Department for Energy Security & Net Zero

Long duration electricity storage consultation

Designing a policy framework to enable investment in long duration electricity storage.

Closing date: 5th March 2024

January 2024

Any enquiries regarding this publication should be sent to us at:
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Executive Summary

Long duration electricity storage (LDES) will be pivotal in delivering a smart and flexible energy system that can integrate high volumes of low carbon power, heat, and transport. LDES provides flexibility in the energy system, helping to replace the need for unabated gas generation, whilst also diversifying our technology mix to provide optionality for meeting our 2035 power sector decarbonisation targets. LDES will allow us to better utilise domestically produced electricity by allowing us to store excess electricity for times of high demand, minimising waste. Deploying up to 20 gigawatts (GW) of long duration electricity storage is estimated to result in system savings of up to £24bn[1], representing a saving to consumers of 3.3% of the total system costs.[2]

After undertaking a Call for Evidence on facilitating the deployment of LDES in July 2021, several significant barriers were identified that were prohibiting the necessary growth in these technologies. This included a lack of revenue certainty, high upfront capital costs and long-build times. The government therefore committed in the British Energy Security Strategy (BESS) to encouraging all forms of flexibility with sufficient large-scale, long duration electricity storage to balance the overall system by developing appropriate policy to enable investment, with this consultation setting out the proposed approach.[3]

We are now consulting on our intention to develop a cap and floor scheme that aims to overcome the barriers we have identified. Namely, we expect this approach would provide revenue certainty for investors by providing a guaranteed revenue should returns from operating assets drop below the agreed floor. This also offers protection to consumers by providing a cap on the revenue that operators can earn, with some or all of the revenue earned over the agreed cap returned to the consumer. We are also proposing to support established and more novel technologies by offering two distinct routes for applying:

Stream 1: Established technologies with a Technology Readiness Level (TRL) of 9, a supply duration of at least 6 hours at a minimum capacity of 100MW.

Stream 2: Novel technologies with a TRL of 8, a supply duration of at least 6 hours at a minimum capacity of 50MW.

We believe this offers the fair balance of enabling investment in proven technology to be supported now, whilst also helping to mainstream less-developed technologies into the energy system, helping capitalise on the innovations and potential cost-reductions they offer. This scheme will also help bring forward the construction of assets to ensure they are deployed into the energy system ahead of our 2035 power sector decarbonisation deadline.

We are seeking views on several elements of our approach, including the eligibility criteria we intend to use for assessing applicants, the design of the cap and floor mechanism and our proposed options for delivering the scheme. Where possible, we have indicated our

[1] This would increase to savings of up around £50bn and £30bn (net present 2025-50, £ (real, 2020) bn) in scenarios with low hydrogen and CCUS deployment respectively.
[2] DESNZ/LCP Delta/Regen (2024), Scenario Deployment Analysis for Long Duration Electricity Storage, https://www.gov.uk/government/publications/long-duration-electricity-storage-scenario-deployment-analysis
[3] DESNZ (2022), British Energy Security Strategy, https://www.gov.uk/government/publications/british-energy-security-strategy

recommendations throughout the consultation but also seek the guidance of respondents in areas of uncertainty.

Contents

General information

Why we are consulting

Long duration storage (LDES) is a key enabler to a secure, cost-effective and low carbon energy system. LDES can help to decarbonise the system by storing excess renewable generation over longer periods of time (days, weeks, and months), replacing flexibility from fossil fuelled generation and helping to alleviate constraints on the grid.

In the Government response to the Call for Evidence, published in August 2022, we concluded that LDES technologies have an important role to play in achieving net zero. It also recognised that these technologies face significant barriers to deployment under the current market framework due to their high upfront costs and a lack of forecastable revenue streams.

The Powering Up Britain plan stated we will put in place an appropriate policy framework by 2024 to enable investment in LDES, with the goal of deploying sufficient storage capacity to balance the overall system.

This consultation is setting out our proposal to introduce a cap and floor scheme for LDES and seeking views on several elements of our approach, including the eligibility criteria, the design considerations and our proposed options for delivering the scheme.

Consultation details

Issued: **9/1/24**

Respond by: **5/3/24**

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Consultation reference: Long duration electricity storage consultation: Designing a policy framework to enable investment in long duration electricity storage.

Audiences: We are keen to hear from storage developers, generators, energy retailers, network operators, technology suppliers, flexibility providers, industry bodies, local enterprise partnerships, non-governmental organisations, academics, and anyone else with an interest in this area.

Territorial extent: This consultation relates to long duration electricity storage only intended to be situated in GB mainland.

How to respond

Respond online at: energygovuk.citizenspace.com/clean-electricity/long-duration-electricity-storage

or

Email to: smartenergy@energysecurity.gov.uk

Write to:

Long Duration Electricity Storage
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When responding, please state whether you are responding as an individual or representing the views of an organisation.

Your response will be most useful if it is framed in direct response to the questions posed, though further comments and evidence are also welcome.

Confidentiality and data protection

Information you provide in response to this consultation, including personal information, may be disclosed in accordance with UK legislation (the Freedom of Information Act 2000, the Data Protection Act 2018 and the Environmental Information Regulations 2004).

If you want the information that you provide to be treated as confidential, please tell us, but be aware that we cannot guarantee confidentiality in all circumstances. An automatic confidentiality disclaimer generated by your IT system will not be regarded by us as a confidentiality request.

We will process your personal data in accordance with all applicable data protection laws. See our privacy policy.

We will summarise all responses and publish this summary on GOV.UK. The summary will include a list of names or organisations that responded, but not people's personal names, addresses or other contact details.

Quality assurance

This consultation has been carried out in accordance with the government's consultation principles.

If you have any complaints about the way this consultation has been conducted, please email: beis.bru@beis.gov.uk.

1. Strategic case for long duration electricity storage

1.1 Why flexibility is important.

In July 2021 the government, jointly with Ofgem, published a new Smart Systems and Flexibility Plan[4] and the UK's first Energy Digitalisation Strategy[5] outlining how we will deliver the flexibility and innovation needed for a net zero system. The Plan and Strategy set out actions to facilitate flexibility from consumers, remove barriers to flexibility on the grid, reform markets to reward flexibility, and digitalise the system, through both policy and innovation. A smart and flexible energy system is essential for integrating high volumes of low carbon power, heat, and transport – improving system resilience and delivering savings as electricity demand increases. Flexibility also helps to deliver a more secure low carbon energy system – efficiently matching supply and demand for energy, and minimising waste.

To date, much of the flexibility that balances and provides stability to our system has been provided by fossil fuels, as we turn up or turn down coal or gas fired power stations. In the future we need an energy system that matches new sources of demand to renewable generation by using low carbon flexibility across the system.

This flexibility will increasingly need to come from low carbon sources. This can include interconnection which shifts electricity in location, demand side response which shifts demand away from periods when supply is scarce to when it is more abundant, and electricity storage which can be provided by a range of technologies (such as pumped hydro storage) that shifts electricity over time to cheaper and cleaner periods. Other sources of grid flexibility include dispatchable low carbon generation (such as biomass and – in the future – hydrogen) and variable low carbon generation (such as solar and wind).

Electricity storage, at all levels, can enable us to use energy more flexibly and de-carbonise our energy system cost effectively. Electricity storage can help us to balance the system at a lower cost and allow us to maximise the usable output from intermittent low carbon generation, such as solar and wind. This has the potential to defer or avoid the need for costly network upgrades and new generation capacity.

Long duration electricity storage (to note, previously we have referred to large-scale, long duration electricity storage with the acronym "LLES" but in line with industry terminology, we will now be referring to this as "LDES") encompasses a group of conventional and novel technologies, storing and releasing energy through mechanical, thermal, electrochemical, and chemical means. Most long (typically over 4, 12, 24 hours) duration electricity storage technologies are in their infancy in terms of development and deployment. Pumped hydro storage is currently the only established long duration storage technology. There is 2.8GW of

[4] DESNZ (2021), Transitioning to a net zero energy system: smart systems and flexibility plan 2021, https://www.gov.uk/government/publications/transitioning-to-a-net-zero-energy-system-smart-systems-and-flexibility-plan-2021

[5] DESNZ (2021), Digitalising our energy system for net zero: strategy and action plan, https://www.gov.uk/government/publications/digitalising-our-energy-system-for-net-zero-strategy-and-action-plan

capacity currently deployed on the GB energy system across four separate plants which were originally commissioned between 1963 and 1984.[6]

Since the publication of the Smart Systems and Flexibility plan, government have carried out several actions to help bring forward storage on to the system. These actions include publishing and responding to a Call for Evidence on large-scale, long duration electricity storage, supporting LDES projects through innovation competitions and defining electricity storage in the Energy Act 2023. Government also recently published the first UK Battery Strategy[7] which brings together government activity to achieve a globally competitive battery supply chain by 2030, that supports economic prosperity and the net zero transition.

In 2021 government launched the Longer Duration Energy Storage Demonstration (LODES) competition[8] to help support the development of LDES technologies. In total, over £69 million of capital funding has been made available to accelerate the commercialisation of first-of-a-kind (FOAK) longer-duration energy storage technologies, through the £1 billion Net Zero Innovation Portfolio[9]. The LODES competition is supporting a range of energy storage technologies across electricity, power-x and thermal storage.

There has been a historic lack of investment in LDES assets, with no new assets constructed in Great Britain in approximately 40 years. The government has committed to put in place an appropriate policy framework by 2024 to enable investment in LDES, with the goal of deploying sufficient storage capacity to balance the overall system. This consultation seeks stakeholder views on how the government intends to deliver this commitment.

1.2 LCP Delta research

LCP Delta and Regen were commissioned by DESNZ to independently assess the role of a range of LDES technologies in delivering the flexibility needed for the electricity system and the impact that these technologies could have on the system across multiple electricity market scenarios.[10] The study builds on previous commissioned analysis on LDES by analysing a wider array of long duration deployment scenarios across a range of wider power sector compositions.[11],[12] The analysis was split into three sections:

1. To support the modelling and broader assessment of LDES technologies, in the first stage of the study Regen conducted an engagement process with leading UK storage technology and project developers. The purpose of this engagement exercise was to

[6] Other demonstration scale, sub transmission network long duration storage assets of other technologies are also in operation.
[7] DBT (2023), UK Battery Strategy, https://www.gov.uk/government/publications/uk-battery-strategy
[8] DESNZ (2021), Longer Duration Energy Storage Demonstration (LODES) competition, https://www.gov.uk/government/collections/longer-duration-energy-storage-demonstration-lodes-competition
[9] DESNZ (2021), Net Zero Innovation Portfolio, https://www.gov.uk/government/collections/net-zero-innovation-portfolio
[10] DESNZ/LCP Delta/Regen (2024), Scenario Deployment Analysis for Long-Duration Electricity Storage, https://www.gov.uk/government/publications/long-duration-electricity-storage-scenario-deployment-analysis
[11] DESNZ (2022), Benefits of long duration electricity storage, https://www.gov.uk/government/publications/benefits-of-long-duration-electricity-storage
[12] The previous research on long duration storage by Afry showed that hydrogen storage could play an important role in providing flexibility and storage to the power sector. However, for this specific piece of research, hydrogen was deemed out of scope because hydrogen storage is not a power sector only technology with much of the hydrogen stored from electrolysis likely to be used in sectors other than power. Hydrogen to power has been included more broadly in the analysis and through alternative system scenarios.

verify, improve and road-test several modelling assumptions and technical characteristics that were to be used in later modelling.

2. In the second stage of the project, scenario deployment through LCP Delta's Envision model assessed the GB impacts of LDES, up to 2050, by evaluating the impact that different capacity levels and types of LDES have on emissions and system costs. The analysis looks at the impact of LDES across a wide range of scenarios with over 1,000 total scenarios modelled. This includes a range of long duration storage technologies from 6 to 32 hours in duration and capacity levels between 1.5GW and 12GW in 2035 rising to between 2.5GW and 20GW by 2050.

3. In the final stage, to understand the locational benefits that LDES can bring to the system, a subset of the LDES scenarios used in the scenario deployment analysis were modelled in LCP Delta's Locational Pricing Model.

The analysis supports a case for deploying long duration electricity storage. Deploying long duration storage is estimated to generate significant system benefits from reduced alternative generation, interconnector, and network costs. In the modelled scenarios deploying up to 20GW of long duration storage by 2050 resulted in savings up to £24bn.[13] This system saving represents up to around 3% of the estimated total system costs. In addition, increased long duration electricity storage deployment allows renewable generation to be utilised more efficiently, with reduced curtailment levels and increased self-utilisation. The analysis also showed that adding LDES can have a positive impact on emissions with emissions reducing by up to around 25% (2.5gCO2/kWh) in 2035.

Hydrogen to power and gas carbon, capture, use and storage (CCUS) are expected to play similar roles to LDES. While it is recognised that with the deployment of hydrogen to power and CCS there are lower base system costs, with uncertainty as to the scale of deployment of these technologies due to practicalities outside of governmental control, it was prudent to assess additional scenarios with lower gas CCUS and hydrogen to power deployment levels. In scenarios of lower hydrogen to power and CCUS deployment, additional renewable generation capacity would be required to meet the system demand while achieving carbon targets.

The analysis found that the case for deploying long duration electricity storage increased when there are reduced deployments of hydrogen to power and/or CCUS. This was because LDES assets were able to prevent the need for additional alternate generation to be built to maintain system stability. In the scenarios of delayed/reduced CCUS and hydrogen, deploying any of the modelled LDES archetypes resulted in a greater system saving compared to the central case (where hydrogen and CCUS deployment is in line with the departments Net Zero High deployment scenario).[14] LDES deployment in the low CCUS and Low Hydrogen scenarios resulted in system savings of up around £30bn and £50bn respectively. This highlights that LDES has significant options value in providing additional flexibility to help manage uncertainty with alternative low carbon peaking capacity.

The modelling highlighted that there are certain LDES asset characteristics that resulted in the larger system savings. To maximise a greater system benefit, the LCP Delta modelling suggests that assets with the following characteristics should be pursued as a priority:

[13] Net Present Value 2025-50, £ (real, 2020) bn).
[14] DESNZ (2021), Energy and emissions projections: Net Zero Strategy baseline, https://www.gov.uk/government/publications/energy-and-emissions-projections-net-zero-strategy-baseline-partial-interim-update-december-2021

- Assets with longer durations of stored capacity available - these would be most beneficial during a prolonged period of low renewable generation, where the asset can provide electricity continuously or during critical peak periods (if appropriately charged).
- Assets with high charging efficiency have greater system savings as there is less wastage in the storage process.
- Assets located outside of typically constrained locations may result in locational constraint savings. This is due the constraints of the electricity transmission system meaning that some stored electricity would not be able to be dispatched when required outside of the constrained network area. The results of this analysis have been published alongside this consultation.[15]

[15] DESNZ/LCP Delta/Regen (2024), Scenario Deployment Analysis for Long Duration Electricity Storage, https://www.gov.uk/government/publications/long-duration-electricity-storage-scenario-deployment-analysis

2. Addressing barriers to LDES deployment

2.1 Call for evidence

Alongside the Smart Systems and Flexibility Plan, we published a call for evidence (CfE) on long duration electricity storage (LDES) to gather evidence from industry about the barriers to deployment.[16] We invited views and evidence on the role of this type of storage in the future electricity system, the barriers these technologies face, what intervention might be suitable to address these barriers as well as the risks associated with intervening.

In the government response to the CfE published in August 2022[17], we concluded that LDES technologies have an important role to play in achieving net zero. In the response, we reiterated our commitment to develop an appropriate policy framework to enable investment by 2024. It also recognised that these technologies face significant barriers to deployment under the current market framework. The main barriers that were identified were:

- high upfront capital costs;
- long build times;
- lack of a track record of the technologies (many are First-Of-A-Kind (FOAK));
- lack of revenue certainty;
- lack of market signals.

We acknowledged that intervention is required to enable investment in LDES projects. Developing policy to support LDES investment will therefore need to address the barriers identified through the CfE.

2.2 Links to REMA

Existing market arrangements are unlikely to deliver a decarbonised and secure electricity system by 2035 at least possible cost to consumers. Government is undertaking a comprehensive Review of Electricity Market Arrangements (REMA) looking at a wide range of options for delivering an enduring market framework that works for businesses, industries and homes.

In July 2022, government published the first consultation on REMA[18] which set out options that could de-risk investment in low carbon flexibility in the long-term. It outlined the position that bespoke support schemes may be needed to de-risk investment in certain types of low carbon, long duration flexibility to accelerate deployment in the coming years, but in the long-term

[16] DESNZ (2021), Facilitating the deployment of large-scale and long duration electricity storage: call for evidence, https://www.gov.uk/government/calls-for-evidence/facilitating-the-deployment-of-large-scale-and-long-duration-electricity-storage-call-for-evidence

[17] DESNZ (2022), Facilitating the deployment of large-scale and long duration electricity storage: government response, https://www.gov.uk/government/calls-for-evidence/facilitating-the-deployment-of-large-scale-and-long-duration-electricity-storage-call-for-evidence

[18] DESNZ (2022), Review of the electricity Market, https://www.gov.uk/government/consultations/review-of-electricity-market-arrangements

having multiple technology-specific mechanisms could create a fragmented market and risks distorting competition. The upcoming second REMA consultation will set out clear direction of travel on electricity market reform including long-term investment support for low carbon flexibility.

As we progress with design and implementation of our minded to cap and floor investment framework for LDES, we will continue to work closely with the REMA programme to consider how the LDES investment framework might evolve in the longer-term in line with future market arrangements.

2.3 Policy Objectives

The aim of the policy framework is to overcome the barriers identified in the CfE to enable investment in LDES. To ensure that the chosen policy framework is able to achieve this, we have identified the following policy objectives:

- Policy Alignment – The policy framework should work alongside and compliment wider energy policy to deliver a resilient, diverse, net zero energy system of the future at least cost to the consumer.
- Reduce System Costs - The policy framework should ensure that consumers are protected from unnecessary system costs from arising from high operational costs throughout the lifetime of the project.
- Enable Investment - The policy framework should enable investment in large-scale, long duration electricity storage technologies through reducing uncertainty in revenue projections.
- System Benefits - Storage projects should be incentivised to respond to market signals and behave flexibly to maximise benefits to the whole system.
- Delivery - The policy framework should deliver projects in a timeframe that will provide the most benefit to the system, meet public commitments and will help the system to meet net zero targets.

We have used these objectives as the criteria for assessing potential approaches to incentivising investment in LDES. This in highlighted further in the assessment of policy options. Policy alignment was considered later as part of the assessment on shortlisted options.

Questions

1. **Do you agree with the policy objectives that have been identified? Please explain your reasoning.**
2. **Are there other factors we should consider in our policy objectives?**
3. **Will these policy objectives help to bring forward LDES projects to help the electricity system reach net zero in the most effective way? If so, why?**

3. Assessment of policy options

Using the policy objectives set out in the previous chapter, we undertook an assessment of several policy interventions to determine the best route to support the investment in LDES. The options assessed included mechanisms suggested by respondents to the 2021 Call for Evidence, such as a Regulated Asset Base (RAB), a cap and floor mechanism, Contracts for Difference (CfD) and a reformed Capacity Market. Many of these options failed to progress past the first round of policy analysis as they were unable to achieve all the policy objectives set out in chapter two. Further details of this initial analysis are given in Annex A.

We shortlisted three options, and following further assessment, we have identified the preferred support route as a cap and floor mechanism.

3.1 Do minimal

This option was used as a baseline, with no targeted changes for LDES, whilst considering changes outlined in the government and Ofgem's 2021 Smart Systems and Flexibility Plan (SSFP). The SSFP sets out action to remove barriers to flexibility on the grid, including LDES. These actions include innovation funding, network charging, changes to the Capacity Market and broader changes to improve market arrangements for electricity storage.

This option ultimately fails to address the key concern of a lack of revenue certainty for investors. Without this, investment is unlikely to materialise (as has been the case for circa 40 years) and therefore no new projects would be brought forward. This option was therefore discounted.

3.2 Extended delivery year in the Capacity Market

The Capacity Market (CM) ensures security of electricity supply by providing a payment for reliable sources of capacity. This payment could potentially be used as a revenue source for further investment in LDES.

The 2023 CM consultation outlined the participation challenges faced by projects with long build times.[19] Several responses presented strong opposition to the government's decision not to introduce a mechanism that allows for projects with longer construction times. Addressing the participation challenges faced by projects with longer build times may enable LDES technologies with lead times of more than the current T-4 delivery year to be allowed to participate in the CM auctions and, if successful, be eligible for up to 15-year agreements. This would provide a source of long-term revenue certainty for investors.

[19] DESNZ (2023), Capacity Market 2023: strengthening security of supply and alignment with net zero (Phase 1) (section 3.6)), https://www.gov.uk/government/consultations/capacity-market-consultation-strengthening-security-of-supply-and-alignment-with-net-zero

More recently, the government's recent CM consultation on proposals to improve security of supply and align with net zero (Phase 2) outlined proposals for the introduction of a Declared Additional (24-month) Long Stop Date, as well as a declared (12-month) long stop date[20].

The government proposes that the Declared Additional (24-month) Long Stop Date be introduced as an interim measure, for a maximum of 3 years from the date of the proposal's implementation and that the policy be reviewed as appropriate, in line with the evolution of government policy, including the REMA programme. Further details on this policy proposal are outlined in the Capacity Market consultation[21].

With longer contract lengths, there is the potential for this option to enable investment (meeting our policy objective) by providing some revenue certainty to investors. However, even with these reforms, the CM is unlikely to be able to offer the required revenues necessary to increase and encourage private investment in developed LDES technologies because of the high upfront capital costs. It's likely that the cost to the taxpayer would also have to increase to lift revenues into an acceptable range, but significant revenue uncertainty would remain out with any agreed contract period. The uncertainties associated with constructing novel technologies also makes it difficult for these projects to meet the required delivery milestones associated with CM funding. This option was therefore discounted.

3.3 Recommendation: Cap and floor regime

A revenue cap and floor regime, developed by Ofgem, is currently in operation to enable investment in electricity interconnectors. These allow trading of electricity between GB and neighbouring energy markets. The interconnector cap and floor regime provides a minimum revenue certainty for investors (floor) to provide debt security and a regulated limit (cap) on revenues to avoid excessive returns. When revenues fall below the floor level, they are topped up by consumers through the financing mechanism. Conversely, when revenues breach the cap, excessive returns are passed on to the consumer.

Following assessment of the shortlisted options, our recommendation is that developing a cap and floor mechanism similar to that for interconnectors is the most appropriate policy to meet our public commitment to enable investment by the end of 2024[22]. A cap and floor scheme would unlock investment from private sources by providing a revenue guarantee, giving investors reassurance that they will receive a return on their stake, as has been demonstrated in the interconnector scheme. This meets our objective of enabling investment. Unlike the CM approach, this is potentially a low-cost option if the floor is met and no top-up is provided (which has been the case with the interconnector model to date). It is also expected to reduce the Weighted Average Cost of Capital (WACC) for LDES projects by reducing the overall investment risk, which is particularly important in addressing the high upfront costs associated with developing LDES and overall system costs (another one of our key policy objectives).

We believe an appropriately designed cap and floor scheme, which addresses the specific operational considerations for electricity storage, will incentivise projects to act flexibly in response to market signals and provide the most benefit to the system. This can be managed alongside other support schemes for other net-zero technologies to ensure a diverse and

[20] DESNZ (2023), Capacity Market 2023: Phase 2 proposals and 10 year review, https://www.gov.uk/government/consultations/capacity-market-2023-phase-2-proposals-and-10-year-review

[21]

[22] DESNZ (2022), British Energy Security Strategy (page 25), https://www.gov.uk/government/publications/british-energy-security-strategy

resilient net-zero energy system is achieved. We are also confident that this approach can be delivered in a suitable timescale to meet government decarbonisation targets, with these combined points all meeting our previously discussed policy objectives.

There are many design options to review for this scheme to achieve this, with considerations to be made on how it is delivered and on how risks associated with this scheme are mitigated. These points are explored in the remainder of this consultation.

Questions:

4. **Do you agree with our assessment that a cap and floor is the most appropriate policy option to enable investment and bring forward the required LDES? Please explain your reasoning.**

4. Scale and scope of an LDES scheme

This chapter sets out government's proposals regarding the overall capacity of an LDES cap and floor scheme, the type of technologies that could be eligible for support, as well as additional attributes that we consider are important for eligibility. External analysis indicates that LDES could provide large net benefits to the GB electricity system, especially in the early 2030s. These benefits are increased depending on attributes such as longer duration, higher efficiency, a lower cost of capital, and location across Great Britain. We have considered these attributes in determining the scope and potential eligibility criteria for an LDES scheme.

4.1 Overall scheme capacity

We expect that low carbon flexibility provided by LDES technologies will combine with flexibility provided by other technologies, of both long and short duration (such as lithium-ion batteries and demand side response), to provide the system stability and balancing for a predominantly renewables-based energy system. For long duration flexibility, such hydrogen to power, gas CCS, unabated gas, and LDES, a range of internal and external models estimate that the GB electricity system could require at least 30 GW, but potentially up to 50 GW, of capacity by 2035, with the aim for as much of this capacity to be low-carbon as possible.

We have explored establishing an LDES-specific ambition for the overall level of deployment. This level would be dependent on the assumed technology costs and the wider levels of technology deployed on the electricity system. The externally commissioned analyses from ARFY and LCP Delta/Regen have both considered the potential for setting a maximum or minimum capacity that could be supported by the scheme.

The AFRY analysis highlighted a low regrets deployment of 2.5-3 GW as LDES could mitigate some of the deployment uncertainty for emerging, innovative, novel solutions (like hydrogen) in the 2030-2040 period. By reducing the risks and costs of LDES deployment, the analysis suggested it would be possible to unlock greater benefits leading to further system cost savings.

The LCP Delta and Regen analysis considered the marginal system benefits that are provided per additional GW of capacity deployed. This identified deploying 3 GW by 2035 as the low regrets option because it resulted in the highest level of marginal system benefit.[23] This analysis went on to explore how uncertainties such as capital costs, alternative technology deployment and the location of LDES technologies influenced their assessment of the desired level of LDES deployment. These are discussed separately below alongside a consideration of the LDES pipeline and wider risks identified through the 2021 CfE.

4.1.1 Capital costs

The capital costs of LDES technologies are critical in determining the net benefits of these technologies. Given the level of technology readiness of many LDES technologies, there is significant uncertainty as to the capital cost and cost reduction potential of future LDES

[23] Referring to the capacity deployment level which resulted in the greatest additional benefit relative to the additional capacity added. This was based on the Even Mix technology scenario with medium capex levels assumed.

projects. Through the LCP Delta and Regen analysis, three different capex assumptions were modelled to understand the resulting system implications.

The research found that the capital costs of LDES technologies are critical in determining whether their deployment results in a net system cost or saving. For example, in comparison to the central capex levels:

1. at low capex levels, every LDES technology modelled provided benefits to the system at every capacity. The maximum benefit for those technologies with the longest modelled duration (16-32hr) increases from £24bn to £27bn.
2. at high capex levels, the system benefits decrease significantly with the modelled LDES technologies of 6 hours in duration and low charging efficiency systems. All levels of capacity deployed, other than those with the longest durations and greater storage efficiencies, resulted in system costs.

4.1.2 Alternative technology deployment levels

LDES can act as a risk mitigation for reduced delivery of other technologies. With lower levels of gas CCS and hydrogen to power deployment, the LCP Delta and Regen analysis found that the system benefits and emission reductions were greater when LDES is added to the system.

Hydrogen to power and Gas CCS are expected to play similar roles to LDES however there is uncertainty around the scale of their future deployment. As an example, compared to the counterfactual base scenario where LDES technologies provided a system benefit of up to £24bn (between 2025 and 2050), in the scenario of low hydrogen to power deployment, adding any LDES shows a greater system benefit with system cost savings being up around £50bn. This shows that adding LDES to the system can help to mitigate the potential delivery risks for gas CCS and hydrogen to power deployment.

4.1.3 Locational system constraints

In the GB electricity system, it is anticipated that there will be significant future transmission boundary constraints between England and Scotland. This is a result of limited transmission capacity at that point in the electricity network combined with the expected increase in renewables deployed in Scotland. Through the LCP Delta and Regen analysis, locating more LDES in less constrained areas was estimated to bring greater benefits to the locational elements of the system than locating LDES assets in more constrained areas. If transmission constraints remain, the added marginal benefit of additional storage in a constrained location is likely to diminish. This could impact the overall desired level of LDES deployment.

However, projects throughout the UK will be considered for support. As discussed in section 5.4, we propose using an administrative approach to allocating projects, meaning projects can be assessed on a case-by-case basis to ensure a wide range of developments are supported.

4.1.4 LDES pipeline and wider risks

In our consideration of overall scheme capacity, we have also reviewed the LDES pipeline. There are 3 GW of pumped hydro storage projects listed on the Renewable Energy Planning Database.[24] Through the evidence submitted to our 2021 CfE and public reports, we note further PSH projects are in development, and that these could potentially come forward if an

[24] DESNZ (2023), Renewable Energy Planning Database, https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract (August 2023)

LDES investment scheme is available.[25] For more novel technologies, the pipeline is less certain although government is supporting the commercialisation of a range of technologies through the LODES programme[26] and its predecessor Storage at Scale.[27]

Stakeholders responding to the 2021 Call for Evidence identified that supporting LDES could lead to an uneven playing field. In their view, this could slow the wider deployment of storage technologies, distort the market for net-zero technologies, potentially increase costs to consumers and create stranded LDES assets. Overall, we consider that these risks can be managed through the detailed design of an LDES investment scheme.

As an example, there are at least 35 GW of lithium-ion Battery Energy Storage System (BESS) sites across the UK with either a planning application submitted, planning application accepted or currently under construction.[28] BESS technologies are already able to participate, and are successful, in other revenue support schemes such as the Capacity Market (CM) which are incentivising their deployment. 8.8GW[29] of new build battery connection capacity have agreements in place to be delivered between 2024/25 and 2026/27, via the CM. We will continue to monitor overall deployment of storage technologies to understand whether an LDES scheme is distorting activity.

Annex B gives further detail on how the risks identified through the Call for Evidence can be managed.

Recommendation

Overall, we are minded not to set a specific ambition for the overall deployment of LDES at this stage in the policy development. Whilst it could provide a direction of travel for the market and decrease uncertainty, there could be drawbacks if this were set too low. An ambition which matches or is lower than the existing planning pipeline, could discourage developers bringing forward additional projects. This might prematurely limit the scheme scope and may mean that potential cost reductions in the novel technologies are not achieved. In addition, there are uncertainties in cost and wider system deployment capacities that would influence the desired level of LDES deployment. However, it is our intention to continue developing the analysis for overall scheme capacity as we recognise that this could be a helpful guide for developers. We welcome views from stakeholders on this.

Questions

5. **Do you agree with our approach to not set an overall scheme capacity?**

6. **Have we sufficiently identified wider risks and do you agree with the proposed mitigations? Please provide your reasoning.**

[25] Including, but not limited to, Corrievarkie, Balliemeanoch, Dorethea, Earba and Sloy.
[26] DESNZ (2021), Longer Duration Energy Storage Demonstration (LODES) competition, https://www.gov.uk/government/collections/longer-duration-energy-storage-demonstration-lodes-competition
[27] DESNZ (2020), Storage at Scale competition, https://www.gov.uk/government/publications/storage-at-scale-competition-project-winner
[28] DESNZ (2023), Renewable Energy Planning Database, https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract
[29] National Grid ESO (2023), CM Registers, https://www.emrdeliverybody.com/CM/Registers.aspx

4.2 Electricity storage definition

The focus of an LDES scheme is to support investment in long duration electricity storage technologies. The Energy Act 2023 has recently defined electricity storage in primary legislation as:

""Stored energy" means energy that—

(a) was converted from electricity, and

(b) is stored for the purpose of its future reconversion into electricity."

As such we consider it appropriate that any technology supported through an LDES scheme should meet the definition of electricity storage as set out in legislation. We recognise that this will exclude some technologies such as geothermal or thermal storage which do not convert the stored energy back into electricity (therefore failing to meet the stored definition and will not provide electricity for end users).

Questions

7. **Do you agree that only those technologies that meet the electricity storage definition should be eligible for an LDES scheme?**

4.3 Additionality

In line with the policy objectives set out in chapter 2, the intention of an LDES scheme is to support investment in projects that are feasible but are not otherwise able to be built. As such, we consider it appropriate to exclude electricity storage technologies that can already be funded under existing market arrangements, such as Lithium-ion Battery Energy Storage Systems (BESS). As described in Section 4.1.4, there is a strong pipeline of BESS projects, with 8.8GW of new build battery connection capacity currently contracted in the CM to be operational between 2024/25 and 2026/27.[30]

We also consider that projects should not be eligible to receive support from an LDES scheme alongside multiple other government support schemes.[31] This will enable an LDES scheme to focus on those technologies which are not otherwise supported by government at present. We anticipate that this will likely affect hydrogen projects where there are additional support schemes under development for production, storage, and power generation. Given the potential multiple uses of hydrogen, these projects may also not meet the definition of electricity storage (Section 4.2) as only those projects with closed loop hydrogen systems would be eligible.

Questions

8. **Do you agree that it is appropriate to exclude technologies that can already be funded under existing market arrangements and/or those that would be eligible for multiple business model support?**

[30] National Grid ESO (2023), CM Registers, https://www.emrdeliverybody.com/CM/Registers.aspx.
[31] We do not consider the CM as an additional support mechanism and believe LDES assets should be able to engage with the CM.

4.4 Duration and efficiency

In the 2021 Call for Evidence, we sought views on defining long duration storage as technologies that could discharge for over 4-hours. Over 80% of respondents rejected this definition, with most suggesting that the duration should be longer. However, there was no agreed stakeholder view as to the most appropriate duration. More recently, we have seen short-duration technologies (Li-BESS) increase their duration either via stacking multiple units or by extending the battery duration.

The LCP Delta and Regen analysis identified the duration and cycle efficiency characteristics of long duration storage technologies through engagement with LDES developers. While some of these have been presented below (Table 1), further information can be found on Figure 9 and Figure 12 of that report.[32]

Table 1 – Duration and cycle efficiency characteristics for different LDES technologies, obtained from LDES developers

Storage technology	Storage duration[33]	Efficiency (%)
Pumped hydro storage	4 hours to multiday	78 - 85
Compressed air energy storage	4 - 8 hours	55 - 60
Liquid air energy storage	12 - 16 hours	55
Flow batteries	4 - 20 hours	76 - 96

The LCP Delta and Regen analysis further identified characteristics of projects that provide the most benefits to the system. These included assets with the longest durations as they provide the greatest system benefits because they are better suited to manage prolonged energy shortfalls and excess. We note that in 2035, over 50% of TWhs are projected to occur in shortfall/excess events lasting more than 24 hours. In combination, this suggests that we should revisit the duration definition for an LDES scheme. We propose that to be eligible for support, projects should be able to demonstrate a minimum duration of 6 hours at a specified power capacity. We discuss proposals for power capacity in section 4.5.1.

LCP Delta and Regen also established that high levels of efficiency are then the next most desired characteristic for LDES technologies. This enables the technologies to make the best use of the electricity on the system and reduce wasted energy. We would welcome stakeholder views on whether setting a minimum efficiency is appropriate.

Questions

9. **Do you agree with our proposal for a minimum duration of 6 hours? If not, please provide a rationale.**

[32] DESNZ (2024), Scenario Deployment Analysis for Long Duration Electricity Storage (Figure 9 and Figure 12), https://www.gov.uk/government/publications/long-duration-electricity-storage-scenario-deployment-analysis

[33] By duration we are referring to the length of time the storage asset could be continuously dispatching electricity at their full capacity.

10. **Do you believe we should be setting a minimum efficiency criterion? Please provide your reasoning.**

4.5 Approach to established and novel technologies

The 2021 call for evidence indicated that established technologies and first-of-a-kind (FOAK), novel technologies face many common barriers to deployment. However, we were also able to identify barriers specific to the technology types. For established technologies, such as pumped hydro storage, long build times result in the inability to access the capacity market and create revenue uncertainty for the project once the asset is deployed.

For the novel technologies that have not yet been proven at scale, such as compressed air energy storage (CAES), liquid air energy storage (LAES) and flow batteries, the lack of track record means it is harder to secure the required investment. There is a higher risk of investing in FOAK technologies compared to established technologies which limits investor appetite. We anticipate Capex, Opex, project length, lead times and capacities will vary between FOAK technologies compared to established technologies.

We consider it may be appropriate to differentiate between the support for established and novel technologies to enable each to attract the required levels of investment. As such, we consider there to be a strong case for a cap and floor scheme to be split into two 'streams'. Each stream could then be tailored to overcome specific barriers and best support its respective LDES technologies. This approach also potentially enables different eligibility requirements for each stream.

We propose that the two streams are:

Stream 1, established technologies: pumped hydro storage, liquid air electricity storage (LAES).

Stream 2, novel technologies: compressed air electricity storage (CAES), LAES and flow batteries

We have not provided an exhaustive list of anticipated technologies for either stream, rather given illustrative examples. We may also anticipate that as novel technologies mature, that they become eligible for Stream 1.

4.5.1 Stream definitions

Stream 1 – Established Technologies

We propose that Stream 1 focuses on supporting established technologies, such as pumped hydro storage. To be eligible for this stream the technologies should have a Technology Readiness Level (TRL) of 9. [34] This is considered as a Marketable Product that is in its final form and has been proven through successful operations. As set out in chapter 2, an LDES scheme is intended to enable investment in projects, reduce system costs and bring system benefits. We therefore consider it appropriate for both new build and refurbished pumped hydro projects to be eligible within this stream. We would welcome feedback on whether this is appropriate. We note that government has recently consulted on further reforms to the

[34] DESNZ (2021), Longer Durations Energy Storage Demonstration competition Stream 1: guidance, https://www.gov.uk/government/publications/longer-duration-energy-storage-demonstration-competition-apply-for-stream-1-pre-commercial-demonstrator-grants

Capacity Market to aid inclusion of low carbon technology. This includes a proposal to offer 9-year capex threshold agreements.[35]

As described in section 4.4, we propose setting the minimum duration for projects in stream 1 at 6 hours. As was set out in our CfE[36], we also propose that this is combined with a minimum power capacity of 100MW. However, we note the analysis suggests longer duration assets bring more system benefits. We would welcome feedback from stakeholders on whether this minimum duration and capacity should be further increased, and the impact to potential projects if it were.

Stream 2 – Novel Technologies

Novel technologies are typically expensive to implement due to their lack of track record and less developed construction and manufacturing processes. However, there is potential to reduce these costs by supporting these technologies to deploy and grow in scale. We propose that Stream 2 focuses on supporting novel technologies that meet the definition for TRL 8. This is considered a Production Prototype or a saleable Beta product. This means that the technology has already been successfully deployed in a demonstration phase. Technologies below TRL 8 are considered to be in their demonstration phase.

Government has supported the development of new technologies via the LODES competition, supporting projects with a TRL from 4 to 7. We do not consider it appropriate that technologies not yet proven at demonstration phase be eligible for support via an LDES scheme. We will continue to consider how government can support innovation below TRL 8 for long duration electricity storage.

LDES demonstration projects supported through government innovation funding range up to 50MW in capacity. We recognise that a lower minimum capacity may be needed than for established technologies. For this reason, we propose that the minimum duration of 6 hours is combined with a minimum power capacity of 50MW.

Questions

11. **Do you agree with the proposed approach to splitting the streams by TRL level? Please provide your reasoning. If not, please suggest an alternative approach.**

12. **Do you agree with the different capacity minima set out for the streams? Please provide your reasoning.**

4.6 System benefits

We consider it important that LDES projects seeking a cap and floor agreement should be able to demonstrate a strong benefits case to the wider system for the lifetime of their project. The benefits offered could include:

- Ancillary services;

[35] DESNZ (2023), Capacity Market 2023: strengthening security of supply and alignment with net zero (Phase 1), https://www.gov.uk/government/consultations/capacity-market-consultation-strengthening-security-of-supply-and-alignment-with-net-zero

[36] DESNZ (2021), Facilitating the deployment of large-scale and long duration electricity storage: government response, https://www.gov.uk/government/calls-for-evidence/facilitating-the-deployment-of-large-scale-and-long-duration-electricity-storage-call-for-evidence

- Location based benefits;
- System costs;
- Consumer benefits;
- Local economy benefits;
- Constraint management;
- Energy security.

Under the Ofgem interconnector cap and floor scheme, an analysis of the benefits that each project would provide to the system if connected to the grid at the proposed location is carried out by an external consultant on behalf of Ofgem, with input from the National Grid Electricity System Operator (NGESO). This helps to inform Ofgem's decision on what interconnector projects are supported through the cap and floor.

We propose that a similar assessment of project benefits is appropriate for an LDES scheme. This would allow the scheme to support projects that can provide system benefits and enable the system to operate more flexibility at the least cost. This also reduces the risk of supporting projects that are detrimental to the system, mitigating the risk of adding additional cost to the consumer. In the event where there are multiple projects applying for support, we may use this assessment as the basis for prioritising which projects to progress under an LDES cap and floor scheme. We will consider how these wider benefits might be assessed and prioritised as we consider the detailed scheme design.

Questions

13. **Do you agree that the identified wider system benefits should be considered when assessing a project?**

14. **Would an approach similar to that of the interconnector scheme be appropriate? if not what alternative would you suggest?**

15. **Are there any wider economic and societal benefits that have not been identified that LDES projects could provide that we should include in the criteria?**

5. Design parameters for cap and floor scheme

This chapter outlines the key design parameters that we have identified for designing a cap and floor scheme for LDES. Within this chapter we have set out how these parameters could affect the outputs of the scheme and any options that are being considered. Where we have established a preference, we have identified this within the text.

5.1 Setting cap and floor levels

In this section, we propose which returns are used to set the cap and floor thresholds. We closely reviewed how this has been managed by the cap and floor scheme offered to interconnectors. Electricity storage projects are inherently different to interconnector projects because they are subject to varying costs to charge the storage asset ahead of its discharge. These will also vary between technologies and will be dependent on the charging efficiency of the individual asset. This means that whilst the interconnector model provides a guide as to how project costs could be calculated, our assessment is that adjustments are needed to create a bespoke support mechanism for electricity storage. However, there are design principles that remain valid from the interconnector scheme, and we have used these where appropriate as discussed below.

The cap and floor range, as well as the thresholds of the cap and floor, is important in providing the right balance of incentives and an appropriate risk-reward trade-off. We propose that:

- The floor level should be set such that a project can recover its debt-related costs to provide certainty to investors that debts will be serviced.
- The cap should be set at a level that incentivises the asset to continue operating to maximise the available storage in the future energy system and to gain a fair return on its equity investment, whilst protecting consumers from excessive cost.

The proposed financial parameter for setting the thresholds of both is discussed below.

16. **Do you agree with allowing recovery of debt via the floor and recovery of equity via the cap? Please provide your reasoning.**

17. **What costs should be eligible for inclusion in the cap and floor reconciliation calculations?**

18. **How do we design the thresholds to be at the appropriate level to balance investment certainty with potential consumer exposure to additional support costs?**

19. **Should we require projects to outline how they intend to operationalise the asset to exceed the floor?**

5.2 Using gross margin

For the LDES cap and floor mechanism, we propose that gross margin is used to set both the cap and floor level. The floor level will represent the minimum amount of annual gross margin that a project is guaranteed to earn, with consumers topping-up revenue below this level for the developer. The cap will represent the maximum amount of annual gross margin revenue that a project can earn before revenue is returned to consumers. We consider gross margin to be the difference between revenues earned from dispatching energy and services of the asset and the costs of buying the energy to charge the asset.

We consider that applying the cap and floor to an asset's gross margin is more appropriate than the pure revenue earned. It would be challenging to set these values ex-ante if based on pure revenues given market volatility and unpredictability. We believe setting on gross margin, which is similar to how these are set for interconnectors, is simpler and more transparent than the alternative of basing this on total revenues. We also consider that any revenue from the CM may need to be accounted for. We welcome stakeholder views on this approach.

Questions

20. **Do you agree using annual gross margin is a suitable approach to setting the cap and floor thresholds? If not, what alternative would you suggest?**

5.3 Addressing operational risks

5.3.1 Dispatch distortion

We have identified a risk that the introduction of a cap and floor scheme to support investment could distort the efficient operation of the electricity storage asset. On the cap, this could be caused by the asset operator reducing its operation as it approaches the cap threshold as they will make reduced gains above the cap, so are not financially incentivised to operate further. This may reduce overall electricity storage flexibility available in the energy system. On the floor, operators may deliberately keep revenues under the floor if the guaranteed returns from the floor are too generous, meaning they are not incentivised to operate above the floor to earn additional returns. This may lead to either a loss of available electricity storage in the system or unnecessary floor payments being made because of a lack of operation from the asset operator.

This risk does not materialise for interconnectors because, unlike LDES assets, they are not buying or selling the electricity that they transmit. Instead, the interconnector faces a rent charge when in use which does not result in potential dispatch distortions.

Potential mitigations against distortions at the floor and cap are discussed below:

5.3.1.1 Floor distortion mitigations

We assess that this risk could be mitigated by:

- Setting the floor at the cost of debt, the return on equity is only achieved once the asset is generating returns above the floor level.

- Introducing a longer period (potentially multi-year) to review gross margin, which equally allow assets to transfer revenues between years to smooth out periods above/below cap. The interconnector cap and floor uses a 5-year review period.
- Setting availability or performance requirements that could withhold floor payments or deduct from other periods above the floor if agreed performance expectations are not met.

We are considering implementing each of these mitigations within the LDES scheme design. As noted in section 5.1, we propose setting the floor at cost of debt. Multi-year review periods and creating performance related conditions are both design features within the interconnector cap and floor scheme that could be translated into an LDES scheme. We would welcome stakeholder feedback on these mitigations and will continue to develop how best to implement these during the detailed design of the scheme.

5.3.1.2 Cap distortion mitigations

This could be mitigated by:

- Introducing a longer period (multi-year) to review gross margin revenues, allowing the asset to transfer revenues between years to smooth out periods above/below cap. As noted above, the interconnector cap and floor uses 5-year review periods.
- Setting soft-caps to return gross margin to asset on sliding scale, where returns are gradually increased to the consumer rather than a cliff-edge point where all returns are removed from the asset operator.
- Setting availability or performance requirements that could penalise the operator if agreed performance expectations are not met.

It is recommended that all of these mitigations are explored to mitigate this risk but we welcome views from stakeholders. We will cover this further in the detailed design of an LDES support scheme.

Questions

21. **What performance incentive could be used to encourage full operation of assets to prevent dispatch distortions around the cap?**
22. **What performance incentive could be used to encourage full operation of assets to prevent dispatch distortions relating around the floor?**
23. **Do you agree with our proposed mitigations, or would you recommend others?**

5.3.2 Gaming risks

There is the potential for asset operators, with the help of third parties, to “game” the cap and floor regime whereby agreements are made which exploit the cap and floor scheme for financial gain. As an example:

- As asset may have dropped below the revenue floor, meaning they can receive top-up payments from government.
- The asset could sell electricity below market rate to a downstream supplier, as the asset will not lose-out on revenue as this will be topped up by the floor payments.

- The downstream supplier would then be able to make additional profit from having sourced cheaper electricity and selling at the higher market prices (at the expense of the taxpayer).
- If the downstream supplier is integrated with the upstream asset, it could result in an overall benefit for the umbrella company.

Similar gaming could be applied to the cap to avoid returning revenue that is in breach of the threshold or through tolling agreements with associated trading arms.

We have considered several mechanisms by which we could minimise the risk of gaming. These include options to minimise distortions as described above which have the purpose of maintaining the incentive for an asset to continue operating. However, we are giving further consideration to the following measures:

- Introducing transparency requirement to allow easier view of potential gaming between relevant parties. This could mandate supported assets to retain data on contracts for how the asset is operated, and electricity is bought/sold.
- Banning vertically integrated offtake and supply agreements within an umbrella company. This would be intended to prevent potential market manipulation but may result in additional cost if the storage asset needs a third party to optimise the charging/discharging operations.
- Developing a deemed revenue index to approximate market behaviour of the asset (see Figure 1. This would then be used as the basis for cap and floor payments. These would be independent of the actual operation of the storage asset and would remove the incentive to game revenue. However, developing an appropriate index is likely complex.

During detailed design of the model, we will seek external expertise to review and advise on the potential risks and mitigations for this scheme. We welcome stakeholder feedback on what we've noted so far.

Figure 2 – Gaming risk illustration

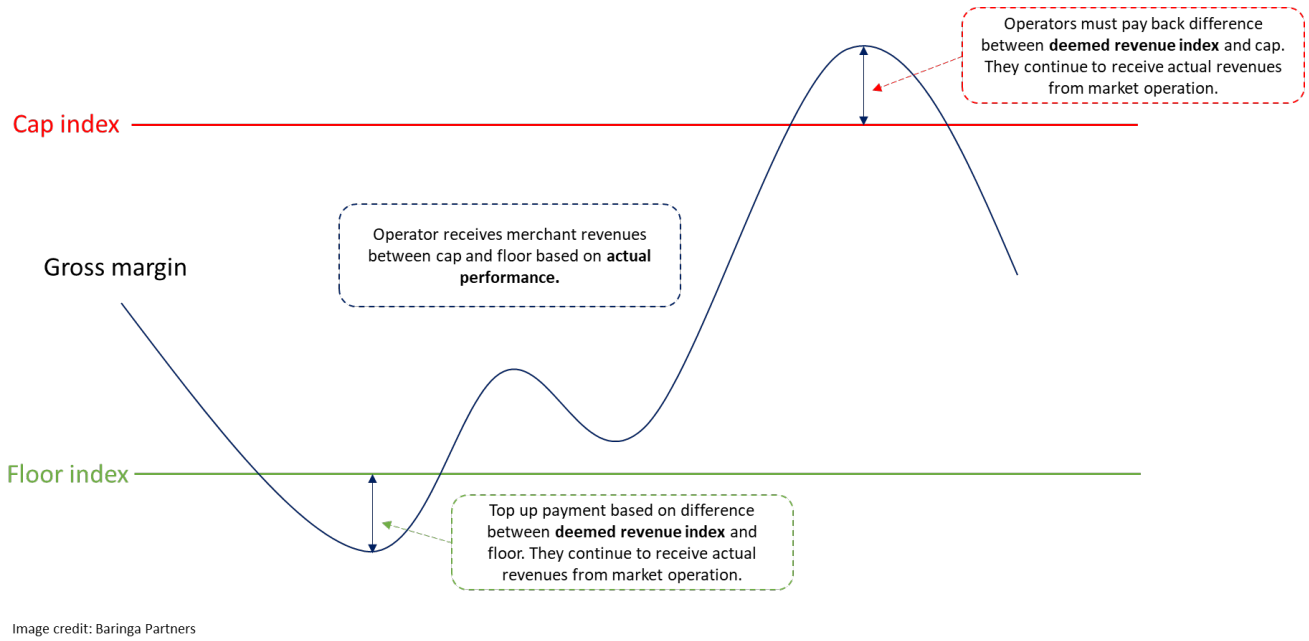

Image credit: Baringa Partners

The most challenging aspect of this option would be to design an appropriate deemed index. We have considered two approaches:

- **A simple index**: based on the average spread between the highest [x] hours and lowest [y] hours x capacity. However, this would not capture the breadth of revenue opportunities available to the asset, undermining its accuracy.
- **A more sophisticated index**: based on the simple index plus an index of revenues in other markets such as the capacity market and balancing services.

We may also consider whether the deemed revenue index could be part of the cap and floor setting process. There could be a mechanism for the developer to set out their proposed deemed revenue index that could be evaluated as part of the application and contracting process. We would welcome stakeholder feedback on this risk and its potential mitigations.

Questions

24. **Have we identified relevant operational risks associated with creating an LDES investment scheme?**

25. **Are our proposed mitigations sufficient for mitigating against the operational risks, like gaming? Please provide your reasoning.**

5.4 Administrative allocation

In the responses to the 2021 call for evidence[37], respondents set out a preference for a competitive process to administer a cap and floor scheme for LDES. Similar schemes to date, such as the Carbon Capture, Usage, and Storage (CCUS) DPA and the cap and floor regime for electricity interconnectors, are both managed through an administrative process. This is detailed further in Annex D. The upcoming second REMA consultation will set out government's recommended option for enabling a transition away from administratively awarded bespoke mechanisms, and we anticipate that the REMA proposals will support deployment of a competitive mix of low carbon flexibility in the long-term.

Whilst a competitive approach for an LDES scheme could lower the cost of projects, the variety of novel FOAK technologies might mean that they could lose out given that they would likely face higher costs. There may also be less flexibility in negotiating contracts and amendments for specific technologies. In section 4.5.1, we set out proposals to establish two streams for established and novel technologies. Whilst it may be possible to introduce a competitive approach for a single stream (for instance the established technologies stream), in practice it is preferable to design a single process that can function effectively across both streams.

Overall, our assessment is that an administrative process would be best suited to delivering a cap and floor mechanism. Whilst this is potentially a more resource intensive option, using an administrative approach would give government assurance that projects that bring the most system benefits rather than those that are the cheapest would benefit from the scheme. This approach is more likely to ensure a range of LDES technologies are supported, and in turn ensures the scheme meets the policy objectives set out in section 2.

[37] DESNZ (2021), Facilitating the deployment of large-scale and long duration electricity storage: government response, https://www.gov.uk/government/calls-for-evidence/facilitating-the-deployment-of-large-scale-and-long-duration-electricity-storage-call-for-evidence

We anticipate that a rigorous assessment process would be required to weigh bids against each other if a high volume of bids are received. This could allow a degree of competition through this prioritisation. In the longer term, we may consider how to introduce further competition and/or how to align with best practice/approaches in other government-supported business models.

26. Do you agree that the cap and floor scheme should be allocated administratively?

5.5 Contract length

The length of a cap and floor contract impacts both LDES developers and consumers through the time over which consumers may be required to provide support to projects if their earnings fall below the floor. While a longer contract length allows for a lower floor, it also increases the period during which the consumer is exposed to this risk. For the range of LDES technologies that we are consider may be part of an LDES scheme, the technical lifespan of the assets varies between 10 and over 50 years, depending on the technology. This means that it would be difficult to set a single contract length as has been achieved for the cap and floor regime for electricity interconnectors, which is 25 years based on the project lifetime.

We have assessed different options for setting the contract length, taking account of Annex C and how Ofgem have managed the interconnector cap and floor regime (see Annex D). We propose that the length of the contract is based on the project lifetime. This is the lifetime prior to refurbishment rather than the technical lifespan of the asset. We believe that a flexible length for the contract ensures that all technologies can be supported proportionally, which this route caters for. This route also reduces assumptions about market conditions and provides certainty for the total length of the contract.

Other contract length options (see Annex C) were reviewed, such as a contract based on the technical lifespan of the project or around the amount of finance provided over a fixed period of time. For these options, the required level of forecasting to determine the level of support that will be required, particularly when reviewing novel technologies, is expected to be too onerous and uncertain. The recommended option takes a simpler approach to considering how long to support projects.

However, we recognise that some LDES technologies may be operating over a longer period than the project contract lifetime. We anticipate that a further regulated regime may be needed for such assets once the cap and floor regime has expired. This would ensure that appropriate legislation applies throughout the technical lifetime of the asset. We will continue to develop proposals for this post-contract phase and would welcome stakeholder feedback on what information may be needed ahead of the start of an LDES scheme.

Questions

27. Do you agree that length of a cap and floor contract should be based the project length?

5.6 Revenue opportunities

One of the policy objectives we identified in section 2 was that 'storage projects should be incentivised to respond to market signals and behave flexibly to maximise benefits to the whole system'.

To meet this objective, we consider it appropriate that LDES assets in receipt of cap and floor support should be able to access and operate in the available electricity system markets. This could include (but is not limited to) wholesale markets, system balancing, the Capacity Market and other revenue generating opportunities such as NG ESO pathfinders.

Questions

28. **Do you agree that cap and floor recipients should also be able to participate in other electricity markets, such as the CM? Please provide reasoning.**

5.7 Additional finance support

Alongside direct government support, the UK's public finance institutions, such as the UK Infrastructure Bank (UKIB) can play a key role in supporting sectors and technologies progress to commercial maturity and scale, helping address barriers to investment. UKIB is a UK government-owned policy bank with £22 billion of financial capacity across its private and local authority lending arms. Its mission is to partner with the private sector and government to increase infrastructure investment across the UK.

All of its investments in private sector projects must deliver against its triple bottom line: delivering against one or both of its strategic objectives (tackling climate change and promoting regional and local economic growth); generating a financial return; and, being additional to the market, crowding-in significant private capital overtime. Therefore, it avoids financing projects that could have been done by the private market alone and can reduce its share of finance for a project if private sector appetite increases. UKIB has already financed short duration electricity storage projects and its Strategic Plan identified its role in reducing investment barriers to longer duration ones too.

We would like to use this consultation as an opportunity to gauge views on whether additional support is needed in addition to the proposed cap and floor scheme.

Questions

29. **To what extent could finance be needed from UK Infrastructure Bank or elsewhere, alongside the cap and floor scheme, to help address barriers to investment in LDES?**

5.8 Pre-qualification criteria

We also want to ensure that LDES projects awarded cap and floor support have a high probability of being delivered. We consider it is then appropriate to develop pre-qualification criteria for projects to demonstrate before they can formally apply for support. We have considered criteria used within similar support schemes such as the Interconnector Cap and Floor, Contracts for Difference, and the Capacity Market, as well as the Longer Duration

Energy Storage Demonstration Programme. These include criteria for the financial position of the project, its connection location and grid agreement, land/lease ownership, planning permission, environmental permits, and whether the project has an electricity generation licence. Further detail on these proposed criteria is given in Annex C. We would welcome stakeholder views on whether these are appropriate criteria and whether any would unfairly penalise established or novel technologies. We are also interested in stakeholder views on the point at which these pre-qualification criteria should be binding – for instance, is this prior to any application, during an application but before a cap and floor is agreed, or before the LDES project is operational. There may be different approaches for each criterion.

Questions

30. **Do you agree that the proposed pre-qualification criteria are reasonable for both streams? Please provide your reasoning.**

31. **Are there additional pre-qualification criteria that should be considered to establish the eligibility of a project?**

32. **If you have a LDES project in the pipeline, how would these eligibility parameters affect your project's application?**

5.9 Additional factors

We have also considered additional design considerations where we would like to seek stakeholder views. These are summarised below along with our proposed stance where available. Further details are given in Annex C.

- Review periods: in our view an LDES cap and floor regime would need review periods to assess if gross margin achieved by the developer has breached either the cap and/or floor thresholds. We suggest that multi-year periods allows the smoothing out of returns over longer periods, potentially reducing the need to provide floor payments or return revenue in breach of the cap.

- Exceptional events: we propose that an LDES cap and floor scheme should take into account and be adjusted for force majeure and exceptional events. This could be based on the principles set out in the electricity interconnector cap and floor regime.

- Proving period: we are considering putting in place a period at the start of the cap and floor scheme by the end of which the project meets certain criteria to demonstrate commitment, progression and its possible performance. This measure is intended to incentivise developers to deliver high quality projects on time.

- Regime start and commissioning date: we propose setting target commission dates for projects. If this target is missed by over 12 months, the duration of the delay period will be deducted from the support period.

Questions

33. **What time length would you recommend for conducting reviews of cap/floor threshold (e,g, annual or multi-year)?**

34. **Do you agree that exceptional event should be considered as part of the review of cap/floor? Please provide your reasoning.**

35. **What criteria could a proving period for LDES be based on?**

36. **Do you agree that target start dates should be set? If not, please explain why.**

37. **Are there any other parameters that we should be considering in the design of the scheme?**

6. Delivery routes

We are considering two possible routes for delivering the LDES cap and floor scheme:

Option 1 – delivered via conditions in electrical generation licences issued by Ofgem.

Option 2 – delivered via CfD-style contracts.

The interconnector cap and floor scheme is delivered and administered by Ofgem as the energy regulator, as per option 1. The alternative route is for the scheme to be delivered by government as per option 2, similar to CfD or CCUS DPA. The roles and responsibilities and the bodies involved in delivering the scheme will vary depending on the chosen route and are set out in this chapter. Either approach would require the lead delivery parties, to increase resources to support and deliver and LDES scheme. Whichever route is selected, it should be noted that any changes in future delivery methods will not be applied retrospectively.

In order to deliver a successful cap and floor scheme for LDES, a strong and clear framework will need to be in place. This includes any relevant secondary legislation and clear roles set out for the relevant bodies (available primary legislation is discussed below).

6.1 Option one – Ofgem delivery

6.1.1 Delivery route outline

The cap and floor scheme for interconnectors is the regulated route for electricity interconnector development in Great Britain. It is implemented through the electricity interconnector licence, set out in fixed-term special licence conditions.

The special licence condition only comes into effect if the regulator issues a direction to switch on Section G (Cap and Floor Conditions) of a licensee's licence after a statutory consultation is carried out. A similar route could be taken for the LDES cap and floor scheme using an electricity generation licence. Electricity storage and electricity storage facilities were defined under the electricity generation licence in 2019. All projects would require a generation licence if the scheme was delivered through this route. The licence condition E1 will be applicable to any applicant for this scheme, and a new section could be added to the generation licence with conditions that apply only to LDES.

Ofgem would be the main delivering body of the scheme under this approach and would be responsible for issuing licences and implementing the special licence conditions. They would hold a role similar to their role for the interconnector cap and floor, including assessing bids, negotiating and then managing contracts with successful projects. Any secondary legislation required to allow this will be examined during the detailed design of this option.

We anticipate that under this delivery route, government and the ESO, soon to be the Future System Operator (FSO) [38], would have roles similar to their current roles under the

[38] Depending on a number of factors, including agreeing timelines with key parties, our aim continues to be for the FSO to be operational in 2024.

interconnector cap and floor, including assessing the benefits of projects to the system. The Department would be expected to set the policy objectives. See Annex E for further details.

6.1.2 Benefits and risks of delivery route

Ofgem has experience with delivering the interconnector cap and floor scheme which can be applied to this route. Ofgem also already hold powers to implement the scheme, meaning they can potentially deliver a cap and floor scheme quicker than the department (but this is to be confirmed during future detailed design of this scheme). As industry is familiar with engaging Ofgem for a scheme like this, we assume this would be a route that provides confidence to asset operators. However, Ofgem, as the independent regulator, would be responsible for selecting and administering projects. This may introduce complexity in coordinating between different support schemes in REMA, CCUS and hydrogen to power. We welcome stakeholder views on benefits, risks and opportunities to deploying this delivery route.

6.2 Option two – government delivery

6.2.1 Delivery route outline

The CfD scheme has primary legislation in place that allows government to negotiate a private law contract with generators. The CCUS DPA scheme is delivered through the primary powers from the CfD legislation, with additional secondary legislation. Similarly, the LDES cap and floor scheme could be delivered through the same CfD primary legislation, by laying secondary legislation. No additional primary legislation is expected to be needed for this delivery route.

Through this delivery route, the department would own and deliver the scheme. Government would make key policy decisions, be the main delivery body, assess bids and negotiate contracts. Similar to the CfD and the CCUS DPA, a third party such as the Low Carbon Contracts Company (LCCC) would then manage the contracts on behalf of the department. The potential role for LCCC in this route would be to manage any contract, amendments, and payments with the successful applicants of the scheme.

Similar to the governance framework for the CCUS DPA and CfD, Ofgem and the FSO, when established, would have roles in the delivery of the scheme. Ofgem would ensure that the participants of the scheme are complying with the rules and agreed contract conditions. Ofgem has a whole market understanding of the energy system and is best placed for a monitoring role within the scheme. The FSO would be expected to have a similar route as in the previous option in assessing the eligibility of applicants. See Annex E for further details.

6.2.2 Benefits and risks of delivery route

As the LCCC delivers the CfD, Capacity Market, CCUS and hydrogen support schemes, they would be well suited and positioned to facilitate this approach. This route also offers easier policy co-ordination between REMA, hydrogen, CCUS and other flexibility teams over the longer term. Under this route, the Secretary of State would be required to approve scheme features such as the opening of an application window, should the detailed design of an LDES scheme require this. DESNZ currently lacks experience in delivering a cap and floor model in comparison to Ofgem, which has some experience via the interconnector scheme (although this LDES scheme will have unique differences that need appropriate consideration). This would require additional DESNZ resource to deliver and more co-ordination between delivery bodies, potentially adding complication to the schemes administration.

We welcome stakeholder views on benefits, risks and opportunities to deploying this delivery route.

Questions

38. **What are the important factors for deciding who is the appropriate body to bring forward this scheme?**

39. **Would either of the delivery routes set out affect the investment case for LDES projects?**

40. **Are there any additional benefits or risks to a delivery route that has not been identified?**

6.3 Scheme funding mechanisms

The route through which the scheme is delivered will have an impact on how the payments are funded.

6.3.1 Transmission network use of system charge

Ofgem's cap and floor scheme for interconnectors is paid for through the Transmission Network Use of System (TNUoS) charges. If a project falls below the floor level, revenue will be topped up through the TNUoS charges process[39]. Similarly, if the projects revenues go above the cap, projects must transfer the amount back to the consumer through TNUoS charges. These charges are adjusted by Ofgem to enable this recovery or redistribution of revenue[40].

TNUoS charges are the amount used for the building, operation and maintenance of the transmission system. These tariffs aim to be reflective of the cost of using the network to help network users make efficient decisions about where and when to use the network. TNUoS is managed by the ESO and regulated by Ofgem. All users of the transmission system pay the TNUoS charges, including consumers through their electricity bills.

6.3.2 Supplier obligation levy

The supplier obligation levy is a compulsory levy on energy suppliers to pay for the CfD scheme. It is also how generators return money when the reference price is above the strike price[41]. The supplier obligation levy is set out in secondary legislation.

This levy is collected by the LCCC who manages the CfD scheme. The levy is calculated per quarter. LCCC sets and notifies supplies three months before the start of the quarter of their interim levy. Suppliers prepay against this interim levy. At the end of each quarter a reconciliation of these interim levys and the supplier's CfD liabilities takes place. Reconciliation payments take place 90 days after this process.

[39] Ofgem (2021), Cap and Floor Regime Handbook, https://www.ofgem.gov.uk/publications/cap-and-floor-regime-handbook
[40] ESO (2023), Final TNUoS Tariffs for 2023/24, https://www.nationalgrideso.com/document/275736/download
[41] DESNZ (2015), Electricity Market Reform: CFD Supplier Obligation, https://www.gov.uk/government/collections/electricity-market-reform-cfd-supplier-obligation

The same payment mechanism is proposed to be used for the CCUS DPA scheme.

6.3.3 Potential funding route for LDES

An impact assessment will be conducted ahead of final decisions on detailed scheme design, including to assess potential business impacts, and covering energy intensive industries. And we propose to ensure that the policy framework requires the organisation assessing cap and floor applications to assess whether and to what extent the cap and floor levels could impact business and consumer energy charges positively or negatively respectively and factor this into decision-making in setting the cap and floor levels.

It is likely that if option 1 (licence-based delivery of scheme) is used that TNUoS charges will be used to fund floor payments. If option 2, then it is likely a supplier obligation levy will be used. These routes will need further review during the detailed design and we are open to stakeholder feedback on concerns with either proposed funding route.

Questions

41. **Do you believe TNUoS charges should be used if the scheme is administered by Ofgem (option 1)? If not, please provide your reasoning and/or an alternate method.**

42. **Do you believe a supplier obligation levy should be used if the scheme is administered using a CfD style approach (option 2)? If not, please provide your reasoning and/or an alternate method.**

Consultation questions

1. **Do you agree with the policy objectives that have been identified? Please explain your reasoning**.
2. **Are there other factors we should consider in our policy objectives?**
3. **Will these policy objectives help to bring forward LDES projects to help the electricity system reach net zero in the most effective way? If so, why?**
4. **Do you agree with our assessment that a cap and floor is the most appropriate policy option to enable investment and bring forward the required LDES? Please explain your reasoning.**
5. **Do you agree with our approach to not set an overall scheme capacity?**
6. **Have we sufficiently identified wider risks and do you agree with the proposed mitigations? Please provide your reasoning.**
7. **Do you agree that only those technologies that meet the electricity storage definition should be eligible for an LDES scheme?**
8. **Do you agree that it is appropriate to exclude technologies that can already be funded under existing market arrangements and/or those that would be eligible for multiple business model support?**
9. **Do you agree with our proposal for a minimum duration of 6 hours? If not please provide a rationale.**
10. **Do you believe we should be setting a minimum efficiency criterion? Please provide your reasoning.**
11. **Do you agree with the proposed approach to splitting the streams by TRL level? Please provide your reasoning. If not, please suggest an alternative approach.**
12. **Do you agree with the different capacity minima set out for the streams? Please provide your reasoning.**
13. **Do you agree that the identified wider system benefits should be considered when assessing a project?**
14. **Would an approach similar to that of the interconnector scheme be appropriate? if not what alternative would you suggest?**
15. **Are there any wider economic and societal benefits that have not been identified that LDES projects could provide that we should include in the criteria?**
16. **Do you agree with allowing recovery of debt via the floor and recovery of equity via the cap? Please provide your reasoning.**
17. **What costs should be eligible for inclusion in the cap and floor reconciliation calculations?**

18. **How do we design the thresholds to be at the appropriate level to balance investment certainty with potential consumer exposure to additional support costs?**

19. **Should we require projects to outline how they intend to operationalise the asset to exceed the floor?**

20. **Do you agree using annual gross margin is a suitable approach to setting the cap and floor thresholds? If not, what alternative would you suggest?**

21. **What performance incentive could be used to encourage full operation of assets to prevent dispatch distortions around the cap?**

22. **What performance incentive could be used to encourage full operation of assets to prevent dispatch distortions relating around the floor?**

23. **Do you agree with our proposed mitigations, or would you recommend others?**

24. **Have we identified relevant operational risks associated with creating an LDES investment scheme?**

25. **Are our proposed mitigations sufficient for mitigating against the operational risks, like gaming? Please provide your reasoning.**

26. **Do you agree that the cap and floor scheme should be allocated administratively?**

27. **Do you agree that length of a cap and floor contract should be based on the project length?**

28. **Do you agree that cap and floor recipients should also be able to participate in other electricity markets, such as the CM? Please provide reasoning.**

29. **To what extent could finance be needed from UK Infrastructure Bank or elsewhere, alongside the cap and floor scheme, to help address barriers to investment in LDES?**

30. **Do you agree that the proposed pre-qualification criteria are reasonable for both streams? Please provide your reasoning.**

31. **Are there additional pre-qualification criteria that should be considered to establish the eligibility of a project?**

32. **If you have a LDES project in the pipeline, how would these eligibility parameters affect your project's application?**

33. **What time length would you recommend for conducting reviews of cap/floor threshold (e, g, annual or multi-year)?**

34. **Do you agree that exceptional event should be considered as part of the review of cap/floor? Please provide your reasoning.**

35. **What criteria could a proving period for LDES be based on?**

36. **Do you agree that target start dates should be set? If not, please explain why.**

37. **Are there any other parameters that we should be considering in the design of the scheme?**

38. **What are the important factors for deciding who is the appropriate body to bring forward this scheme?**

39. **Would either of the delivery routes set out affect the investment case for LDES projects?**

40. **Are there any additional benefits or risks to a delivery route that have not been identified?**

41. **Do you believe TNUoS charges should be used if the scheme is administered by Ofgem (option 1)? If not, please provide your reasoning and/or an alternate method.**

42. **Do you believe a supplier obligation levy should be used if the scheme is administered using a CfD style approach (option 2)? If not, please provide your reasoning and/or an alternate method.**

Next steps

Response Timeline:

This consultation has set out, as far possible, how we intend to design and deliver the cap and floor scheme for supporting LDES. We welcome responses up until 8 weeks after publishing, closing our consultation on the **5th of March 2024.**

Detailed Design of Model:

The detailed design of the model still needs to be completed and will in part be guided by the responses received to this consultation. Specific areas where we will provide further details will likely include:

- How the applications for both streams will be managed and what differences will exist between both routes.
- Final guidance on the costs recoverable via the cap and floor scheme and how the thresholds of the cap/floor will be set.
- The methodology of assessing future applicants against the eligibility criteria we have noted.
- Additional details on how we incentivise operation within the cap and floor scheme (potentially including factors such as availability targets).
- The exact roles of the final delivery partners (after the delivery option has been selected).
- The exact mechanism of providing funding for floor breaches.

We will seek further engagement on these points in 2024.

Annex A – Full Options Analysis

This annex details the options analysis that was completed to determine our recommended approach to delivering a policy framework for enabling investment in LDES by 2024. An initial long list of options was comprised and reviewed, before reviewing a distilled short-list.

A.1 - Full list of options

The list of options detailed in Table 2 was developed through stakeholder engagement and engagement with teams across DESNZ and Ofgem.

Table 21 - Policy options

Policy	Description
Do nothing	No changes, the market and environment stay exactly as it is.
Do minimal	No specific changes for large-scale, long duration electricity storage. This means implementing the changes in the smart plan, such as innovation funding, and individual changes to remove market barriers for all types of storage.
Review of Electricity Market Arrangements (REMA)[42] – flexibility specific options	REMA is exploring options that will competitively allocate revenue support for all low carbon flexibility in the long-term. Options considered include a multi-technology revenue cap and floor and optimised capacity market (introducing split auctions, multiple clearing prices or multipliers for certain characteristics). This is discussed further in section 2.2
REMA – locational pricing option	REMA is considering reform to the wholesale market, including sending sharper locational signals through either nodal or zonal pricing. Locational pricing could sharpen operational signals for low carbon flexibility, which has the potential to benefit LDES.
Extended delivery year in the Capacity Market	Payments made to capacity providers on £/kw/year basis based on competitive auction that allocates contracts of 1,3, or 15 years. Already available to LDES/PHS but difficult to access T-4 and compete commercially. To be feasible, need to allow for an extended delivery year for technologies that cannot build in the current timeframe, in practice allowing for 6-7 years to build new assets that cannot build in 4-5 years, which is under consideration.
(Cap and) floor	Similar to mechanism for interconnectors, there is a floor on revenues (based on project costs + debt interest) and some form of consumer protection, such as a cap on revenues (project cost + equity return). Revenues below/above these levels are topped

[42] The Government is undertaking a comprehensive Review of Electricity Market Arrangements (REMA) looking at a wide range of options, from the continued evolution of existing schemes to more fundamental changes. Options include creating sharper market signals to reward consumers whose behaviour helps drive decarbonisation and splitting the wholesale market so that volatile gas prices do not set the price of cheaper renewables.

Policy	Description
	up/refunded to consumers, but developer is exposed to market within these bands. The revenue cap could be hard, where any excess returns are passed onto consumers, or soft, where excess revenues are shared between operators and consumers to encourage optimisation of assets. Other forms of consumer protection may be possible and more effective.
Contract for Difference	Guaranteed price for energy output via strike price (reached through auction or negotiation). Incentive to generate electricity, but not at specific times (same price regardless).
Regulated asset base (RAB)	A regulator or other authority approves expenditure and determines a reasonable return on investment, capping prices or revenues to ensure investability of the asset whilst protecting consumers.
Dispatchable power agreement (DPA)	A DPA, which is planned for CCUS, proposes an availability payment and a variable payment. The availability payment aims to help with the capex, while the variable payment would reward delivery of energy.
Feed-in tariff	Top-up payment for exported energy, on top of wholesale price.
Incentive payments	Create a new policy revenue stream to pay storage to charge (and/or dispatch) at certain times, for example to use excess supply or a guaranteed premium above their charge rate.
Capital grant	Direct grant funding, reducing overall capex costs, boosting return / reducing risk for developers.
Government investment	HMG invests equity capital to finance capex, owning shares in the project company. Possibility of selling down the stake post-construction and could generate return.
Government loan	HMG provides debt to finance project capex (potentially a 'soft' loan, with favourable terms to the borrower). May be one-off or part of new HMG vehicle (e.g. Green Credit Bank).
Government guarantee	HMG provides financial product to de-risk project financial structure and reduce the overall cost of capital/achieve financeable package.
Sustained response balancing service[43]	ESO could design a forward balancing product for a sustained response product, this would be designed to meet demand when there are long periods of low or high renewable generation.
Strategic Reserve	Creation of a pool of assets that are only to be used in times of need, could be delivered through a payment to asset owner, or ESO could own assets.

[43] ESO options where BEIS/ Ofgem do not have direct ability to deliver.

A.2 Criteria for initial assessment for policy options

The following criteria were used as part of the options analysis assessment, which formed the basis of our policy objectives discussed in section 2.

System Benefits: As set out in the Call for Evidence, government wants storage to be incentivised to respond to varying price signals and provide flexibility when it is needed. The current market signals go some way to providing this, but there is potentially a market failure in providing the long-term flexibility signals required to obtain the optimal amount of flexibility for the electricity system. Therefore, this assessment sought to indicate if the policy options proposed were able to provide operational signals or further dilute or distort existing market signals for supported storage assets to respond flexibly, as well as being a first step in identifying the possible magnitude of wider market distortions that could be caused by different interventions.

Enable Investments: The provision of revenue certainty was identified through the Call for Evidence as the major barrier to investment in LDES, to encourage LDES deployment this would need to be addressed. Revenue certainty was mentioned by the most stakeholders as the key barrier to securing financing. Stakeholders believe that their assets would then be able to operate in the market once built but without revenue certainty they cannot secure the investments needed based on confidence of the return on investment and associated cost of capital.

Reducing System Costs: The magnitude of cost is a first step to assessing the potential value for money of different policies. The AFRY analysis looked at the role of LDES in the future energy system and found that LDES is necessary under certain scenarios to reduce system costs but less needed in others.[44] With these findings in mind, we wanted to ensure that costs were proportionate, as the associated costs would ultimately be borne by taxpayers through bill impacts or through general taxation expenditure. This can be considered as the level of potential cost risk to the consumer for each of the policy options.

Delivery: The timing of LDES deployment is very important to maximising the benefits of these technologies. One of the key findings of the AFRY analysis was that LDES provides the most value to the overall system around 2035 prior to the establishment of a large hydrogen economy. Taking this into account with the Carbon Budget 6 commitment[45] and the changes brought by the Russia-Ukraine war announced through the British Energy Security Strategy,[46] the need for LDES has increased and needed on shorter timescales. To maximise system value, ideally LDES projects should be operational by 2030. Therefore, any selected option must help facilitate this.

[44] DESNZ (2023), Benefits of long duration electricity storage, https://www.gov.uk/government/publications/benefits-of-long-duration-electricity-storage

[45] In Carbon Budget 6, Government committed to cutting emissions by 78% by 2035 compared to 1990 levels, and in addition decarbonising the electricity system by 2035, subject to security of supply.

[46] DESNZ (2022), British energy security strategy, https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy

Table 32 - Criteria and success factors for initial assessment

Criteria	Red	Amber	Green
Incentivises market flexibility	Provides the wrong operational signals or heavily dilutes existing useful market signals, e.g. to cause discharge in times of surplus, or charge in times of scarcity	Provides very little or no operational signals beyond current market arrangements or some dilution of existing useful market signals	Strengthens signals for LDES to provide flexibility for whole system e.g. long-term flex in times of scarcity/surplus compared with current market arrangements
Revenue certainty	Does not provide revenue certainty	Provides some revenue certainty (e.g. for a period of time below 10 years; or small amount) that is unlikely to enable investment	Provides revenue certainty for an extended period of time at a level that is likely to enable investment
Magnitude of costs	High level of cost risk to the consumer (e.g. >£billions of initial funding and/or a high level of ongoing payments)	A significant level of cost risk to the consumer (e.g. <£billions of initial funding and/or a medium level of ongoing payments)	Acceptable level of cost risk to the consumer based on no initial funding and low levels of ongoing payments
Timings of policy to enable operational assets in 2030	Very unlikely to have policy in 2024	Low feasibility to have policy in 2024	Feasible to have policy in 2024

The discounted options from this analysis are detailed below:

A.2.1 Discounted Options

Policy options rated as red against one or more of the criteria are deemed inappropriate to enable investment in LDES. These policy options, alongside our reasoning, can be seen below:

1. 'Do Nothing': This option would see no changes implemented to current market arrangements. Current market arrangements do not enable investment in LDES; therefore, doing nothing will not change this landscape and help achieve the required objectives. This was not a credible option as incremental changes to the market to enable flexibility are to be expected and driven by various actors across the system.

2. REMA – Flexibility specific options: These options, including specific technology support schemes and major Capacity Market reforms, aim to provide better investment signals for flexibility, while incentivising assets to continue responding to operational flexibility signals. However, these options form part of the REMA workstream where timeframes are long and a

final decision on options are uncertain. It is expected that a suite of options will be delivered in mid-late 2020's, therefore not in line with our critical milestone of 2024.

3. REMA – Locational pricing option: Locational pricing would increase granularity and accuracy of market and investment signals for LDES; however, these signals would not provide revenue certainty and in some cases introduce significant investor uncertainty. In addition, this option would require major reform to market arrangements and is therefore not expected to be delivered until late 2020's (if the decision is to go ahead) and so not in line with our critical milestone of 2024.

4. Contract for Difference: This option would provide a guaranteed price for each unit of output and so providing an element of revenue certainty, although assets are still exposed to input costs. This option would therefore incentivise bulk output (regular cycling) rather than optimising output to deliver system benefits, leading to increased market distortions. Opening this option for LDES assets (i.e., eligible for current framework) would require significant change to the CfD arrangements, making it infeasible by 2024.

5. Regulated Asset Base: The 'RAB' model option would provide fixed revenues for developers from the start of construction, improving investor confidence; however, this type of model would see the consumer underwrite the full cost of the asset and therefore takes on the full cost risk, as opposed to an appropriate amount of risk sharing in order to sufficiently de-risk investment in exchange for delivery of potentially beneficial plant. This option, in its current form (e.g. Nuclear RAB) would not incentivise optimal market behaviour for dynamic plant such as LDES to deliver system benefits, and likely lead to significant other distortions. Further, it would require significant re-design to introduce bespoke arrangements for LDES and is very unlikely to be feasible by 2024.

6. Dispatchable Power Agreement: This is currently being implemented for gas CCUS projects, and therefore would require a redesign to facilitate LDES projects. While the approach of an availability payment may be suitable in providing revenue certainty, this would lock consumers into a significant fixed sum over the deemed life of the asset. Any variable payment would need to avoid driving inefficient charging and discharging behaviour or having negative impacts on the wider market. Further, there is a very low feasibility of deliverability of such a redesign by 2024.

7. Feed-in tariff: Although this option could have provided revenue certainty, similar to the Contract for Difference option, this option provides a guaranteed output price and would therefore incentivise bulk output (regular cycling) rather than optimising output to deliver system benefits, leading to increased market distortions.

8. Incentive payments: This option could have theoretically been designed to incentivise flexible operational response; however, this does not provide revenue certainty and rather an additional revenue opportunity. Therefore, this option would not sufficiently meet investor requirements to enable investment.

9. Capital grant: Suitable for novel technologies (e.g., LODES Competition) but not for established technologies. Capital grant would not be large enough to meet investor requirements of long-term revenue certainty so therefore would not enable investment in LDES. Additionally, this would require inclusion in a future spending review period, which would not guarantee funding is provided (as this funding request will be compared with other government priorities) and may not enable the construction of infrastructure in the timelines required.

10. Government investment: Reduces the amount of capital required but does not meet investor requirements of long-term revenue certainty so would not enable investment in LDES. Additionally, this would require inclusion in a future spending review period, which would not guarantee funding is provided (as this funding request will be compared with other government priorities) and may not enable the construction of infrastructure in the timelines required.

11. Government loan: Did not meet investor requirements of long-term revenue certainty so would not enable investment in LDES. Additionally, this would require inclusion in a future spending review period, which would not guarantee funding is provided (as this funding request will be compared with other government priorities) and may not enable the construction of infrastructure in the timelines required.

12. Government guarantee: Did not meet investor requirements of long-term revenue certainty so would not enable investment in LDES.

13. Sustained response balancing service: The creation of a new flexibility service could have provided a need for additional long-term flexibility; however, this service only provides an additional revenue opportunity rather than a minimum level of revenue certainty.

14. Strategic reserve: Creation of a new arrangement outside of the current market structure to provide revenue certainty for a security of supply service. However, this would remove capacity from current markets (where LDES can provide most value), and unlikely to be delivered by 2024.

A.2.2 Short-Listed Options:

Following the initial assessment, three policy options were chosen as the most appropriate to enable investment in LDES and will be taken forward to the full assessment. The assessment of these three options is detailed in section 3, with the preferred option to develop a cap and floor scheme for LDES assets.

1. ‘Do Minimal’.

2. Capacity Market (Extended Delivery Years).

3. Cap and Floor Scheme.

Annex B – Additional risk considerations

B.1 – Additional risks

Implementing an LDES cap and floor scheme is not without risk. A summary of the risks identified, along with applicable mitigations, are detailed below. Several of these risks were specifically highlighted in responses to the 2021 Call to Evidence.

B.1.1 Potential impact on other storage technologies

There is a risk that by supporting LDES with investment support, an uneven playing field is created for storage technologies which may hinder the development of new storage technologies as well as slowing the deployment of storage generally (through lack of market-lead competition). This could include a reduced deployment of lithium-ion Battery Energy Storage Systems (BESS). In the planning pipeline there is at least 35GW of BESS across the UK with either a planning application submitted, planning application accepted or currently under construction.[47] BESS technologies are already able to participate, and are successful, in other revenue support schemes such as the Capacity Market which are incentivising their deployment. For example, it is expected that by 2026 over 12GW of BESS will be operational with the vast majority of this capacity with Capacity Market agreements.[48]

For long duration electricity technologies, previous support has been provided via the LODES competition, supporting projects with a TRL from 4 to 7 to aid innovation in this sector. This scheme will support schemes from TRL 8 to 9, meaning the projects have already proven to be successful or are capable of being used operationally, which is appropriate for the level of support that is on offer.

We have proposed that an LDES scheme use an administrative process rather than through competition for allocation. This enables a system-wide view to be taken on the benefits provided by individual projects. In our view, this would help mitigate technologies being supported which provide the least benefit to the energy system, ensuring the support provided is justified. It has already been noted that without this type of intervention, growth in this sector is unlikely to materialise. Several other business models are also either in place, or intended to be in place, to support other net-zero technologies (including for CCUS and hydrogen) which will help ensure fair balance of support across other technology types.

Whilst we do not anticipate this risk to materialise, we would welcome feedback on this, in particular on whether the deployment of lithium-ion batteries or other technologies would be affected.

[47] DESNZ (2023), Renewable Energy Planning Database, https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract DESNZ Renewable Energy Planning Database, Department for Energy Security and Net Zero (August 2023), Renewable Energy Planning Database,; https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract

[48] Modo Energy (2023), , 2023, Modo Energy, (2023), Battery Energy Storage Buildout Report 2023,; modoenergy.com/research/8296

B.1.2 Distorting the market for other net-zero technologies

As noted, several other business models are either in place, or intended to be in place, to support other net-zero technologies (including for CCUS and hydrogen). A mixture of technologies is expected to be needed as we transition to net-zero, including electricity storage. LDES technologies supported by this scheme would be expected to complement other shorter duration technologies and operate alongside longer-scale storage facilities like hydrogen, serving different demands and customers. It is therefore not anticipated that this scheme will pull revenue from other net-zero technologies and we will work to ensure this is avoided during allocation. We welcome views on this assessment, and whether we should consider potential mitigations.

B.1.3 Increasing overall system costs

There is a risk that by stepping in to provide support, overall system costs may increase, which may have been avoided if left to the market to determine the best way to provide the required services. However, as noted, without government intervention it is unlikely this sector would grow at the pace necessary to deliver net-zero. Long Duration Electricity Storage would reduce costs to consumers through lowering their energy bills, by avoided electricity grid reinforcement and avoided peak generational plant build. LCP's modelling estimates savings for the energy system (and ultimately the energy consumer) of up to £24 billion by 2050. We have also proposed that projects will be prioritised that provide the greatest overall system benefit through maximising the flexibility available in the energy system. This reduces consumer costs by reducing reliance on fossil-fuel energy providers during peak demands, reducing renewable generation to meet peak demand and reducing the need for additional new grid capacity. This is therefore not a risk we view as significant.

B.1.4 Over procuring LDES

It’s clear from the analysis completed as part of producing this consultation and from the response to our Call for Evidence that support is needed to grow the availability of LDES in our energy system. We do not believe we will help instigate the over-procurement of LDES technologies as a result of this scheme but would welcome views on concerns from this (as similarly discussed above on how LDES support may distort the market for other storage technologies).

B.1.5 Over-reliance on LDES

There is a risk LDES is over-supported via this cap and floor scheme, meaning in the long term we become over-reliant on this one type of technology. This will be managed during the application window as we will review the wider system benefits provided by each project, ensuring they go on to complement and add flexibility to the energy system (see section 4.6).

B.1.6 Stranded assets

Our intention is that projects selected for support would have strong commercial cases and a high likelihood of succeeding. However, there is potential that projects supported by the cap and floor scheme do not generate the revenue anticipated, becoming stranded assets. These would potentially remain eligible for revenue payments from floor protection offered by the scheme. Similar risks will have been present in other business models, including the interconnector cap and floor scheme. This risk will be studied further during the detailed design of this scheme, with learnings from other schemes applied where appropriate. We welcome feedback on how best to mitigate this risk.

Annex C - Design considerations

C.1 Pre-qualification criteria

Only eligible projects will have the opportunity to be supported under the cap and floor for LDES. Projects will need to demonstrate that they meet a set of eligibility criteria in order to be considered.

While some of the eligibility criteria will vary between the two streams, such as TRL and duration requirements as outlined above, there will be a pre-qualification criterion that will apply to all projects.

Once projects can demonstrate that they meet the pre-qualification eligibility criteria, they can be assessed further based on how they meet the policy objectives set out in section 2 as well as on the wider system benefits that they are able to provide to the system.

This pre-qualification criteria have been established by considering criteria of schemes such as Interconnectors Cap and Floor, Contracts for Difference and the Capacity Market, as well as the Longer Duration Energy Storage Demonstration Programme. This should ensure that novel technologies are not unfairly penalised through these criteria. Projects will be initially assessed on the pre-qualification criteria before processing on to a further in-depth assessment of the cost benefits of the project. This will be when the priority principles are drawn out.

We therefore propose the following pre-qualification criteria given in Table 4 should be used:

Table 43 - Eligibility Criteria

Eligibility Criteria	Minded to position	Justification
Connection Location	To be supported by the LDES cap and floor, projects will be required to be connected to the GB electricity grid.	As in line with previous schemes and to achieve the desired outcome of energy security, eligible projects should connect to the GB grid.
Financial position of the project	Projects should demonstrate that they have a strong commercial case and will be able to reach deployment stage on time.	Projects brought forward through this scheme should be able to demonstrate their commercial plan to ensure they are deliverable.
Refurbished/New projects	This scheme will be open to new storage projects and significant refurbishments.	The scheme objective is to bring forward investment in projects that would otherwise not make to it to development. This includes refurbishments but we would welcome feedback on whether this is needed/appropriate. Projects requiring refurbishment are also able to participate in the capacity market. Further reforms have been proposed in the

Eligibility Criteria	Minded to position	Justification
		consultation[49] on the Capacity Market to aid inclusion of low carbon technology, including the proposal to offer 9-year capex threshold agreements.
Grid Connection Agreement	Projects should either have a valid Grid Connection Agreement (GCA) or can provide GCA by 6 months prior to the commencement date.	In line with the Interconnector Cap and Floor, Contracts for difference scheme and LODES competition, a valid grid connection offer is required to ensure that the project is deliverable. However, given it may not be possible to have these in place when initially applying for cap and floor support for projects with longer build times, this can wait until 6 months prior to commencement.
Planning Permission	Projects should have the relevant planning consents in place.	In line with the CM, the CfD and LODES, projects should have the relevant planning consents in place for the application process.
Environmental Permits	All projects should have the correct relevant environmental permits in place.	In line with the LODES competition, all projects should have the relevant environmental permits in place required to deliver.
Generating licence	Technologies should have a generation license where applicable.	All stations will require a generation licence in order to be able to export to the grid, in line with the Interconnector Cap and Floor.
Lease/ Land ownership	All projects should have sufficient proof of landownership or lease agreements	Projects should have proof of ownership or lease contracts to avoid any delays to delivery due to land use disputes.

Further details on the methodology of how these factors will be used in assessment will be provided in due course (see the next steps detailed in section 8).

C.2 Length options

LDES technologies have different expected lifespans (see Table 5) and for novel technologies coming through demonstration stage, the lifespan will be untested at present. For this reason, it is difficult to set a single scheme length in the same way that has been for the cap and floor regime for electricity interconnectors. (see annex D).

[49] DESNZ (2023), Capacity Market 2023: Phase 2 proposals and 10 year review, https://www.gov.uk/government/consultations/capacity-market-2023-phase-2-proposals-and-10-year-review

Table 54 - Technology lifespans

LDES technology	Typical technology lifespan (years)
Compressed-Air Energy Storage (CAES)	25 – 30
Liquid Air Energy Storage (LAES)	30 - 40
Pumped Storage Hydropower (PSH)	50+
Flow batteries	10 – 30

We prefer a flexible length of the scheme for LDES to ensure adequate support is provided across technologies. We have identified four scenarios for potential durations of support that could be used (see Table 6):

Table 65 - Scheme length considerations

Possible scheme length determinant	**Considerations**
Technology lifespan	The length of a scheme could be based on the typical lifespan of a technology. This could take the form of a specified fraction of the lifespan of any given LDES technology. While in principle this would provide fair treatment in terms of support provided relative to the time during which a project is operational, this is difficult to determine for novel technologies where the lifespan is still untested. For projects with particularly long lifespans this option may leave consumers exposed to risk for an extended period of time.
Project lifetime	The project lifetime is the lifetime prior to refurbishment rather than the technical lifespan of the asset. Cost assessments based on a shorter project lifetime rather than technical lifetime are easier to make and it avoids making assumptions about conditions that are too uncertain and long-term to incorporate in the business plan. For projects with particularly long technology lifespans this option leaves consumers exposed to risk for shorter period of time. Regarding the project lifetime for LDES, we envisage that it will be up to the developer to identify the project duration. The developer would need to provide a justification for the choice and the administering authority will have a role in approving the exact lifetime together with taking a decision on the exact design of the cap and floor range.
Maximum floor level per annum	The scheme length could be based on the floor required and set as a maximum per annum relative to the costs to be covered by the scheme. This would be on a project-to-project basis. In principle, this would provide each technology the same cover based on the methodology for setting the floor.
Financing lifetime	The scheme length could be linked to the financing lifetime. This defines the cap and floor in relation to a (predefined) investment lifetime

Possible scheme length determinant	Considerations
	and capital payback period. This could for example be linked to the ex-ante internal rate of return (IRR) or breakeven point for a project. This option would allow for projects to be supported such that it is able to raise appropriate investment. Financing timelines are dependent on the choice of the financing options and the behaviour of financial markets and are therefore uncertain.

We propose to use the project lifetime as the basis for scheme length.

C.3 Review periods and adjustments

To remain effective, a cap and floor scheme for LDES will require periodic reviews for each asset. This allows:

- for adjustments to the levels of the cap and the floor;
- total gross margin revenues to be calculated and to determine whether these exceed or fall below the cap and floor levels.

Based on similar approaches taken by other support mechanisms (see annex D) we believe periodic reviews on a multi-year basis may provide the right balance between avoiding excessive regulatory burden from monitoring and reporting, against the length of time the developer could potentially be exposed to the cap and floor thresholds. This would allow revenue to be viewed over longer periods, allowing peaks/troughs to be balanced-out to minimise the likelihood of cap/floor thresholds being breached.

C.4 Exceptional events and force majeure

We consider the cap and floor scheme should take into account and be adjusted for force majeure and exceptional events. This could be based on the principles set out in the electricity interconnector cap and floor regime.

Exceptional events and force majeure are considered in the cap and floor regime for electricity interconnectors both in the pre-operational and operational phases of the project[50]:

- If a force majeure prevents the interconnector from becoming operational on the agreed operation start date, then Ofgem will consider delaying the regime start date accordingly. If the delay is not caused by a force majeure event the regime will only run for the pre-determined scheme length minus the delay period.

[50] Ofgem (2021) Cap and Floor regime handbook, https://www.ofgem.gov.uk/publications/cap-and-floor-regime-handbook

- Electricity interconnector developers will lose automatic eligibility for floor payments for each individual year if availability is below the project's minimum availability target in that year unless this was caused by an ‘exceptional event’ (i.e., force majeure).

C.5 Proving period

We are considering putting in place a period at the start of the cap and floor scheme during and by the end of which the project meets certain criteria to demonstrate commitment and progression and its possible performance. This is to incentivise developers to deliver high quality projects on time. This includes proving technical capability as well as demonstrating financial commitment to a given project.

C.5.1 Technical proving period

For the electricity interconnector cap and floor regime, there is a 60-day proving period to demonstrate that the interconnector is available for the use of conveyance of electricity at 100% rated capacity. Details of the proving period are set out in special conditions of the interconnector licence[51].

C.5.2 Financial commitment

The CCUS DPA similarly includes a period where, after entering into a contract, certain conditions need to be met by the generator[52]. This includes milestone requirements. This is designed to demonstrate commitment to and progression of a project as part of the DPA. The generator will be required to demonstrate by the milestone delivery date (18 months from the start of the contract) either:

- An actual spend of 10% of total project pre-commissioning costs; or
- The satisfaction of specified project commitments.

We would welcome views from stakeholders on an appropriate proving period for electricity storage assets supported under a cap and floor scheme.

C.6 Regime start and commissioning date

We acknowledge that there are natural incentives on developers for the timely delivery of projects, but we think time limits to commissioning and the regime start will encourage the submission of realistic business plans which will protect consumers from unnecessary delays.

The start date of the 25-year cap and floor regime for any particular electricity interconnector reflects an element of the minimum eligibility criteria for the relevant cap and floor application window. For interconnectors, the start date of the regime is often the date specified in the regime decision document or any later date that Ofgem may specify in the future.

[51] Ofgem (2021) Cap and Floor regime handbook, https://www.ofgem.gov.uk/publications/cap-and-floor-regime-handbook

[52] DESNZ (2022), Carbon capture, usage and storage DPA consultation, https://www.gov.uk/government/consultations/carbon-capture-usage-and-storage-ccus-dispatchable-power-agreement-business-model

In situations where projects are delivered later than 12 months after a target connection date, the 25-year duration of the cap and floor regime will be reduced by the length of the delay. This will effectively give the regime a pre-determined end-date of 25 years after this time period lapses, regardless of the operational start-date. Some of the regime period lost due to delays may be reinstated where the delay was caused by an event or circumstance of pre-operational force majeure (as noted in the exceptional events and force majeure section). The intention of this requirement is to balance the need to prevent decisions from being open-ended and to protect developers against events outside of their control. Where there are excessive delays before commissioning Ofgem may revoke their decision to award a cap and floor. This is a last resort. [53], [54]

We consider that a similar set of requirements and approach to the regime start date would be appropriate for an LDES cap and floor scheme.

[53] Ofgem (2021) Cap and Floor regime handbook, https://www.ofgem.gov.uk/publications/cap-and-floor-regime-handbook

[54] Ofgem (2014), Decision to roll out a cap and floor regime to near-term electricity interconnectors, https://www.ofgem.gov.uk/publications/decision-roll-out-cap-and-floor-regime-near-term-electricity-interconnectors

Annex D – Interconnector and CCUS DPA Approaches

D.1 Interconnector Cap and Floor:

D.1.1 Introduction:

The cap and floor regime is the regulated route for electricity interconnector development in Great Britain (GB). It is a market-based approach which aims to incentivise developers to deliver interconnector capacity by limiting developers' exposure to electricity market price risk. Ofgem rolled out the regime to new electricity interconnectors in August 2014 to incentivise the timely delivery of more interconnectors.

D.1.2 Implementation Method:

In November 2016, Ofgem published their decision on changes to the standard conditions of the electricity interconnector licence, the electricity interconnector licences held by Nemo Link, the electricity interconnector cap and floor pilot project, and National Grid Interconnectors Ltd and the electricity transmission licence held by National Grid Electricity Transmission plc. These changes implemented Nemo Link's cap and floor regime and inserted provisions into the Electricity System Operator (ESO) licence to enable the transfer of money between the ESO and Nemo Link. The cap and floor regime is set out in fixed-term Special Licence Conditions and detail cap and floor regime obligations and incentives that apply for each licensee.[55]

D.1.3 Approach to Allocation

Ofgem facilitate the scheme under an administrative regime. Under the current arrangements for the electricity interconnector cap and floor regime, developers are asked to submit their project proposals to Ofgem through pre-determined and time-limited application windows, along with sufficient information and analysis demonstrating that their projects are in GB consumers' interest. Application windows are a key facilitator of the developer-led approach underpinning the regime, allowing developers to identify the location, size and timing of their proposed projects based on price signals in the market. However, the approach also allows Ofgem to compare and contrast projects on similar timeframes, and to take account of interactions between projects in their assessment. Ofgem opens application windows based on government ambitions for interconnection as recently confirmed in Powering Up Britain: Energy Security Plan.[56]

Once the eligibility of each applicant for the electricity interconnector cap and floor regime is confirmed, each project is assessed through the Initial Project Assessment stage of the

[55] Ofgem (2021), Cap and Floor Regime Handbook, https://www.ofgem.gov.uk/publications/cap-and-floor-regime-handbook Ofgem (2021) Cap and Floor regime handbook, https://www.ofgem.gov.uk/publications/cap-and-floor-regime-handbook

[56] DESNZ (2023), Powering Up Britain: Energy Security Plan, https://www.gov.uk/government/publications/powering-up-britain/powering-up-britain-energy-security-plan DESNZ (2023), Powering up Britain: energy security plan, https://www.gov.uk/government/publications/powering-up-britain/powering-up-britain-energy-security-plan

regime. This assessment aims to understand social welfare impacts of each project by considering:

- the impacts of projected flows between the connecting markets through independent socio-economic market modelling;
- the impacts on the operation of GB's transmission system and the costs of onshore transmission reinforcements needed to accommodate the four projects with support of modelling from NGESO; and,
- a qualitative assessment of hard-to-monetise impacts, such as strategic or sustainability benefits that the projects could provide.
- Only interconnector projects that are in the interest of the consumer will be awarded a cap and floor.[57]

D.1.4 Scheme Length:

The cap and floor regime for electricity interconnectors is 25 years[58] and is based on the project lifetime. The length of the scheme for electricity interconnectors is fixed and does not change based on the project. The technical lifespan (including maintenance and refurbishment) of these assets is 40 years or more and the interconnector operational for the longest period of time in Great Britain and currently still operational was commissioned in 1986.[59]

Ofgem considered two main options for the duration of the regime for interconnectors:

- lifetime of financing and;
- lifetime of the asset.

The option of basing the duration of the scheme on the lifetime of financing was seen as too uncertain and dependent on the choice of the financing options and the behaviour of financial markets. The project lifetime is the lifetime prior to refurbishment rather than the technical lifespan of the asset.

The main reasons for Ofgem choosing the project lifetime approach include:

- It is easier to make cost assessments based on a shorter project lifetime rather than technical lifetime;
- It avoids making assumptions about conditions that are too uncertain and long-term to incorporate in the business plan;

[57] Ofgem (2021), Interconnector policy review: Working paper for Workstream 1 – review of the cap and floor regime, https://www.ofgem.gov.uk/publications/interconnector-policy-review-working-paper-workstream-1-review-cap-and-floor-regime Ofgem (2021), Interconnector policy review: Working paper for Workstream 1 – review of the cap and floor regime, https://www.ofgem.gov.uk/publications/interconnector-policy-review-working-paper-workstream-1-review-cap-and-floor-regime

[58] Ofgem (2021),) Cap and Floor Regime Handbookregime handbook, https://www.ofgem.gov.uk/publications/cap-and-floor-regime-handbook

[59] Interconnexion France-Angleterre (IFA) (2023), IFA Interconnector, https://www.ifa1interconnector.com

- the flexibility for the exact lifetime combined with certainty that the parameters will be fixed for this period allows for cost optimisation of cost of capital particularly for parties interested in investing via project finance route.[60, 61]

D.1.5 Revenue Review Period

Each electricity interconnector licensee with a cap and floor must submit relevant revenue information to Ofgem each year. These revenues are then periodically assessed by Ofgem. This revenue assessment can take place every five years (default regime) or every year (where regime variations are approved) and are designed to determine the need for any adjustments to the cap and floor, and to determine whether revenues were below the floor or above the cap. There is also a provision for developers to request a within-period adjustment (covering whole years) on the grounds of financeability; or pre-empting a material end-of-period adjustment. Any within-period adjustment is subject to a true-up on a Net Present Value neutral basis at end of the assessment period.[62]

Ofgem chose a multi-year assessment approach as default as it was seen as a compromise between a one-off assessment and an annual assessment. A one-off assessment reduces the administrative burden and mitigates against unnecessary triggering of the cap and floor that may happen in the volatile early years of the project. However, if intervention is delayed until the end of the investment period, the project could already have stopped operating, or could default before any caps are applied. In addition, it increases the risk that the developer would be exposed to financial difficulties or, conversely, be earning excessive returns during the period. An annual and a multi-year evaluation avoid these drawbacks.[63]

D.2 CCUS DPA:

D.2.1 Introduction

The CCUS DPA Contract is a private law commercial contract between the generator and the DPA counterparty, the Low Carbon Contracts Company Ltd (LCCC), and is based on the successful CfD AR4 for low carbon generation.

D.2.2 Implementation Method

The DPA business model is split into:

- the Front End Agreement, which is the document between the generator and the DPA counterparty, which includes the bespoke values and definitions agreed prior to the agreement date, such as the description of the generation facility;

[60] Ofgem (2011), Preliminary conclusions on the regulatory regime for project NEMO and future subsea electricity interconnector investment, https://www.ofgem.gov.uk/publications/preliminary-conclusions-regulatory-regime-project-nemo-and-future-subsea-electricity-interconnector-investment
[61] Ofgem (2023), Cap and Floor Regime for Regulated Electricity Interconnector Investment for application to project NEMO, https://www.ofgem.gov.uk/publications/cap-and-floor-regime-regulated-electricity-interconnector-investment-application-project-nemo
[62] Ofgem (2021), Cap and Floor Regime Handbook, https://www.ofgem.gov.uk/publications/cap-and-floor-regime-handbook
[63] Ofgem (2011), Cap and floor regime for regulation of project NEMO and future subsea interconnectors, https://www.ofgem.gov.uk/publications/cap-and-floor-regime-regulation-project-nemo-and-future-subsea-interconnectors

- the DPA Contract, which is a set of standard terms, which will be common for all DPA recipients; and
- the Direct Agreement, which is a further agreement which can be entered into by the DPA counterparty, the generator, and a lender/security trustee. This sets out the rights of the lender/security trustee in relation to the DPA.
- the gain share schedule, which outlines the provisions of the proposed gain share mechanism which may be applied to the DPA.[64]

D.2.3 Approach to allocation:

The contracts are allocated administratively and are defined during initial negotiations.

D.2.4 Scheme Length

The length of the CCUS DPA is 10 years with an extension period of up to 5 years if a project meets extension conditions[65]. This period is similar to that of the Contracts for Difference for Allocation Round 4 (CfD AR4), typically 15 years, which the CCUS DPA is based on. The intention is to provide flexibility across a range of different approaches to implementing power CCUS whilst also facilitating competitive pricing and term lengths that are proportionate to the remaining operational life of each respective Project.

D.2.5 Revenue Review Period

For CfDs the strike price is set for the lifetime of the contract. However, each calendar year the LCCC calculates an Indexation Adjustment which becomes effective on the first day of the Summer Season (starting 1 April) of such year. The purpose of these adjustments is to keep the Strike Prices aligned with movements in CPI inflation and electricity market charges (if applicable in the CfD contract).

For the CCUS DPA sales revenues, surrendered compliance credits, linked entity credit transfers/sales and unutilised credits will be self-reported by the emitter to the LCCC on a monthly basis. On an annual basis, an independent auditor's report will be submitted to the LCCC to confirm self-reported data. The contract can be extended from year 10 onwards on a yearly basis up to 15 years after an annual review of specific conditions the emitter and market conditions must meet. The DPA also includes an opex reopener to allow for changes to the strike price, if necessary[66].

[64] DESNZ (2022), Carbon capture, usage and storage (CCUS): Dispatchable Power Agreement business model, https://www.gov.uk/government/consultations/carbon-capture-usage-and-storage-ccus-dispatchable-power-agreement-business-model,
[65] DESNZ (2022), Carbon capture, usage and storage DPA consultation, https://www.gov.uk/government/consultations/carbon-capture-usage-and-storage-ccus-dispatchable-power-agreement-business-model
[66] DESNZ (2019), Carbon capture, usage and storage (CCUS): business models, https://www.gov.uk/government/consultations/carbon-capture-usage-and-storage-ccus-business-models, DESNZ (2019), Carbon capture, usage and storage business models consultation, https://www.gov.uk/government/consultations/carbon-capture-usage-and-storage-ccus-business-models

Annex E – Delivery routes

We have set out what the roles and responsibilities of the various delivery bodies under both delivery routes in the following tables:

Table6 7 - Option 1 delivery roles

Organisation	Potential Role (Based on Interconnector Cap and Floor scheme)
Government	• Policy owner, set the policy objectives and make key policy decisions, i.e. scope and size of scheme.
Ofgem	• Scheme administrator (acting as an economic regulator as for Interconnectors). • Set outs and grants special licence conditions. • Assess bids and negotiate contracts. • Manage contracts and payments to successful applicants.
Future System Operator (currently Electricity System Operator)	• Assess new applications for their benefits to the system – on behalf of Ofgem.

Table 8 - Option 2 delivery roles

Organisation	Potential Role (Based on CfD scheme)
Government	• Policy owner and scheme administrator. • Assess bids and negotiates contracts. • Determine the rules for the negotiation process and how frequently windows would open for each stream.
Ofgem	• Monitoring participants use of the asset to ensure it is in line with market signals and take enforcement action where appropriate. • Resolve disputes.
Future System Operator (currently Electricity System Operator)	• Assesses the eligibility of applications.
Low Carbon Contracts Company	• Manages contracts with successful participants, incl. adjustments. • Manages payments.

This consultation is available from: www.gov.uk/government/consultations/long-duration-electricity-storage-proposals-to-enable-investment.

If you need a version of this document in a more accessible format, please email alt.formats@energysecurity.gov.uk. Please tell us what format you need. It will help us if you say what assistive technology you use.