SSE – Written evidence (LES0003)

SSE plc is a FTSE-30 company headquartered in Perth, Scotland and with interests across the UK and Ireland, Europe, North America and Asia Pacific. We are a leading generator of renewable electricity and one of the largest electricity network companies in the UK. We develop, own and operate low carbon infrastructure to support the low-carbon transition. This includes onshore and offshore wind, hydro power, electricity transmission and distribution grids, and efficient gas-fired generation, where we are at the leading edge of decarbonisation with developments in carbon capture and storage and hydrogen. We also provide energy products and services for businesses.

In November 2021, SSE announced a fully funded, £12.5bn Net Zero Acceleration Programme, which will see us expand on our ambition to be the UK's clean energy champion, creating 1,000 jobs a year to 2025. In May 2023 this plan was updated with a fully funded £18bn five-year investment plan to 2027. The programme will see SSE building the world's largest offshore wind farm at Dogger Bank. We will also deliver over 20% of the necessary upcoming electricity networks investment in the UK to connect renewable energy and enable electrification of heat and transport, alongside investment in critical technologies like carbon, capture and storage, hydrogen, solar and pumped storage hydro. Our investment could total up to £40bn across the decade to 2031/32.

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1. How much medium- and long-duration energy storage will be needed to reach the Government's goal of a fully decarbonised power grid by 2035 and net zero by 2050, and by when will it need to be ready?

The UK will need to deliver up to a six-fold increase in its electricity storage capacity by 2030 to boost the resilience of our energy system and complement the growth in variable power generation. To underpin the surge in renewables an electricity storage plan should be put in place to strategically deploy short-, medium- and long-duration storage technologies ahead of system need. Left to market signals alone there would be an under procurement of electricity storage as each storage asset will cannibalise each other. Therefore alongside a strategic plan for electricity storage deployment, a support mechanism for different storage needs will be required to ensure sufficient volume is deployed and to reduce costs through mitigating risks (as is done under the CfD for wind). A study by Aurora[1] has shown that 24GW of long-duration electricity storage (greater than four hours duration), an eight-fold increase, is required by 2035 to meet the Government's decarbonisation commitment cost-effectively and securely.

Under what scenarios would the grid draw heavily on long-duration storage? How well are these scenarios understood?

As the deployment of renewable energy developments is accelerated to support the transition to net zero, long-duration energy storage will play an integral role in maximising the use of renewable energy.

[1] Aurora Energy Research (2022) – Long Duration Electricity Storage in GB

For example, National Grid ESO, as part of its 2023 Future Energy Scenarios (FES), stated that more than a tripling of pumped storage capacity may be required by 2050 to reach Net Zero across the economy[2].

2. How sensitive is the amount of storage needed to assumptions about the future balance of supply and demand on the grid?

- **What role could nuclear power, fossil fuel generation with carbon capture and storage, or other energy technologies, play in reducing the need for energy storage on a net zero grid?**
  Carbon capture & storage (CCS) and hydrogen have been identified by the Climate Change Committee (CCC) as vital for balancing a renewables-led system through providing flexibility to the system. Both CCS and hydrogen will also support the decarbonisation of industries where emissions are hard to abate such as steel making. The level of ambition for these technologies and the pace at which policy is being developed to support deployment is not where it needs to be. Importantly, power CCS can provide an economic long-term user of CCUS infrastructure, helping to deploy CCUS and hydrogen infrastructure within industrial clusters, and reducing costs to other users.

  Government should commit to making the UK the world leader in CCS technology to accelerate decarbonisation and boost UK energy security by:

  - Delivering 7-9GW of power generation from CCS by 2030 with regular auctions for Dispatchable Power Agreements (DPAs).
  - Delivering at least four low carbon industrial clusters by 2030 to bring jobs and industry to the UK's industrial heartlands, and targeting to store at least 30m tonnes of CO_2 per year by 2030 with greater ambition for power CCS.
  - Develop a CO_2 import hub in Scotland to decarbonise other UK cluster without access to CO_2 stores and imports from elsewhere in Europe.

- **What role could greater grid interconnectivity between Great Britain, Northern Ireland and other nations play in addressing the imbalance between supply and demand?**
  The UK has a significant opportunity to take a central role in European energy security by creating hubs for offshore wind and hydrogen in the North, Celtic and Irish seas to become a net exporter of electricity by 2027, and a net energy exporter by 2040.

  A well-designed and well-built offshore grid can deliver at the lowest cost and in the most efficient way, allowing power to flow to the right place at the right time. This will involve interconnection and cooperation between the UK and neighbouring countries through a harmonised approach,

[2] National Grid ESO - Future Energy Scenarios

requiring alignment on electricity and carbon markets. The next generation of electricity interconnectors will be vital to achieving this: Multi-Purpose Interconnectors (MPIs), which connect the UK and Europe to clusters of wind farms in the North Sea. Beyond MPIs, development of Energy Islands where grid infrastructure and additional energy infrastructure could be located cost effectively should be explored.

Beyond electricity infrastructure, hydrogen interconnectivity will be important to unlocking the renewables potential of Ireland and Scotland to boost European energy security. Alongside coordinated infrastructure plans, appropriate market arrangements will be required to ensure cost and benefits are shared fairly.

3. Which technologies can scale up to play a major role in storage?

<u>Pumped Storage Hydro</u>

Pumped storage hydro is the world's largest, most proven, cost-efficient, and mature electricity storage technology that can deliver critical system flexibility. It accounts for over 94 per cent of installed global energy storage capacity, well ahead of lithium-ion and other battery storage technologies.

Pumped hydro storage works by using two reservoirs of water at different elevations over a short distance that can generate power as water moves down from one reservoir to the other, passing through turbines. It can also pump water back into the upper reservoir at times of excess renewable energy generation; this allows the excess renewable power to be captured and stored, similar to a giant natural battery. Then the energy is discharged for use during those periods where renewable energy generation is lower. This flexible technology will be critical to a renewables-led energy system in the UK in the years ahead by reducing curtailment, transmission congestion, and the overall costs and emissions in the power sector.

Coire Glas

- SSE's up to 1.5GW Coire Glas project with 30GWh of storage capacity in the Scottish Highlands would store enough water to power 3 million homes for 24 hours non-stop.
- It would be the UK's largest-ever electricity storage project, more than doubling the country's current storage capacity.

Sloy

- SSE has also announced plans to convert its existing conventional 152.5MW Sloy hydro power station to pumped storage.

<u>Hydrogen Storage</u>

Hydrogen can act as a form of energy storage for the electricity system, particularly when integrated with electrolytic hydrogen production. As with other forms of storage, it has the ability to demand shift, using renewable electricity to produce hydrogen when output is high. The hydrogen can then be stored and used at times of peak demand, as a fuel in power stations, providing dispatchable, flexible capacity or as a fuel for industrial uses. Storage can also support CCS enabled hydrogen production.

For CCUS-enabled hydrogen production, it can support efficient baseload electricity production. Applying CCUS to electricity and hydrogen production will enable the UK and Europe to continue to utilise its existing gas storage capacity while reducing its carbon emissions.

Hydrogen transport and storage infrastructure will be crucial to the development of a sustainable hydrogen economy. This supporting infrastructure will help underpin investment in production and fuel switching, bolstering low-carbon hydrogen, security of supply and balancing the supply and demand dynamics expected in the market.

Given there is a pressing requirement for new low-carbon power generation to support an increasingly renewables-led system, hydrogen can provide vital low-carbon flexibility and is in a position to provide an early anchor demand for storage, with wider system value expected in the medium term as the market develops.

Hydrogen will have a role to play in other sectors as well, and as demand increases, we anticipate the requirement for storage does too. Large-scale storage is likely to be needed to support the UK Government's 10GW hydrogen production ambitions. We believe that underground storage, through salt caverns and depleted gas fields provide the best opportunities to deliver this, combined with smaller scale above ground storage facilities.

SSE has three main hydrogen projects in development which we can share more detail with the Committee on request:

Aldbrough Hydrogen Storage

- In July 2021, SSE Thermal and Equinor announced plans to develop one of the world's largest hydrogen storage facilities. The facility could be storing hydrogen as early as 2028.

Aldbrough Hydrogen Pathfinder

- SSE is developing a first-of-a-kind project in the Humber which would unite hydrogen production, storage and power generation in one location by the middle of this decade.

Gordonbush Hydrogen Project

- SSE is also developing plans to co-locate a hydrogen production plant at our existing Gordonbush Wind Farm, 2km north-west of Brora in Scotland.

- **Which timescales for storage are different technologies most suited to? Is there a preferred technology for medium-duration and long-duration storage?**
  Last year AFRY Management Consulting published a report titled the 'Benefits of Long Duration Electricity Storage' which detailed which technologies are best suited to help balance the system over different durations.[3]

4. What policy support is currently in place to support deployment of storage technologies? Is it sufficient to support deployment at scale?

Pumped Storage Hydro
There is currently no policy support mechanism through an appropriate market framework in place to enable investment in large-scale long-duration electricity storage technologies to be deployed at scale in the UK. Given its high capital costs, long lead times and the lack of revenue certainty faced by pumped storage developers, there is broad industry support for a revenue stabilisation mechanism in the form of an adapted 'cap and floor' scheme. This would also be alongside broader consideration of how the electricity market, including the Capacity Market values the contribution of low-carbon, flexible assets such as pumped storage.

Hydrogen
Despite the important role of hydrogen storage in delivering a hydrogen economy, it is challenging to identify a merchant investment case at present due to demand and supply uncertainty, so we believe a business model will be crucial to facilitate investment. The UK Government has set out a minded-to position on the design of a hydrogen storage business model, which is designed to support investment in these assets, recognising that large scale storage assets, which will be fundamental for a hydrogen economy, can have a longer development and construction lead time compared to other elements of the hydrogen value chain, for example production. Maintaining momentum in finalising this business model, with legislative underpinning set out in the Energy Bill, will be crucial in supporting the delivery of a hydrogen economy and delivering on the UK Government's hydrogen production target of 10GW by 2030.

- **How good is the economic case for long-duration energy storage? What policies and market structures need to be put in place to make the business case viable?**
  Demand side flexibility, lithium-ion batteries and long duration storage will be required to decarbonise electricity systems cost effectively. However, long duration storage options like hydro pumped storage and hydrogen storage have steep upfront costs and long lifetimes, meaning current market mechanisms to support new build such as the Capacity Market (CM) and Contracts for Difference (CfD) will not provide the correct level and structure of payments to unlock investment in this strategic geological long duration storage capacity for the UK. These existing support

[3] https://bid3.afry.com/download/18.75ef5e4f1817ff175a6c13b7/1660301878769/benefits-long-duration-electricity-storage.pdf

mechanisms are also designed for different purposes – hydrogen electrolysis and hydrogen storage do not provide system security (as defined in the CM), and do not directly provide electricity (as the CfD contracts are structured to incentivise).

Pumped Storage Hydro

- As noted, pumped storage requires an adapted Cap and Floor revenue stabilisation mechanism to enable investment given its high capital costs, long lead times and the lack of revenue certainty.
- Alongside an adapted Cap and Floor, both network charging and the Capacity Market need to be reformed to better value the role such flexible assets provide in terms of alleviating constraints and supporting security of supply.

Hydrogen

The Government needs to take a holistic approach to the development of a hydrogen economy, recognising the need for hydrogen production, transport, storage and demand to be brought forward in a joined-up way. The Government should:

- Accelerate the development of policies to bring forward infrastructure across the hydrogen value chain, to underpin the delivery of 10GW hydrogen production by 2030 and consider a phase out date for high carbon hydrogen within industrial clusters where there is access to a low carbon alternative.
- Build investor confidence in hydrogen storage by providing interim support for development, while business models are progressed, to enable commercial operation of assets by 2030 as well as defining a hydrogen storage target for 2040.
- Recognise the need for strategic investment in the delivery of CO2 and hydrogen networks, offering the UK's regional heartlands the opportunity to decarbonise through shared infrastructure and unlocking the renewable energy potential of Ireland, Northern Ireland and Scotland.

- **How will the grid need to change to support long-duration storage? Which stakeholders (e.g. energy companies, the Electricity System Operator, National Gas) should be planning for these changes?**

  Pumped Storage Hydro

  Reforming Transmission Network Use of System (TNUoS) charges to recognising the contribution of pumped storage to relieving constraints, rather than charging them at a high rate as if they worsen constraints, would avoid deterring investment in pumped storage in Scotland.

  Hydrogen

  The Future System Operator (FSO), which will be the successor organisation to National Grid ESO, is likely to be best placed to consider the interactions between the electricity/power system and the hydrogen system. Given an expected reliance on renewable power generation to support electrolytic production of hydrogen and the role of hydrogen in the power sector, there will be benefits for these to be considered in tandem. The speed at which planning and approvals are taken is essential to the build out of this economy.

Strategic planning will be required prior to the FSO taking on this role, so in the meantime DESNZ could be well-placed to begin the strategic planning process as it has done with CCUS, to support the delivery of government targets (including 10GW of production by 2030 with half from electrolytic production), carbon budgets and net zero goals.

- **What role does the Review of Electricity Market Arrangements need to play to support medium- and long-duration storage development?**
  REMA should ensure the electricity system has a mix of short, medium and long duration electricity storage capabilities to deliver on its 2035 objectives to decarbonise the electricity system, with a particular need to ensure market frameworks value sustained response.

  Deploying 21GW of batteries, 5GW hydro pumped storage and 40GW of hydrogen electrolysers (with hydrogen storage and 25GW of hydrogen-fired electricity generation), would save £2bn by 2040 and help develop the UK's hydrogen economy and secure a domestic supply[4].

  While proponents may argue that locational marginal pricing (LMP) will support the business case for flexible storage assets, we do not agree. What is important for investment decisions in capital infrastructure be it batteries, hydro pumped storage or hydrogen electrolysers is being able to forecast expected revenues. Therefore, while LMP may increase volatility increasing usage of storage assets, the downside risk of an unforecastable market will add to the cost of capital of storage assets. We are clear that to deliver a decarbonised electricity system by 2035, nodal and zonal need to be removed from the next steps of REMA due this Autumn.

- **Is the Government's current reliance on market actors and technology competitions likely to deliver the storage needs on time?**
  As the UK transitions to a decarbonised electricity system by 2035 there will be an increasing need for flexibility, in particular electricity storage at all scales and in the most optimal locations. The current market arrangements are clearly not sufficiently incentivising those storage technologies best able to provide system flexibility over much longer durations and therefore there is need do so as outlined.

[4] LCP (2022) - Impacts and implications of the British Energy Security Strategy (BESS)

5. How well developed is the UK industry across different storage technologies, such as hydrogen or redox flow batteries? How does the UK compare to global competitors in these industries?

- **Are there any storage technologies that have a significant export potential for the UK?**

  Hydrogen
  - Due to its industrial heritage, geography and geology the UK has a competitive advantage in this space. The UK will be able to export both knowledge and manufacturing capabilities overseas with the opportunity to export low-carbon hydrogen and import CO2 for storage, unlocking significant economic benefits across all regions.
  - Government should be proactive around identifying the potential of hydrogen transporters and their associated networks with these presenting the possibility of a major export opportunity in the long term.
  - In the medium to longer term, offshore pipelines being the cheapest form of hydrogen transport can also facilitate trade with other countries (export and import) and connect offshore hydrogen storage facilities with producers and consumers.

- **For which technologies does the UK have significant existing research or industrial capacity? Is the Government doing enough to support the industry to grow and drive exports and economic growth?**

  Pumped storage hydro
  - The UK has been a pioneer in hydropower development and already has 2.8GW of pumped storage hydro capacity, built during the last century to address the need for power system flexibility. Despite all four facilities operating having been commissioned between 30 and 60 years ago, they are still operating well and have many decades of future life ahead of them.
  - A recent Scottish Renewables report[5] found that six pumped storage projects currently under development in Scotland could deliver £5.8 billion of GVA and almost 15,000 jobs by 2035. However, as mentioned the lack of an appropriately designed revenue support mechanism is holding back such development.

  Hydrogen
  - In addition to work to develop a hydrogen storage business model, a business model for offshore hydrogen pipelines is needed to unlock offshore storage opportunities, and future export and import opportunities. Whilst we note that older gas pipeline and depleted storage infrastructure can be repurposed, this may not be located in the appropriate areas.
  - Specific consideration needs to be given to how to transport hydrogen from Scotland, where there is significant wind resource, to England as

[5] Scottish Renewables - 'The Economic Impact of Pumped Storage Hydro'

a large demand centre. This should unlock the potential for large volumes of hydrogen production, optimise the use of wind energy by reducing curtailment and encourage the development of export markets.
- The development of a Regulated Asset Based (RAB) model by UK Government to support investment in hydrogen transmission infrastructure is welcome, and should be considered.

7. What steps should the Government take now to ensure this storage can come online later in the current decade?

Pumped Storage Hydro
In the British Energy Security Strategy, the Government committed to having an appropriate policy framework in place by 2024 to enable investment but no detail has yet been provided. The Government's timetable to make an announcement needs to be urgently accelerated to ensure projects such as Coire Glas can support the grid by the end of the decade.

Hydrogen
- Maintain commitment to deliver business models for hydrogen transport and storage infrastructure by 2025.
- Set out a clear allocation process, ahead of time, to provide developers with clarity on how and when support can be accessed.
- Given longer lead times for the development of hydrogen storage assets, compared to other elements of the hydrogen value chain, consider support to maintain investor confidence in projects and to progress development of them before they reach final investment decisions.
- Identify and develop demand-side interventions for hydrogen off-takers. In particular, to recognise the ability of hydrogen to provide large scale storage within the power system, focus on creating routes to market for hydrogen-fired power stations.

25 August 2023