,000 (25%) hours across the year where the price is below £10/MWh compared to less than 300 hours in 2025. These very low-price periods give opportunities to flexibility technologies. For example, storage can charge, and electrolysers can produce hydrogen at very low cost while consumers are incentivised to move their demand to these periods through Demand Side Response (DSR).

After these first 2,000 hours prices will be set by other forms of generation such as interconnectors, hydrogen to power and Gas CCS. In 2030, unabated gas will still be setting the price in many periods. These higher prices also provide opportunities for flexibility providers allowing arbitrage for storage between low and high price periods, and an inventive for consumers to shift their demand away from peak periods, via DSR, In 2025, there are 6,000 hours (75%) of prices above £50/MWh. This is still high in 2030 at over 40% of hours but decreases to under 30% of hours. The decreasing number of high price periods to 2050 could create risks for flexibility in the longer term as there are less arbitrage opportunities.

This relative abundance of cheap low carbon power may well drive prices down for customers able to access these periods, but it won't drop bills to zero as other aspects of the energy system will need to be financed such as network infrastructure and an increasing amount of policy support – for example, these £zero/MWh plants will be backed by CfD that are paid for through consumer bills.

Key Takeaway

Opportunities for flexibility will continue in the longer term as volatility will remain in the wholesale market in the long term with near zero prices and larger prices. However, increasing number of near zero price periods by 2050 may reduce some of this volatility.

No. of periods with price at different levels for 2025, 2030 and 2050 in LCP Delta Clean Power scenario

LCP Delta Highlights

We help our clients to invest in and navigate the energy transition

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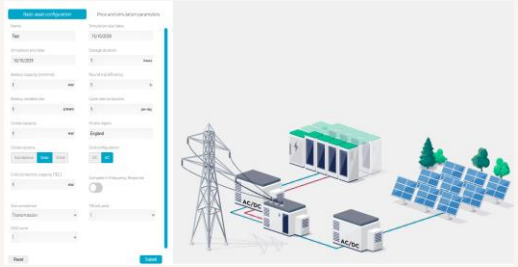
Cutting-edge power intelligence

LCP Delta's Power Insights service is your source for expert analysis on the key developments shaping the power and gas markets in Great Britain and Europe.



STOREcast

Self-serve storage forecasting

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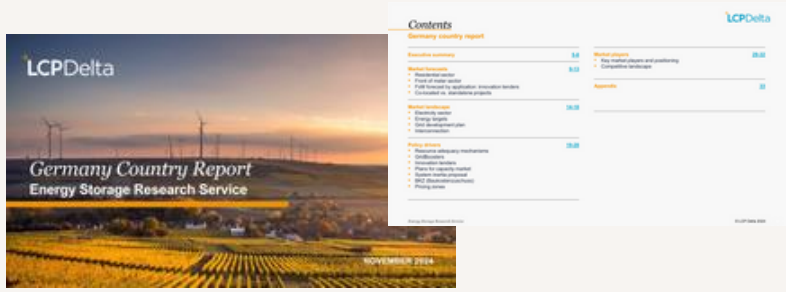
Enact

Real-time analytics

Enact provides real-time integration and analytics for short-term energy market covering performance benchmarking, leaderboards and real time trading support for the UK market.



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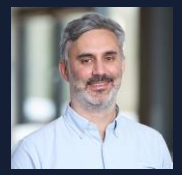

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Annex

Defining Clean Power 2030

Assessment of metrics

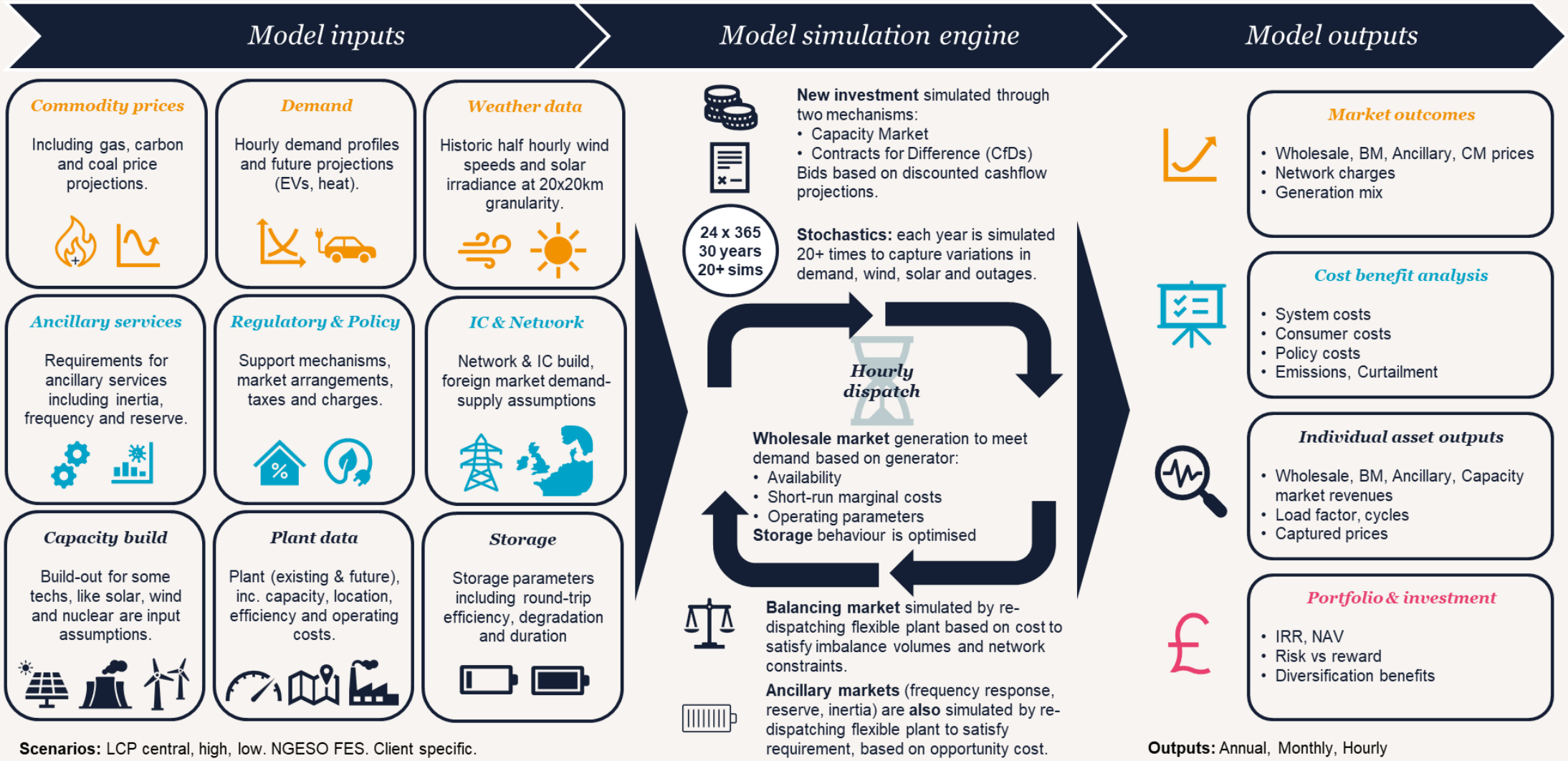
LCPDelta

LCP Delta detailed Assessment of possible metrics for Clean Power 2030

Metric	Simple	Measurable	Achievable	Ambitious
% of low carbon generation	Low carbon already has a definition in government stats, but what techs defined as low carbon is not always obvious and NESO's definition appears to be slightly different to the definition in government stats	This metric is already reported in government statistics and has been used by the CCC	If defined at the right level, this this metric will be achievable. Setting at 98% in line with previous CCC recommendation is likely to be too high but between 95% and 97% could be achievable	If defined at a sufficiently high level (>95%), then this target will be ambitious and a step up on the previous government ambitions for power in 2030.
% of zero carbon generation	Zero carbon has a very clear definition (i.e.: no emissions) and is often already quoted by ministers as what Clean power means so is easily understandable by the public	Given its simplicity of the metric, this will easily be measurable from existing government statistics	To be truly clean power and simple for public then this will need to be set to 100% which is unlikely to achievable given need for some unabated gas and low carbon techs to ensure security of supply	All generation from zero carbon sources would be extremely ambitious target and a significant step up from previous ambition
% of demand met by low carbon	Low carbon as a % of demand in 2030 is likely to be over 100% given GB may be a net exporter of electricity by this point. This is likely to be confusing for the public. The metric also masks any use of unabated gas on the system	While this is not a metric currently reported in government stats, it is easy to calculate.	Defining this metric at over 100% (as NESO have suggested) come with risks attached as this is reliant on GB becoming a net exporter. This means the government target would be directly linked to decarbonisation policy in other counties	This target is ambitious as it show that GB is generating enough low carbon energy to meet all of our demand (although not necessarily at the right times)
Emissions Intensity	This is already a widely reported metric and has been used by CCC and government previously when setting ambitions for power sector decarbonisation	This metric is already reported in various places and is easy to measure from existing government stats	If set at the right level, then this metric is likely to be achievable. Setting at <50g as suggested by NESO would be an achievable level	A target of <50g as suggested by NESO is no more ambitious than previous government commitments. This metric is also more difficult to highlight successes as it requires knowledge of where emissions intensity is now
Net Emissions	Net Zero emissions is already a widely recognised and understood term that could be applied directly to the power sector. Given previous 2035 target was often misinterpreted as this then using this metric effectively moves the 2035 target forward by 5 years.	Net emissions means including negative emissions from BECCS. Under government classifications, negative emissions would not be included in power so this measure would not line up with gov carbon accounting	Given the need for some unabated gas and emissions from low carbon generators, meeting this target would mean being reliant on building out BECCS. Timelines around BECCS in power are uncertain meaning there are higher risks to this target not being met	Setting a net zero target for the power sector by 2030 would be sufficiently ambitious target and easy to communicate on the world stage.

LCP Delta EnVision

LCP Delta's EnVision framework captures plant and market fundamentals to model the GB power system in detail up to 2050



System Cost Framework

LCP Delta's system cost framework is used to assess the economic impact of Clean Power

- LCP Delta's system cost framework is used to assess the system impacts of a policy change or change to the system,
- This approach aligns with Government value for money (VfM) guidance as set out in the Green Book.
- The approach to system costs uses the framework for Whole System Costs that was developed in 2015 between LCP, Frontier Economics and UK Government.
- This approach is used by the Government for power sector impact assessments and VfM assessments.
- System costs represent the costs of building, operating and maintaining the power system for both consumers and producers. They are broken down into various components as shown in the graphic opposite.

LCP Delta system cost framework

Generation costs

- Fuel and variable operating costs (VOM) costs of plants associated with meeting electricity demand hour to hour, i.e. wholesale market dispatch

Carbon costs

- Carbon costs based on carbon emissions priced at social cost of carbon.
- The carbon cost can be split into two parts, carbon costs at the market price (carbon price plants pay) and unpriced carbon costs (additional carbon costs valued at DESNZ carbon appraisal price)

Capex Costs

- Capital costs include pre-development, construction and infrastructure costs (all £/kW) for building new plants.
- For system cost, this is cost of financing these investments, so are spread over the economic lifetime of the plant based on the assumed hurdle rate for the technology.

Fixed Opex Costs

- Fixed operating costs of plants, any operating costs that do not vary with output, and represented in £/kW terms.

Interconnector costs

- Costs associated with building, maintain and operating interconnectors.
- Costs are a 50:50 split between imports priced at the domestic market price and exports are priced at the foreign market price. Costs are proportioned to the markets owning each interconnector.

Network costs

- Cost of maintaining, reinforcing and extending the transmission network