<u>Government Response to the House of Lords Science and Technology Committee report: *Long-duration energy storage: get on with it*</u>

Government response to the Committee's recommendations

As we increase the integration of renewables into our energy system, we must be able to continue to source energy for periods of reduced wind and sun. Energy storage is an effective way of catering for the inherent intermittency of renewables, allowing excess energy to be stored during generation peaks and used during low generating periods. A range of technologies and storage vectors can be used, such as stored hydrogen or making use of Long Duration Electricity Storage (LDES) technologies (such as pumped hydro storage). To support energy security a combination of storage assets will be required to meet the varying needs of the energy system in the future. We are moving at pace to enable industry to deliver these.

The House of Lords Science and Technology Select Committee published its report *Long-duration energy storage: get on with it* on 13 March 2024. The report made 30 recommendations, which fall broadly under 10 themes:

- Energy Storage Targets
- Energy Storage Definitions and Metrics
- Energy Storage Support Scheme Coverage and Pace of Delivery
- Strategic Reserves
- Hydrogen Usage and Safety
- Hydrogen Supply Chain
- Electricity Storage Technology Innovation
- Networks
- Planning and Roles
- Other Low Carbon Flexibility Technologies

The government has responded to the 30 recommendations collectively within these themes.

We would like to thank the Committee for their thorough report, bringing expert challenge from external stakeholders across a wide range of complex topics in this area. As we continue to shape, develop and deliver our plans, we will factor in the guidance provided by this report and look forward to further discussions in the months and years ahead.

Energy Storage Targets

We note the Committee's several recommendations in relation to setting targets for future storage capacity. The exact level of flexible capacity needed on the system is highly dependent on peak and annual demand, the future nature of system stress events and the deployment of renewables and nuclear capacity. We agree with the committee's conclusions that future electricity systems are very likely to need storage operating on intra-day, inter-day, inter-seasonal, and potentially inter-annual timescales to maintain energy security. The amount of each type of storage required for a low carbon emission system, at the lowest cost, depends on the wider generation mix and demand profile.

For short-duration flexible technologies, i.e. batteries and demand-side response (DSR), a range of external models estimate that the GB electricity system could require up to 55 GW of capacity by 2035. For long-duration flexible technologies, i.e., hydrogen to power (H2P), gas CCS, unabated gas, and LDES, a range of external models estimate that the GB electricity system could require between 30 and 50 GW of capacity by 2035; the Government's aim is for as much as possible of this capacity to be low carbon.[1] The exact level of flexible capacity needed on the system is highly dependent on peak and annual demand, the future nature of system stress events and the deployment of renewables and nuclear capacity.

At present, we continue to review the benefits of setting capacity targets for our individual support schemes and business models, such as the LDES cap and floor arrangement and Hydrogen Storage Business Model (HSBM). On LDES targets, we anticipate that minimum procurement capacity ranges will be set out ahead of future allocation rounds. On hydrogen capacity targets, we are working closely with industry to understand barriers to the development of critical infrastructure and have used this understanding to inform our hydrogen transport and storage (T&S) strategy work and the design of the HSBM as well as the Hydrogen Transport Business Model (HTBM).

Our ambition for the first allocation round of the T&S business models is to support up to two hydrogen storage projects at scale and associated regional pipeline infrastructure to be in operation or construction by 2030. This ambition will enable the foundations of early regional hydrogen networks to be put in place, and we recognise that this is an early step in a steep curve in our hydrogen T&S infrastructure needs. As more evidence on hydrogen production and demand becomes available, we will provide further detail on our analysis on the scope and scale of T&S infrastructure required for the early 2030s and beyond, including setting ambitions for future allocation rounds of the HTBM and HSBM.

Energy Storage Definitions and Metrics

The importance of duration in the context of energy storage is two-fold; we need to be able to store energy for sufficient lengths of time (days, weeks, months) and must be able to provide power from this storage for suitable timeframes to accommodate the intermittency of renewables. We expect that hydrogen storage will be able to provide inter-day and inter-seasonal storage for a range of demand purposes, including industrial usage and for use in converting to power. Separately, we expect LDES technologies like Pumped Storage Hydropower (PSH) to provide on-demand generational power for intra-day and inter-day demands, alongside other flexible technologies.

The government has released analytical reports on the need for long duration storage and resulting system impacts over the past couple of years.[2] We will work closely with National Grid Electricity System Operator (ESO) to review the storage requirements to manage the network.

In the Hydrogen Production Delivery Roadmap (December 2023) we set out that our first 10 GW of capacity could produce around 60 TWh per year of low carbon hydrogen, providing around 10 MtCO2e per year in carbon savings, once fully operational. This assumes we deploy 4 GW of CCUS enabled hydrogen and 6 GW of electrolytic hydrogen operating at load factors of 95% and 50% respectively. These figures serve as an illustrative assumption, as operating patterns will

[1] External modelling of both short- and long-duration flexibility requirements includes work done by AFRY for the CCC's 'Net Zero Power and Hydrogen: Capacity Requirements for Flexibility', the NIC's Second National Infrastructure Assessment, and the National Grid ESO's 2023 Future Energy Scenarios.

[2] Modelling of the Ability of a Mixed Renewable Generation Electricity System with Storage to Meet Consumer Demand, https://www.mdpi.com/2673-4826/3/1/2, BEIS (2022), Benefits of long-duration electricity storage, https://www.gov.uk/government/publications/benefits-of-long-duration-electricity-storage and DESNZ (2024), Long duration electricity storage: scenario deployment analysis, https://www.gov.uk/government/publications/long-duration-electricity-storage-scenario-deployment-analysis

vary considerably for each individual project depending on a range of factors including their electricity source, the needs of their off-takers, and their access to storage.

In the 'Hydrogen transport and storage infrastructure: minded to positions'[3], published in August 2023, we set out examples of hydrogen storage technologies that have the potential to provide long duration hydrogen storage, this includes salt caverns, depleted gas fields and aquifers. We also set out a range of use cases for different hydrogen storage technologies. A benefit of some hydrogen storage technologies is the ability to flexibly supply hydrogen over a range of timescales from intra-day to interseasonal, for example, salt caverns can operate across intra-day, inter-day and inter-seasonal timescales.

For the first allocation round of the hydrogen storage business model, we propose that support be focussed on geological storage infrastructure with a minimum technology readiness level (TRL) of 7, such as salt caverns. We will consider what further government support may be required to enable the development of less mature technologies for hydrogen storage.

For our LDES cap and floor arrangement, the eligibility criteria we consulted on specified both a minimum power (e.g. MW) and duration of dispatch at maximum power (e.g. hours) of individual projects for our proposed two application routes. Through the cap and floor development process, we will continue to review these thresholds in light of consultation feedback.

Energy Storage Support Scheme Coverage and Pace of Delivery

The Committee called for the details of business models to be finalised and set out to support commercial long duration energy storage. The government agrees and will ensure our proposed schemes are aligned, ensuring that it is clear to industry which scheme is best for each user case. As noted, we have two bespoke support schemes for introducing energy storage, our HSBM and our LDES cap and floor regime. Whilst these are similar, they are catering for two different storage facilities operating in very different markets, therefore two separate schemes have been proposed.

The need for two schemes:

Given the nascent hydrogen market, the HSBM aims to help mitigate demand risk for storage providers which is a key market barrier to investment in storage. By providing government support for storage development we aim to reach a liquid and competitive hydrogen market enabled by an integrated and resilient network, connected to several hydrogen storage facilities at various scales. Given the time needed to construct new-build storage assets, storage facilities must be developed to be in place for when demand is expected in the 2030s, hence the need for intervention now.

The LDES cap and floor regime is specifically aiming to address revenue uncertainty associated with LDES assets (like pumped storage hydro) operating in an already mature market. It will provide an insurance-type function to investors to unlock investment.

The differences in the two approaches reflect the differences in revenue certainty expected. We expect HSBM-supported assets will require public investment to attract private sector investment, at least during the early years of the hydrogen economy when there may be relatively few hydrogen storage users. For LDES assets, we hope to repeat the success of the electricity interconnector cap and floor regime where no floor payments have yet been needed in practice

[3] https://www.gov.uk/government/consultations/proposals-for-hydrogen-transport-and-storage-business-models

but the security of the cap and floor provides enough certainty to unlock investment from developers.

HSBM details:

The government agrees with the Committee on the need to support investment in initial hydrogen storage projects which is why, for the first HSBM allocation round, our ambition is to allocate support to up to two storage projects at scale with associated transport pipeline infrastructure. We intend for this ambition to support the development of emerging regional networks with potential to scale up beyond these early regions as the hydrogen economy grows.

The ambition for the first allocation is based on our current evidence of the near-term needs of the hydrogen economy. This is guided by our strategic planning process and aims to ensure the hydrogen economy has the transport and storage infrastructure we expect it to need by 2030. As more evidence on hydrogen production and demand becomes available, we will provide further detail on our analysis on the scope and scale of T&S infrastructure required for the early 2030s and beyond.

We want the HSBM to support projects which have the greatest chance of being commercially viable which is why, as previously mentioned, we have set a minimum TRL of 7 for projects to be eligible for HSBM support. This will reduce the risks for government in supporting projects using technologies which are not yet proven at scale. For that reason, depleted oil and gas fields which currently are considered to have a TRL of 3-4, such as Centrica's Rough gas storage facility, will not be eligible for HSBM support in the first allocation round. Officials continue to engage with Centrica about the project and are exploring alternative means of support, including innovation support to increase technology maturity.

Whilst government wants to ensure that we support a nascent hydrogen economy at pace, we want to do so without putting the current security of supply of natural gas at risk. This is why, for the first allocation round, projects proposing to convert entire natural gas storage facilities will also not be eligible for HSBM support.

LDES cap and floor details:

For the LDES arrangement, we have proposed two application routes; one for mature technology (TRL 9) and one for more novel technology (TRL 8). The mature stream will require a minimum power capacity of 100 MW, while for the more novel stream this is 50 MW. Both streams also require minimum output durations of 6+ hours at the maximum discharge power. As noted, we continue to review the minimum eligibility criteria for each scheme and will provide any necessary updates as part the response to our consultation in the summer of 2024.

Timelines:

The government is working at pace to bring forward these regimes. We propose to launch the first allocation round for the HSBM and publish the full application guidance in Q3 2024 with a view to awarding contracts to successful projects from Q4 2025 onwards. For the LDES cap and floor arrangement, we aim to complete the design by the end of 2024 and for an initial allocation round to be opened to applications in 2025.

Strategic Reserves

The government welcomes recent analysis on the potential role that strategic energy reserves could provide to the energy system and will consider this further when formulating future plans and ambitions. This will include further assessment of the key role hydrogen storage will need to play in supporting electricity generation during periods of high electricity demand. Strategic reserves, if needed, could be supplied by hydrogen storage or another long duration energy store. We will consider further how we will assess the UK's need for strategic reserves and which energy source, or combination of energy sources may be best placed to provide this. We will consider the evidence provided by external sources, including the National Infrastructure Commission and Royal Society. If hydrogen storage is to be used for strategic reserves, we will consider how best to fund this and what government intervention may be necessary to ensure the hydrogen is stored for very long periods and used only in specific circumstances.

Alongside this, as announced in the December 2023 Energy Security Plan Update[4], we will issue a Call for Evidence in the coming months and as part of this we will consider the future role that natural gas storage, and other sources of gas flexibility, can play in the longer-term, taking account of the need to align with future plans for hydrogen storage.

More broadly, at present our primary long duration flexible electricity generation technology is unabated gas. Unabated gas generation currently plays a critical role in ensuring our electricity system remains stable and secure as renewables need to be complemented by flexible technologies which can provide power when the wind is not blowing, or the sun does not shine. Unabated gas made up 38% of our total electricity generation mix in 2022, but as we expand the deployment of low carbon long-duration alternatives, the role for unabated gas will be reduced. However, all of government's modelled scenarios, as well as the Climate Change Committee (CCC), see a small but important peaking role for unabated gas out to at least 2035 to provide security of supply. The CCC's 2023 report notes that a power system without unabated gas in 2035 would be likely to increase costs and delivery risks[5]. We are working to support the deployment of low carbon long duration flexibility such as Power CCUS, hydrogen to power and LDES technologies, and mitigate potential barriers indicated by analysis, some of which are specific to individual technologies, and some of which are likely to exist for any First of a Kind technology. These technologies are expected to respond to shortfalls in renewable generation by accessing the relevant infrastructure to do so, for example hydrogen storage and carbon storage.

Ahead of hydrogen and carbon storage infrastructure being available, we expect new gas capacity to be built net zero ready. Our Decarbonisation Readiness proposals consulted on in March 2023 would require new build and substantially refurbishing combustion power plants to be built in such a way that they can convert to hydrogen-firing or retrofit carbon capture equipment within the plant's lifetime. We intend to publish our response and accompanying legislative changes in Q2 2024. We are making it easier for gas generation to convert to low carbon by committing to develop policy mechanisms that will enable gas plants to leave

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[4] Role of gas storage and other forms of flexibility in security of supply, https://www.gov.uk/government/publications/role-of-gas-storage-and-other-forms-of-flexibility-in-security-of-supply, DESNZ (2023)

[5] Delivering a reliable decarbonised power system, https://www.theccc.org.uk/wp-content/uploads/2023/03/Delivering-a-reliable-decarbonised-power-system.pdf, Climate Change Committee (2023)

Capacity Market agreements to decarbonise, without any penalty. We have also recently published a consultation seeking views on market intervention to support hydrogen to power deployment, and we intend to publish a response in Q2 2024.[6]

Hydrogen Usage and Safety

Government anticipates low carbon hydrogen will become increasingly used in the 2020s and 2030s to decarbonise industrial processes; to provide cleaner, homegrown power; as a feedstock or fuel for heavy transport applications including shipping and aviation; and potentially to heat homes. It can play a vital role in enabling these sectors to contribute to our aim to have slashed emissions by 78% by 2035 in line with Carbon Budget Six, decarbonise the UK power system by 2035, subject to security of supply, and keep us on track towards delivering our legally binding target of net zero greenhouse gas emissions by 2050.

Demand for hydrogen:

The Hydrogen Transport and Storage Networks Pathway sets out our current understanding of where, when, and for what purposes early demand for hydrogen is likely to materialise and provides potential ranges for hydrogen demand across key sectors in 2030, 2035 and 2050.

We have brought forward measures to stimulate demand for hydrogen across end use sectors which complement the funding we are providing via our hydrogen production and T&S business models. For example, innovation funding such as the £500m Industrial Energy Transformation Fund supports the development of hydrogen technologies, while regulations such as the Sustainable Aviation Fuel mandate incentivise sectors to switch away from fossil fuel. The UK's regulatory and policy framework is designed to support off-takers to invest and switch to hydrogen when commercial conditions are right.

Heat pumps and heat networks are established technologies that will be the primary means for decarbonising heating over the next decade and play a key role in all 2050 scenarios. Given the diversity of buildings and consumers' needs, no single solution can provide the best low carbon heat option for everyone. Hydrogen could potentially have a role in slower time in some locations, alongside heat pumps and heat networks. It is important we continue to assess the technical feasibility, costs, benefits, and other impacts of using hydrogen instead of natural gas to heat buildings in the UK. This will enable us to take decisions in 2026 on the role of low carbon hydrogen in heating.

Hydrogen safety:

The government recognises the importance of garnering public support for hydrogen. We are also carrying out work to assess the barriers in the planning process for hydrogen projects. For example, in December 2023 we published the 'Hydrogen projects: planning barriers and solutions – research findings' which identified barriers associated with obtaining planning permission and proposed short and long-term solutions for addressing these challenges.[7] This work also identified public attitudes and opposition to hydrogen storage deployment as potential barriers.

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[6] https://www.gov.uk/government/consultations/hydrogen-to-power-market-intervention-need-and-design

[7] DESNZ (2023), Hydrogen projects: planning barriers and solutions , https://www.gov.uk/government/publications/hydrogen-projects-planning-barriers-and-solutions

We are also engaged in a range of initiatives that investigate the public acceptability of hydrogen storage and recognise that this is an important area. We work collaboratively with several research institutions who are actively progressing work to further assure the safety case for hydrogen storage. For example, HyStorPor (funded by UKRI Engineering and Physical Sciences Research Council) has progressed research to provide evidence related to the safe storage of hydrogen, particularly in depleted gas fields. This work includes assessing rock integrity and mitigations to prevent potential adverse microbial reactions.

HyStorPor also ran a programme of research into the societal aspects of hydrogen storage. This covered areas such as:

- Using lessons learned for successful public engagement from other uses of the subsurface, such as underground gas storage and carbon dioxide capture and storage (CCS),
- Engaging with online opinion-shapers to ensure dialogue is informed by a good understanding of how the geological storage fits into the broader energy system,
- Ensuring the rationale for hydrogen and its storage is clearly articulated, and supported with feasible timelines for deployment.

We welcome the recommendations regarding commissioning further research into the safety and public acceptability of hydrogen storage and will consider this as our overall evidence base on hydrogen storage develops. We will also ensure that relevant information is made publicly available as the evidence base develops. We will consider how and when it is best to conduct further research into public perception of hydrogen. For example, it may be best to consider this once we have more certainty on where initial hydrogen storage infrastructure will be located.

Hydrogen Supply Chain

Electrolyser capacity:

It is government's ambition to have up to 10 GW of low carbon hydrogen production capacity by 2030, subject to affordability and value for money, allocating up to 6 GW to electrolytic production, with alternative technologies also contributing towards this total, and 4 GW to CCUS enabled hydrogen.

The best way to develop supply chains is to get significant numbers of projects to final investment decision as soon as possible. In December 2023 we announced 11 successful projects from HAR1 totalling 125 MW, the largest number of commercial scale electrolytic hydrogen production projects announced at once anywhere in Europe. We also launched the HAR2 competition, through which we are aiming to allocate up to 875 MW subject to value for money and affordability, putting us on track to achieve our 2025 hydrogen ambitions.

We are aiming to run annual allocation rounds of the Hydrogen Production Business Model from 2025 out to 2030 and have set out ambitious capacity aims of up to 1.5 GW across HARs 3 and 4 subject to value for money and affordability.

While other countries have set out considerable headline figures alongside their hydrogen strategies, investors have told us that the UK strategy – and the range of funding government is delivering to make it a reality – represent the most comprehensive, specific and detailed set of policy commitments on hydrogen worldwide. This clear pipeline provides confidence to investors and incentivises supply chain companies to increase capacity.

Our comprehensive funding, policy and regulatory environment includes the Green Industries Growth Accelerator (GIGA), offering over £1billion of funding to support the expansion of clean energy supply chains across the UK. This includes around £390million earmarked for hydrogen and carbon capture.

The Net Zero Innovation Portfolio is a £1 billion fund to accelerate the commercialisation of innovative low-carbon technologies, systems and business models through the 2020s. We have also set out a roadmap and detail on key challenges and innovation needs to support scaling up low carbon hydrogen demand and supply in our net zero research and innovation framework, published alongside the Net Zero Strategy. We are collaborating closely with the research community on current challenges across the hydrogen value chain and find innovative solutions.

This long term supportive environment has already shown that UK hydrogen companies have world-leading fuel cell, hydrogen production and material technologies. For example, ITM Power's Gigafactory, opened in August 2021, is one of the world's largest electrolyser factories, with a 1GW per annum capacity to manufacture the electrolysers needed to produce low carbon hydrogen for use across the economy.

Workforce and skills:

A growing number of skilled workers will be needed to deliver hydrogen projects across the UK. We anticipate that by 2030 the UK's growing hydrogen sector could support over 12,000 jobs and unlock up to £11 billion in private investment, as we work towards our ambition of deploying up to 10GW low carbon production capacity.

The UK government is part of the Hydrogen Skills Alliance (HSA), a collaboration between Cogent Skills and the High Value Manufacturing Catapult that is committed to building a skilled workforce for the UK hydrogen sector. Over the last six months, the HSA has been carrying out forward assessments of workforce and skills requirements. We are grateful to the HSA for leading this work which will also be used to inform hydrogen's role as part of the Green Jobs Plan. This cross sectoral plan, announced in March 2023 and which will be published in the first half of 2024, involves collaboration between government, industry and skills providers and will be an action plan to deliver a skilled and sufficiently sized workforce. A key priority in 2024 will be the development of a Hydrogen Skills Strategy, in collaboration with the HSA and the Hydrogen Delivery Council's jobs, skills and supply chains working group.

Electricity Storage Technology Innovation

Alongside our bespoke schemes, we have already provided significant support to industry to further develop innovative energy storage technologies. We are supporting battery technologies that have grid-scale applications through the Longer Duration Energy Storage Innovation Programme (part of HMG Net Zero Innovation Portfolio) which has made over £69 million of capital funding available to innovative longer duration energy storage technologies, including flow batteries. The Storage at Scale competition and Stream 1 of the Longer Duration Energy Storage Innovation Programme (part of HMG Net Zero Innovation Portfolio) are providing grant funding towards large-scale pilot projects of early-stage energy storage technologies co-funded with industry.

We recognise that a variety of electricity(/energy) storage technologies will be needed to achieve net zero, including technologies that can deploy at different scales and provide output for different durations such as lithium-ion battery storage and pumped hydropower storage, as well as potentially emerging technologies such as compressed air energy storage, flow batteries, and thermal storage among others. We are in the process of launching research into thermal storage which we expect to provide information on both large scale and long-term storage that will inform future policy interventions.

Looking to the future, we are considering whether future innovation funding would be suitable for continuing to develop innovative energy storage technologies and will communicate our recommendations in due course. The Department is taking forward work to identify priority areas for innovation, including engagement across the Department and with other stakeholders and an update of the Energy Innovation Needs Assessments (EINAs) in consultation across government and with external experts.

Networks

Connections Action Plan:

We agree with the Committees' comments relating to the need to reform our planning system to accommodate the additional strain associated with accommodating more energy assets. The government is working with industry and Ofgem to implement the joint government/Ofgem Connections Action Plan[8] (CAP), published in November 2023, which set out measures to significantly reduce connection delays and overhaul the grid connections process. The CAP aims to reduce the average delay a viable project faces to connect to the transmission network from 5 years to 6 months.

Since the CAP was published, over 40 GW of energy projects have been, or are being, offered earlier grid connection dates. This includes circa 13 GW of capacity released by changing the way the network impact of battery storage projects is modelled, allowing battery storage projects to connect to the network four years earlier on average.

Also as part of the CAP, the Electricity System Operator (ESO) has begun the process of inserting delivery milestones into over 1157 existing connection agreements and such milestones are now included in the agreements of all new connection customers as a matter of course. This will enable the ESO to terminate connection agreements of stalled projects, freeing up capacity to accelerate those that are ready to connect. We expect to see benefits of queue management from Autumn 2024.

In addition, Ofgem's decision to introduce a letter of authority requirement[9] for all new transmission connection applications came into effect on 28 March 2024, making it harder for speculative projects to enter the queue.

Building on the CAP and considering the continued rapid growth of the connections queue, the government and Ofgem are working with the ESO to outline further reforms by summer 2024 to reduce the size of the connections queue and further accelerate connections. The ESO will also implement a stringent new process for new connection applications from January 2025 so that

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[8] DESNZ (2023), Electricity networks: connections action plan, https://www.gov.uk/government/publications/electricity-networks-connections-action-plan

[9] Ofgem (2024), CMP427: update to the transmission connection application process for onshore applicants, https://www.ofgem.gov.uk/publications/cmp427-update-transmission-connection-application-process-onshore-applicants

projects are only offered a specific connection date when they are ready to progress. It will set out further details this autumn.

The Ofgem-chaired Connections Delivery Board oversees implementation of the CAP and provides strategic direction for future reforms. Minutes and monthly progress reports are published.[10] Ofgem also publishes a monthly article reflecting on progress and ongoing challenges in connections reform.[11] The ESO holds monthly Connections Reform webinars and will conduct a programme of stakeholder and customer engagement over the course of 2024 in advance of enduring reform implementation in 2025.[12] Individual network companies also hold regular connection customer webinars and conferences to keep them updated on developments and to seek feedback.

The focus of connections reform is on ensuring the connections process allows viable projects to connect faster, rather than favouring particular technologies. To note, we have also accepted the recommendations in the Winder Report in full.

Planning and Roles

We agree with the Committee on the need to not only improve our planning system, but to also ensure it is suitably resourced, with clear responsibilities set for stakeholders. We thank them for raising this. Government has committed to improving the planning process through the Nationally Significant Infrastructure Projects (NSIP) Action Plan, which sets out 18 actions to make the system more optimal, while keeping communities and the environment at the heart of decision-making. Wider planning reforms led by the Department of Levelling Up, Housing and Communities (DLUHC) are currently underway, delivered through the Levelling Up and Regeneration Act and reviews of national planning policy. These include actions to support local authorities, such as development of the Planning Capability and Capacity programme to provide direct support needed now, the £24 million Planning Skills Delivery Fund to help local planning authorities clear planning backlogs and upskill, and the increase in planning fees to provide additional resourcing and financial sustainability for local planning authorities.

In December 2023, Government published a research report, conducted by Verian, that explored non-economic regulatory planning barriers for hydrogen projects and identified potential solutions to these challenges[13]. The research proposed a series of short-term and long-term solutions that could be used to help mitigate identified planning barriers, including the development of planning guidance for developers. We are assessing these proposals and their potential effectiveness and wider impacts as part of our future work, and continue to work closely with relevant regulators on addressing challenges in the planning system. We will also continue to examine the applicability and suitability of the existing regulatory framework for onshore hydrogen storage, and explore whether changes are required.

Roles and responsibilities

Government is establishing a National Energy System Operator (NESO), as an expert, impartial body with responsibilities across both the electricity, gas and hydrogen systems, to drive

[10] https://www.energynetworks.org/industry/connecting-to-the-networks/connections-delivery-board
[11] https://www.ofgem.gov.uk/news-and-views/blog/preparing-faster-more-efficient-electricity-connections-process
[12] https://www.nationalgrideso.com/industry-information/connections/customer-connection-events
[13] https://www.gov.uk/government/publications/hydrogen-projects-planning-barriers-and-solutions

progress towards net zero while maintaining energy security and minimising costs for consumers. NESO will be established in public ownership, in a way which ensures its independence - not only of asset ownership and other commercial energy interests, but also from day-to-day operational control of government. As a trusted and expert body at the centre of the gas and electricity systems, NESO should ultimately be able to weigh up and advise on the impacts and trade-offs across energy vectors and plan our energy system from a more strategic, whole system perspective.

We have consulted on and laid the Strategy and Policy Statement, which both Ofgem and NESO have a statutory duty to have regard to. This sets out our energy policy priorities for both organisations and should ensure strategic alignment between the three organisations as well as industry. We set out the roles and responsibilities in meeting these strategic priorities in this document. Here we set out that, at a high level, government sets the policy direction, whilst Ofgem is the independent regulator and makes decisions on business and investment plans. NESO will be the whole system planner, the operator of the electricity system and expert advisor to government and Ofgem. However, we expect NESO's role and remit will continue to evolve over time. Both NESO and Ofgem will be important partners of government in delivering our energy ambitions.

We are also developing a framework agreement which will set out the relationship between the Secretary of State as shareholder and NESO, which we plan to publish shortly after designation. NESO's resilience and supply security roles, along other new roles such as delivering the Strategic Spatial Energy Plan (SSEP), will be codified in NESO's licences, which we are currently consulting on.

NESO will also be responsible for creating the Centralised Strategic Network Plan (CSNP), which will provide independent, coordinated, and longer-term approach to wider network planning in GB to help meet the government's net zero ambitions. The CSNP will establish a 'funnel' of potential projects which could meet a range of future needs, which will narrow to a delivery pipeline as forecast system need becomes more certain. The SSEP will be published in time for the first iteration of the CSNP, due for publication in 2026.

In the 'Hydrogen transport and storage infrastructure: minded to positions'[14], published in August 2023 we set out that strategic planning, combined with elements of market-led development, is necessary to enable the efficient, cost-effective and timely roll-out of both hydrogen transport and storage infrastructure.

NESO will be ideally placed to take a whole system view of hydrogen transport and storage infrastructure needs, and how these can be coordinated with electricity infrastructure, due to its roles in strategic planning of the electricity and gas systems. To ensure a whole system approach, in December 2023 we set an ambition for NESO to formally take on strategic planning activities for hydrogen transport and storage from 2026. This is subject to further work on the scope and detail of these activities, including how strategic decisions are communicated, and we aim to consult later in 2024. In the interim, early strategic direction will be provided by the UK government working together with Ofgem, industry and ESO/NESO, and to that end we published the first Hydrogen Transport & Storage Networks Pathway in December 2023[15].

[14] https://www.gov.uk/government/consultations/proposals-for-hydrogen-transport-and-storage-business-models

[15] https://www.gov.uk/government/publications/hydrogen-transport-and-storage-networks-pathway

Strategic Spatial Energy Plan

Government will shortly commission the ESO (in advance of becoming NESO) to begin work on the SSEP. As announced in the Transmission Acceleration Action Plan (TAAP), the first iteration of the SSEP will cover infrastructure for power generation, including hydrogen assets, to enable the creation of a more efficient electricity network and reduce waiting times for generation projects to connect to the grid. This will move to a whole energy system plan in future iterations.

The SSEP should be developed iteratively, and updated regularly through close collaboration between NESO, Ofgem and government, as well as the Scottish and Welsh governments and industry. In the TAAP, we set out our ambition that the SSEP will ultimately cover the whole energy system, land and sea, across GB. This will support government and regulators, in tandem with energy markets, to assess the optimal locations, quantities and types of energy infrastructure needed to transition to low-carbon, homegrown energy. However, producing a comprehensive multi-vector plan that effectively meets our future energy needs will, naturally, take time to get right.

Our ambition is that Ofgem will endorse the plan alongside government at the point of publication. The obligation to undertake the SSEP, in line with the Commission, will be set out in NESO's licence which will give it the empowerment and funding needed to resource appropriately and deliver the SSEP. We are currently consulting on NESO's Day 1 licence with Ofgem.

Following our commission, NESO will produce a comprehensive methodology document which is expected in Summer 2024. It will set out their proposed procedure for completing the SSEP, including their plans for robust stakeholder and community engagement. The SSEP will be used to help plan the future of the energy system.

We are working to ensure that both the initial and future iterations of the SSEP align with existing statutory planning and consenting processes. Following production of the plan, our intention is for the SSEP to become part of the framework of planning systems across GB; we will explore whether and how it is appropriate, for example, to amend the National Policy Statements (NPS) in the future to incorporate the SSEP or its spatial outputs.

Other Low Carbon Flexibility Technologies

We welcome the Committee's encouragement to be bolder in our support of new, innovative technologies and approaches. Fortunately, there is already substantial work being undertaken in these areas that we can build on.

Demand Side Response

Government is supportive of industry-led innovation like the Electricity System Operator's (ESO) Demand Flexibility Service (DFS)[16], which has demonstrated its capability to provide 400 MW of peak delivery. The DFS has expanded its reach, with over 2.4 million households and businesses signed up to the DFS during winter 2023/24 - a 50% increase compared to the previous winter.

[16] https://www.nationalgrideso.com/industry-information/balancing-services/demand-flexibility-service-dfs

The return of DFS for winter 2024/25 is a matter for the ESO and subject to approval by Ofgem. As a novel form of Demand Side Response (DSR), the DFS provides helpful learnings to inform the ongoing work to implement the joint 2021 government and Ofgem Smart Systems and Flexibility Plan[17], which set out a range of actions for government and Ofgem to take forwards, to fully unlock the benefits of DSR from electricity consumers of all sizes and types.

The Government is supporting deployment of "energy smart" technology, like smart meters. Smart meters will facilitate Market-wide Half-Hourly Settlement (MHHS)[18] and support the delivery of MHHS benefits. Consumers who want to take advantage of new products incentivised by half-hourly settlement, such as time of use tariffs and smart appliances, will need a smart meter as they accurately record half-hourly measurement of energy usage and automatically communicate this information to energy suppliers. Consumption data from smart meters also drives consumer engagement in the energy market and makes switching suppliers easier and quicker. At the end of 2023, there were 34.8 million smart and advanced meters in Great Britain in homes and small businesses (61% of all meters). Energy suppliers have been set minimum installation targets to deliver smart meters to 74.1% of their domestic meter points by the end of 2025.

The government's Smart Secure Electricity Systems Programme (SSES) is establishing a robust and proportionate regulatory framework for DSR that supports innovation, while protecting consumers and the wider electricity system. This framework will protect consumers and grid stability while at the same time ensuring that the electricity system benefits from increased flexibility and the wider economic benefits of smart energy are harnessed as much as possible. Produced in collaboration with industry and subject to ongoing consultation, the programme is designed to unlock the potential of DSR to empower consumers to engage in smart electricity, benefitting from lower energy bills for using their devices in lower-demand periods[19].

We are working to sharpen market signals for provision of DSR, including through our Review of Electricity Market Arrangements (REMA). We recently published our second consultation outlining a range of policy options aimed at improving market design to, among other things, better reward flexibility[20].

Interconnectors

Government considers that interconnectors will continue to play a key role in GB's future energy system, including in the transition to net zero and in enhancing the energy security of GB. The Government agrees that efficient UK-EU electricity trading arrangements are needed to maximise the benefits to consumers of current and future interconnectors. The UK and EU committed to developing efficient electricity trading arrangements in the Trade & Cooperation Agreement, and the Government is clear that development of these arrangements should be progressed as a matter of priority.

As we set out in the Energy Security Plan, we are also actively exploring the potential for international projects, beyond traditional interconnectors, to provide clean, affordable and

[17] https://www.gov.uk/government/publications/transitioning-to-a-net-zero-energy-system-smart-systems-and-flexibility-plan-2021
[18] https://www.mhhsprogramme.co.uk/
[19] https://www.gov.uk/government/consultations/delivering-a-smart-and-secure-electricity-system-implementation
[20] https://www.gov.uk/government/consultations/review-of-electricity-market-arrangements-rema-second-consultation

secure power. For example, the Xlinks UK-Morocco Power Project is a proposed large scale onshore wind, solar and battery storage site in Morocco that would exclusively supply power to the GB grid via high voltage direct current subsea cables. We are currently evaluating – without commitment – the viability and merits of the project and how it could contribute to the UK's energy security. We also believe, based on forecasts from the Electricity System Operator, that GB will become a net exporter of electricity by 2030 as we continue to develop offshore wind in the North Sea. This means that interconnectors not only present a means of providing flexibility, but also offer an opportunity to reduce the curtailment of renewables, which can be costly to GB, by providing access to an export market.

Heat Networks and Thermal Storage

District heat networks can offer significant benefits to the grid, particularly through using thermal storage to shift demand but also by utilising excess electrical production. Both can translate into better prices for consumers on heat networks. Heat Networks currently supply a very small proportion of heat in the UK and therefore the benefits and opportunities presented by thermal storage from future growth can be overlooked. Through Heat Network Zoning we will be providing clearer indications as to where the large heat network opportunities in England will be located to provide clearer signals to the energy sector. The Department is also interested in exploring ways to appropriately incentivise and reward heat network operators for this grid service. This will be part of the strategy for growing a low carbon heat network sector.

Domestically at a household level, the Government recognises the potential of thermal storage, in the form of heat batteries, which use electricity to charge a thermal store, and release this stored heat into a central heating system to provide space heating and hot water when needed. Heat batteries could play a significant role in complex to decarbonise homes because they are compatible with existing radiators, can operate at a similar flow temperature to a gas boiler and do not require external space. This provides a particular advantage for homes where it is prohibitively expensive to upgrade a property's insulation for a low temperature heat pump system and where there is no external space.

We have taken some action to integrate thermal storage into existing policy. For example, in the Home Energy Model (HEM) consultation heat batteries are included as a type of heat source. The HEM will replace SAP as the methodology used to produce EPCs. Additionally, on VAT relief the government gave significant consideration to the inclusion of thermal storage and following this, officials have been working to resolve the two outstanding issues that prevented thermal storage becoming eligible for VAT relief.

Before expanding further support for thermal storage in domestic heating policy we are continuing to explore the feasibility of heat batteries by considering the load shifting ability of the heat batteries and the impact it might have on the electricity network if installed in homes with a higher heating demand than can be met by the device. This involves working with industry to ensure design standards are in place to prevent undersizing the storage capacity of the heat battery.