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Full name or organisation's name

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- ☒ Yes
- ☐ No

Questionnaire

Chapter 1 – Introduction and vision

Question 1

What are your views on the vision set out for 2030 and 2045? Are there any changes you think should be made?

Please give us your views.

BGS expertise

The British Geological Survey (BGS) is a world leading applied geoscience research centre, which provides objective and authoritative geoscientific data, information, and knowledge to inform UK Government and other stakeholders on the opportunities and challenges of the subsurface environment. We undertake research related to a range of energy transition technologies and resources, including Carbon Capture and Storage, Geothermal Energy, Energy Storage, Critical Minerals and Offshore Renewables. In our response, we focus on Hydrogen and CCUS but also wish to highlight the opportunities that exist in Scotland for geothermal energy and thermal energy storage. We can be available to provide more detailed explanations in these areas as well as in other areas where we have expertise – as listed above.

Hydrogen and CCUS

We welcome the inclusion of low-carbon hydrogen production with CCUS in the vision as part of the energy transition for power generation, industry and the existing oil and gas sector. These transition technologies are enabled by the notable carbon dioxide (CO₂) storage capacity offshore Scotland. Support for biomass gasification with CCS for the production of hydrogen with negative emissions is also welcomed and facilitated by Scotland's substantial geological storage resource.

The porous strata suitable for CO₂ storage might also be used for hydrogen storage. Research is in progress within the British Geological Survey (BGS) in the '[Managing the Offshore Energy Transition](#)' project to inform this emerging technology which is particularly relevant to Scotland where no suitable salt formations required for cavern storage are present.

Geothermal Energy & Thermal Storage

We acknowledge the recognition of geothermal energy in the strategy as an international opportunity but wish to highlight that there are also several opportunities for the development and use of geothermal energy and thermal storage in Scotland.

The available geothermal resources are mainly suitable for geothermal heating (and cooling), including (1) Ground Source Heat Pump (GSHP) systems; (2) Mine Water energy, and (3) Deep Geothermal energy. Developing these geothermal energy systems in Scotland could make an important contribution to the decarbonisation of heating.

We would therefore propose that geothermal energy is considered in more detail in the strategy, for example in a separate section within Chapter 3: Energy Supply.

Chapter 2 - Preparing for a just energy transition

Question 2

What more can be done to deliver benefits from the transition to net zero for households and businesses across Scotland?

Please give us your views.

Question 3

How can we ensure our approach to supporting community energy is inclusive and that the benefits flow to communities across Scotland?

Please give us your views.

Question 4

What barriers, if any, do you/your organisation experience in accessing finance to deliver net zero compatible investments?

Please give us your views.

Question 5

What barriers, if any, can you foresee that would prevent you/your business/organisation from making the changes set out in this Strategy?

Please give us your views.

Question 6

Where do you see the greatest market and supply chain opportunities from the energy transition, both domestically and on an international scale, and how can the Scottish Government best support these?

Please give us your views.

Question 7

What more can be done to support the development of sustainable, high quality and local job opportunities across the breadth of Scotland as part of the energy transition?

Please give us your views.

Question 8

What further advice or support is required to help individuals of all ages and, in particular, individuals who are currently under-represented in the industry enter into or progress in green energy jobs?

Please give us your views.

Chapter 3 Energy supply - Scaling up renewable energy

Question 9

Should the Scottish Government set an increased ambition for offshore wind deployment in Scotland by 2030? If so, what level should the ambition be set at? Please explain your views.

Please give us your views.

Question 10

Should the Scottish Government set an ambition for offshore wind deployment in Scotland by 2045? If so, what level should the ambition be set at?

Please explain your views.

Question 11

Should the Scottish Government set an ambition for marine energy and, if so, what would be an appropriate ambition?

Please explain your views.

Question 12

What should be the priority actions for the Scottish Government and its agencies to build on the achievements to date of Scotland's wave and tidal energy sector?

Please give us your views.

Question 13

Do you agree the Scottish Government should set an ambition for solar deployment in Scotland? If so, what form should the ambition take, and what level should it be set at? Please explain your views.

Please explain your views.

Question 14

In line with the growth ambitions set out in this Strategy, how can all the renewable energy sectors above maximise the economic and social benefits flowing to local communities?

Please provide further details.

Question 15

Our ambition for at least 5 GW of hydrogen production by 2030 and 25 GW by 2045 in Scotland demonstrates the potential for this market. Given the rapid evolution of this sector, what steps should be taken to maximise delivery of this ambition?

Please give us your views.

Production of large-scale low-carbon hydrogen by reforming natural gas requires development and operation of Carbon Capture and Storage projects to permanently store the by-product CO₂. The ambition to maximise delivery of low-carbon hydrogen needs to be matched by sufficient matured storage capacity, as part of a CCS project, that is available to operators when needed. A strategic approach should be followed, and support given to CO₂ storage site appraisal to increase understanding and readiness of contingent capacity for future storage sites and operators.

Question 16

What further government action is needed to drive the pace of renewable hydrogen development in Scotland?

Please give us your views.

Question 17

Do you think there are any actions required from Scottish Government to support or steer the appropriate development of bioenergy?

Please give us your views.

Question 18

What are the key areas for consideration that the Scottish Government should take into account in the development of a Bioenergy Action Plan?

Please give us your views.

Question 19

How can we identify and sustainably secure the materials required to build the necessary infrastructure to deliver the energy strategy?

Please explain your views.

Chapter 3 - North Sea Oil and Gas

Question 20

Should a rigorous Climate Compatibility Checkpoint (CCC) test be used as part of the process to determine whether or not to allow new oil and gas production?

Please give us your views.

Question 21

If you do think a CCC test should be applied to new production, should that test be applied both to exploration and to fields already consented but not yet in production, as proposed in the strategy?

Please explain your views.

Question 22

If you do not think a CCC test should be applied to new production, is this because your view is that:

- ☐ Further production should be allowed without any restrictions from a CCC test
- ☐ No further production should be allowed
- ☐ Other reasons

Please explain your answer.

Question 23

If there is to be a rigorous CCC test, what criteria would you use within such a test? In particular, in the context of understanding the impact of oil and gas production in the Scottish North Sea specifically on the global goals of the Paris Agreement, should a CCC test reflect:

- ☐ A) the emissions impact from the production side of oil and gas activity only Further production should be allowed without any restrictions from a CCC test
- ☐ B) the emissions impact associated with both the production and consumption aspects of oil and gas activity i.e. also cover the global emissions associated with the use of oil and gas, even if the fossil fuel is produced in the Scottish North Sea but exported so that use occurs in another country – as proposed in the Strategy
- ☐ Some other position

Please explain your answer.

Should a CCC test take account of energy security of the rest of the UK or European partners as well as Scotland? If so, what factors would you include in the assessment, for example should this include the cost of alternative energy supplies?

Should a CCC test assess the proposed project's innovation and decarbonisation plans to encourage a reduction in emissions from the extraction and production of oil and gas?

In carrying out a CCC test, should oil be assessed separately to gas?

Question 24

As part of decisions on any new production, do you think that an assessment should be made on whether a project demonstrates clear economic and social benefit to Scotland? If so, how should economic and social benefit be determined?

Please explain your views.

Question 25

Should there be a presumption against new exploration for oil and gas?

Please give us your views.

Question 26

If you do think there should be a presumption against new exploration, are there any exceptional circumstances under which you consider that exploration could be permitted?

Please give us your views.

Decarbonisation of heating for buildings remains a large challenge for Scotland. Solving it likely requires use of a range of renewable technologies. Geothermal energy has potential to make a significant contribution to zero emissions heat deployment across Scotland through delivering heat from various geothermal heat sources and/or enabling the temporary storage of heat.

Previous reports commissioned by the Scottish Government have identified the potential for geothermal heating and cooling in Scotland (see <https://www.gov.scot/policies/renewable-and-low-carbon-energy/geothermal-energy/>) but these geothermal opportunities seem not to be considered in this strategy.

The Scottish Enterprise Green Heat Innovation Support Programme, the Scottish Government Heat Network Fund, the Heat in Buildings Strategy and Heat Networks (Scotland) bill already support some geothermal installations. However, experience from other countries have shown that progress in adoption of geothermal technologies is more likely to occur if targets for geothermal energy are clearly defined and supported by government strategies, such as the Energy Strategy and Just Transition Plan.

The three main opportunities for developing Geothermal Energy in Scotland are for heating (and cooling) applications from:

- Ground Source Heat Pump (GSHP) systems;
 - Mine Water energy systems;
 - Deep geothermal systems.
1. Ground Source Heat Pumps (GSHP) systems can either be closed-loop systems (they pump fluid through a pipe loop in the ground to extract heat or cold) or open-loop systems (heat is extracted directly from groundwater that is pumped from a shallow aquifer). In both systems, heat pumps are used to raise the temperatures to provide sustainable, low-carbon heating to individual dwellings or to small district heat networks. This is a proven technology which is already widely deployed in the UK and Europe. UK wide, around 50,000 GSHPs are estimated to be operational. Because of the thermal storage capacity of the ground/water, GSHPs tend to have higher coefficients of performance (COP) compared to air source heat pumps (ASHPs).
 2. Mine Water energy systems use water in abandoned, flooded mine workings to provide heating, cooling or thermal storage. These systems make use of the large volumes of water stored in flooded mines. Heat is extracted from the water using a heat pump and distributed via heat network to provide low carbon heating in previous coal mining areas, which often coincide with areas of fuel poverty. A small-scale mine energy heating scheme at Shettleston Housing Association (65kW, 16-unit social housing) has operated for two decades. The scheme was closed following problems with the system that were attributed to a lack of maintenance and maintenance contractors. The UK Geoenergy Observatory in Glasgow is a bespoke research facility that provides unique research and innovation infrastructure for mine water energy technologies.
 3. Deep geothermal energy systems (greater than 500 m below surface) can provide a heat source for district heating. Such systems require drilling of two deep wells, typically 1-3 km deep, to access deep aquifers. Water is pumped from one well and returned to the aquifer via the second well after heat extraction. Water temperatures are often high enough for direct use of the water for heating, i.e. without need for heat pumps. At present, there are no deep geothermal schemes operational in Scotland, but the technology itself is well-established and widely used in countries like the Netherlands, France and Germany. Potential for deep geothermal developments exists in sedimentary basins of central and northern Scotland or in the granites of Aberdeenshire, but further investigations are needed to better understand the recoverable resource.

In addition to extracting heat, the systems outlined above can also be used as underground thermal energy storage (UTES) systems for the temporal storage of heat or cold, e.g. from industrial processes, heating or cooling application etc.

We recommend that geothermal energy from different sources as well as UTES are considered in Scotland's energy strategies and planning. However, it should be recognised that, although it is based on established technologies, geothermal energy is still a nascent sector in the UK that is likely to require financial and policy support, in the form of financial incentives (e.g. feed in tariff), public investment in pilot projects (e.g. technology demonstrators) and setting of clear targets for the deployment of geothermal technologies.

Chapter 4 Energy demand - Heat in buildings

Question 27

What further government action is needed to drive energy efficiency and zero emissions heat deployment across Scotland?

Please give us your views.

Chapter 4 Energy demand - Energy for transport

Question 28

What changes to the energy system, if any, will be required to decarbonise transport?

Please give us your views.

Question 29

If further investment in the energy system is required to make the changes needed to support decarbonising the transport system in Scotland, how should this be paid for?

Please give us your views.

Question 30

What can the Scottish Government do to increase the sustainable domestic production and use of low carbon fuels across all modes of transport?

Please give us your views.

Question 31

What changes, if any, do you think should be made to the current regulations and processes to help make it easier for organisations to install charging infrastructure and hydrogen/low carbon fuel refuelling infrastructure?

Please explain your views.

Question 32

What action can the Scottish Government take to ensure that the transition to a net zero transport system supports those least able to pay?

Please give us your views.

Question 33

What role, if any, is there for communities and community energy in contributing to the delivery of the transport transition to net zero and what action can the Scottish Government take to support this activity?

Please give us your views.

Question 34

Electric vehicle batteries typically still have around 80% of their capacity when they need replacing and can be used for other applications, for example as a clean alternative to diesel generators. What, if anything, could be done to increase the reuse of these batteries in the energy system?

Please give us your views.

Chapter 4 Energy demand - Energy for agriculture

Question 35

What are the key actions you would like to see the Scottish Government take in the next 5 years to support the agricultural sector to decarbonise energy use?

Please give us your views.

Chapter 4 Energy demand - Energy for industry

Question 36

What are the key actions you would like to see the Scottish Government take in the next 5 years to support the development of CCUS in Scotland?

Please give us your views.

An updated strategic assessment of demand for CO₂ storage capacity required by Scotland to achieve its net zero targets should be completed. Targets for CO₂ emissions reduction, including CCS, have been significantly revised since the last appraisal of the storage capacity demand. Appraisal of demand to meet industry plans for industrially sourced CO₂ and hydrogen with CCS at Grangemouth and St Fergus by the ALIGN-CCUS and ELEGANY projects, 2016 to 2020, was based on 1.5°C rather than net-zero emissions targets. Ambitions for net-negative emissions technologies combining CO₂ storage with direct air capture and bioenergy sources were not included in the assessment. The requirement for appraised storage capacity will inform both the Scottish Government and prospective operators of the 'pipeline' of appraisal needed. Also, the licensors and regulators, such as North Sea Transition Authority (NSTA) and Crown Estate Scotland, of the anticipated storage capacity, sites and leases that will be needed. BGS has gained research council funding for use of the seabed and subsurface for the '[Managing the Offshore Energy Transition](#)' project which includes an updated assessment of the storage capacity demand for UK Track-1 and reserve industrial clusters. The project has commenced and re-assessment of demand for the Scottish industrial cluster is planned in 2024, working with NSTA and Crown Estate Scotland, with the results to inform Scotland's energy strategy.

Question 37

How can the Scottish Government and industry best work together to remove emissions from industry in Scotland?

Please give us your views.

Question 38

What are the opportunities and challenges to CCUS deployment in Scotland?

Please give us your views.

Question 39

Given Scotland's key CCUS resources, Scotland has the potential to work towards being at the centre of a European hub for the importation and storage of CO₂ from Europe. What are your views on this? Please explain.

Scotland's substantial theoretical CO₂ storage resource, around 46 Gt CO₂, is an opportunity to support an export market for storage of CO₂ sourced from Europe. BGS and Storegga won funding in February 2023 from the [Industrial Decarbonisation Research and Innovation Centre](#), to assess the value of the UK North Sea CO₂ storage capacity. The research and communication of the results to be completed in 2023. The results will inform policy makers and storage developers of potential scenarios of European storage demand to inform policy development for energy strategies in Scotland and the UK.

Chapter 5 Creating the conditions for a net zero energy system

Question 40

What additional action could the Scottish Government or UK Government take to support security of supply in a net zero energy system?

Please give us your views.

Question 41

What other actions should the Scottish Government (or others) undertake to ensure our energy system is resilient to the impacts of climate change?

Please give us your views.

Chapter 6 Route map to 2045

Question 42

Are there any changes you would make to the approach set out in this route map?

Please give us your views.

Question 43

What, if any, additional action could be taken to deliver the vision and ensure Scotland captures maximum social, economic and environmental benefits from the transition?

Please give us your views.

Impact assessment questions

Question 44

Could any of the proposals set out in this strategy unfairly discriminate against any person in Scotland who shares a protected characteristic? These include: age, disability, sex, gender reassignment, pregnancy and maternity, race, sexual orientation, religion or belief.

Please explain your views.

Question 45

Could any of the proposals set out in this strategy have an adverse impact on children's rights and wellbeing?

Please explain your views.

Question 46

Is there any further action that we, or other organisations (please specify), can take to protect those on lower incomes or at risk of fuel poverty from any negative cost impact as a result of the net zero transition?

Please give us your views.

Question 47

Is there further action we can take to ensure the strategy best supports the development of more opportunities for young people?

Please give us your views.

Just Transition energy outcomes

Question 48

What are your views on the approach we have set out to monitor and evaluate the Energy Strategy and Just Transition Plan?

Please give us your views.

Question 49

What are your views on the draft Just Transition outcomes for the Energy Strategy and Just Transition Plan?

Please give us your views.

Question 50

Do you have any views on appropriate indicators and relevant data sources to measure progress towards, and success of, these outcomes?

Please explain your views.