



House of Commons  
Scottish Affairs Committee

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# Hydrogen and carbon capture in Scotland

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**Sixth Report of Session 2022–23**

*Report, together with formal minutes relating to the report*

*Ordered by the House of Commons  
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# 1 Introduction

1. Our interest in hydrogen and carbon capture in Scotland was prompted during our inquiry into renewable energy in Scotland in 2021.<sup>1</sup> In that report, we focused on the vast potential for Scottish renewable energy to make progress against the UK and Scottish Governments' ambitious net zero targets. We received various submissions of evidence outlining how hydrogen can also help meet these net zero targets,<sup>2</sup> and concluded that we would return to hydrogen later in the Parliament.<sup>3</sup>

2. From the outset of our inquiry, it became clear that hydrogen had a distinct role to play in meeting net zero targets. Dr Nigel Holmes—Chief Executive Officer, Scottish Hydrogen and Fuel Cell Association—explained the importance of hydrogen:

To meet net zero we will need hydrogen. We will not be able to reach net zero without hydrogen. Similarly, we will not be able to deliver net zero without carbon capture and storage and this is where we need all the technologies working together if we are going to deliver net zero.<sup>4</sup>

The UK Government and Scottish Government recognise that low carbon hydrogen in the UK and Scotland will be an essential part of the energy mix to achieve net zero.<sup>5</sup>

3. Hydrogen is not only important for achieving climate targets, however. Crucially at this time, hydrogen production, use and storage could improve energy security in the UK by reducing reliance on energy imports.<sup>6</sup> This has become particularly pertinent since Russia's invasion of Ukraine on 24 February 2022, with restrictions on Russian gas in the European market and consequent energy price inflation.<sup>7</sup> Rising energy costs have been a major contributor to the cost of living crisis facing households across Scotland and the rest of the UK, and we are now inquiring into that issue, in relation to people living in rural areas of Scotland, separately.<sup>8</sup>

4. The hydrogen industry has the potential to provide job security for workers in Scotland as they transition from the oil and gas industry in the coming years.<sup>9</sup> Hydrogen could provide cleaner energy production and increase Scotland's international competitiveness, including in export. Dr Nigel Holmes—Chief Executive Officer, Scottish Hydrogen and Fuel Cell Association told us that

[In] Germany, they are making a very rapid transition away from being dependent on Russian gas to try to find alternative ways of importing

1 Scottish Affairs Committee, Fourth Report of Session 2021–22, [Renewable energy in Scotland](#), HC 51, 17 September 2021

2 Net zero targets are in place for 2045 in Scotland and 2050 in the UK. The initial UK Government target set out in 2008 was an 80% reduction of 1990 levels by 2050. This was amended by [Climate Change Act 2008 \(2050 Target Amendment\) Order 2019](#) to net zero by 2050; Scottish Government, [Climate Change Policy - Reducing greenhouse gas emissions](#), December 2020

3 Scottish Affairs Committee, Fourth Report of Session 2021–22, [Renewable energy in Scotland](#), HC 51, 17 September 2021, paragraph 57

4 [Q37](#)

5 UK Government, [UK Hydrogen Strategy](#), 17 August 2021, page 9; Scottish Government, [Hydrogen Policy Statement](#), 21 December 2020, page 6

6 OEUK ([HCC0023](#)), Shell ([HCC0043](#)), [Q104](#) [Bethan Vasey], [Q106](#) [Louise Kingham]

7 UK Government, [British Energy Security Strategy](#), 7 April 2022, page 5

8 Scottish Affairs Committee, [Cost of living: impact on rural communities in Scotland](#), 16 December 2022

9 [Q41](#) [Dr Jillian Couto-Phoenix], [Q46](#), [Q48](#), [Q49](#), [Q55](#), [Q71](#), [Q85](#), [Q87](#), [Q88](#), [Q91](#), [Q109](#), [Q110](#), [Q111](#)

natural gas and also future proofing those facilities; redeveloping ports so that they can then import either hydrogen or hydrogen derivatives in the very near future.<sup>10</sup>

5. Whilst we acknowledge the challenges and constraints faced by hydrogen, it is with the above opportunities in mind that this report focuses on the hydrogen strategies of the UK Government and Scottish Government. We go on to consider carbon capture and storage, export and storage of low carbon hydrogen, jobs and skills training and hydrogen for homes. Our central point is that the UK Government provides all necessary support to ensure that Scotland can meet its potential for low carbon hydrogen production and storage, thereby supporting the UK and Scotland in achieving net zero targets. The Scottish Government and the UK Government independently set targets for hydrogen production: Scottish Government target of 5GW by 2030 and the UK Government target of 10GW by 2030.

### *Twin track approach to hydrogen*

6. The UK and Scottish Governments have taken a twin track approach to hydrogen. The UK Government said the dual approach supported “both electrolytic (green) and CCUS-enabled (blue) hydrogen”.<sup>11</sup> For the purposes of this report—and to aid the reader—we have offered a basic description of these forms of hydrogen that can be used for energy generation: blue hydrogen is made by splitting natural gas (methane) into hydrogen and CO<sub>2</sub>; the CO<sub>2</sub> is captured, stored or reused. If the CO<sub>2</sub> is not stored but the same process is followed, it is grey hydrogen. Meanwhile, green hydrogen is created by splitting water into hydrogen and oxygen through electrolysis powered by renewable energy; no CO<sub>2</sub> is emitted during this process. Carbon Capture Utilisation and Storage (CCUS) is the process whereby CO<sub>2</sub> is captured either from point emission sources or from the air and stored or used. Carbon Capture and Storage (CCS) is the description of capturing CO<sub>2</sub> and storing it in suitable deep geological formations, as the last stage for blue hydrogen production.

7. The evidence we received recognises that blue hydrogen will be phased out as green hydrogen deployment increases.<sup>12</sup> Much of the evidence about both blue and green hydrogen was summarised by the Climate Change Committee which said the UK’s “net zero pathways see even low-carbon use of fossil gas with CCS to produce ‘blue’ hydrogen peak by the late-2030s as ‘green’ hydrogen production from renewables increasingly takes over”.<sup>13</sup> The Royal Society of Edinburgh also said that blue hydrogen could be “a potential ‘bridge’” to green hydrogen.<sup>14</sup> Clare Jackson—Chief Executive, Hydrogen UK—explained that “blue is able to scale a little bit more quickly than green, which will enable us to get those demand sectors going faster and to invest in the enabling infrastructure—networks

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10 [Q42](#)

11 UK Government, [UK Hydrogen Strategy](#), 17 August 2021, page 10

12 Tom Baxter (Consultant Chemical Engineer at PDB); David Cebon (Professor of Mechanical Engineering at Cambridge University); Bernard van Dijk (Airplane performance lecturer at University of Amsterdam); Jochen Bard (Director of Energy Process Technology Division at Fraunhofer IEE); Paul Martin (Chemical Engineer and Process Development Expert at Spitfire Research) ([HCC0004](#)), Scottish Renewables ([HCC0007](#)), MCS Charitable Foundation ([HCC0009](#)), Comhairle nan Eilean Siar ([HCC0017](#)), European Marine Energy Centre (EMEC) Ltd ([HCC0039](#)), Royal Society of Edinburgh ([HCC0044](#)), PA Consulting ([HCC0048](#))

13 Climate Change Committee, [Letter: Climate Compatibility of New Oil and Gas Fields](#), 24th February 2022

14 Royal Society of Edinburgh ([HCC0053](#))

and storage—faster if we have this twin-track approach”.<sup>15</sup> At the start of our inquiry, there was general consensus in favour of developing blue hydrogen first, but there has been some movement of opinion during the subsequent energy crisis, resulting from the war in Ukraine, which has quickly changed the situation, favouring green hydrogen.<sup>16</sup>

### Scottish hydrogen projects

8. The Scottish Government’s Hydrogen Action Plan, published on 14 December 2022, contains details and a map of 61 current and planned hydrogen projects in Scotland. We note that this includes 16 end user projects, 20 multi-vector projects, 17 production projects, six storage projects and two transmission/ distribution projects.<sup>17</sup>

### Our inquiry

9. We launched our inquiry, *Hydrogen and carbon capture in Scotland*, on 6 January 2022 and published a call for written evidence.<sup>18</sup> As part of the inquiry, we received 53 submissions of written evidence and held four public oral evidence sessions. This included an evidence session in Fife during our visit to the H100 Fife site. We also visited the REFHYNE project in Cologne, Germany, to see Europe’s largest PEM green hydrogen electrolyser.<sup>19</sup> We would like to thank our hosts on both visits and everyone who took the time to talk to us and submit evidence. We are particularly grateful to Dr Katriona Edlmann, our specialist adviser for the inquiry, whose support and contributions provided vital insights into this important subject matter.<sup>20</sup>

10. Our inquiry spanned several months. We have made every effort to ensure that the findings of this report are accurate and up to date. However, we realise that policy in this area is rapidly evolving and it is possible that some aspects of this report may become obsolete shortly after publication.

11. After the final evidence session of our inquiry, the UK Government announced on 7 February 2023 that responsibility for hydrogen would move from what was the Department for Business, Energy and Industrial Strategy (BEIS) to the new Department for Energy Security and Net Zero.<sup>21</sup> We note this change and the implications for the title of the UK Minister, Rt Hon. Graham Stuart MP. At the time of his giving evidence, he was Minister for Energy and Climate. He is now Minister of State in the new Department. As a result, for simplicity, he is referred to, throughout this report, as the UK Government Minister. We also refer to Michael Matheson MSP, Scottish Government Cabinet Secretary for Net Zero, Energy and Transport as the Scottish Government Cabinet Secretary. We had the Cabinet Secretary in to give evidence, and following that session he was asked to clarify his evidence on the Scottish Government’s use of misleading statistics. In his response to this

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15 [Q64](#)

16 International Energy Agency, [Global Hydrogen Review 2022](#), September 2022, page 93; UK Government, [Hydrogen strategy update to the market, July 2022](#), 20 July 2022

17 Scottish Government, [Hydrogen Action Plan](#), 14 December 2022, page 18

18 Scottish Affairs Committee, [Hydrogen and carbon capture in Scotland; call for evidence](#), 6 January 2022

19 [Note of visit to Cologne, Germany, 7–8 June 2022](#)

20 Dr Katriona Edlmann was appointed on 7 February 2022 (see the [Committee’s formal minutes](#)). She had four interests to declare (for further details see the [Committee’s formal minutes](#)).

21 UK Government, [PM: Making government deliver for the British people](#), 7 February 2023

committee on 3 March 2023, he has stood by his evidence which raises serious concerns for his fellow Scottish Government Ministers and information they have provided to the Scottish Parliament.<sup>22</sup>

### ***Scrutiny of hydrogen policy elsewhere in Parliament***

12. Given the current widespread interest in hydrogen, there was other notable work undertaken across the UK Parliament while we carried out our inquiry. This included a report by the Science and Technology Committee, published on 19 December 2022, on *The role of hydrogen in achieving Net Zero*.<sup>23</sup> The Transport Committee published its report, *Fuelling the future: motive power and connectivity* on 2 March 2023<sup>24</sup> and the All Party Parliamentary Group on Hydrogen published its 2023 annual report on 23 January 2023.<sup>25</sup> The Parliamentary Office of Science and Technology has published a relevant note on longer duration energy storage.<sup>26</sup>

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22 [Correspondence with Michael Matheson MSP, Cabinet Secretary for Net Zero, Energy and Transport, on follow up to hydrogen and carbon capture in Scotland on 16 January 2023](#), dated 23 January and 3 March 2023.

23 Science and Technology Committee, Fourth Report of Session 2022–23, [The role of hydrogen in achieving Net Zero](#), HC 99

24 Transport Committee, Third Report of Session 2022–23, [Fuelling the future: motive power and connectivity](#), HC 159

25 All Party Parliamentary Group on Hydrogen, [What do we need to make Hydrogen a reality? Annual Report](#), 23 January 2023

26 Parliamentary Office of Science and Technology; [Longer duration energy storage](#), 20 December 2022



## 2 Hydrogen strategies

### UK Government hydrogen policy

13. The UK Government has launched a range of reports, strategies and funds that address hydrogen policy across all of the UK and which support the UK's path towards net zero by 2050.<sup>27</sup> In his evidence to us the UK Government Minister, Graham Stuart MP, said that Scotland “has a key role to play in the development of a UK hydrogen economy, with potential to produce industrial-scale quantities of hydrogen”.<sup>28</sup> He sought to explain the UK Government's overall approach:

Hydrogen and CCUS [Carbon Capture Utilisation and Storage] will be critical to delivering UK energy security, high-skilled jobs and economic growth and will help the UK to reach net zero. There are certain areas of industry and other areas where we can find no route except by use of carbon capture and hydrogen. Therefore, if we convert our current position into a leadership role, there are huge benefits that will spring from that for Scotland and the rest of the UK. [ ... ] The UK approach is to promote every aspect of the hydrogen economy—production, demand, networks, storage, and research and development—and to give industry maximum clarity about Government support, and to drive private sector investment right across the value chain.<sup>29</sup>

14. Minister Stuart told us that there could be further announcements relating to hydrogen and net zero in March 2023,<sup>30</sup> although, at the time of writing, the main UK Government policies relating to hydrogen can be found in these documents:

- *Ten Point Plan for a Green Industrial Revolution (€ Net Zero Hydrogen Fund);*
- *The UK Hydrogen Strategy;*
- *The North Sea Transition Deal;* and
- *The British Energy Security Strategy and Hydrogen Sector Development Action Plan.*

Annex 1 provides an overview of each of these main policy documents and other UK Government initiatives.

### Scottish Government hydrogen policy

15. The Scottish Government also has a range of strategies and reports which outline its policies on hydrogen. These form part of its plan to reach net zero by 2045,<sup>31</sup> a deadline we note is five years earlier than the UK Government target, as per Climate Change

27 Net zero targets are in place for 2050 in the UK. The initial UK Government target set out in 2008 was an 80% reduction of 1990 levels by 2050. This was amended by [Climate Change Act 2008 \(2050 Target Amendment\) Order 2019](#) to net zero by 2050;

28 [Q230](#)

29 [Q230](#)

30 [Q255](#)

31 Scottish Government, [Climate Change Policy - Reducing greenhouse gas emissions](#), December 2020

Committee recommendations from which both targets are derived.<sup>32</sup> Cabinet Secretary Michael Matheson MSP told us that the Scottish Government sees “the development of domestic hydrogen and hydrogen production for export as an important part of our just transition to net zero”<sup>33</sup> and that “the developing global hydrogen market [ ... ] has the potential to bring great benefits to Scotland and the UK as a whole”.<sup>34</sup> However, the Cabinet Secretary also told us that

realising this opportunity means acting at pace to secure our place within the global hydrogen market and achieve our vision of Scotland as a net exporter of renewable hydrogen and hydrogen for supply in the UK and EU markets as early as the mid-2020s.<sup>35</sup>

At the time of writing, the main Scottish Government policies relating to hydrogen are contained in:

- *The Hydrogen Policy Statement;*
- *The Hydrogen Assessment Report;*
- *The Hydrogen Action Plan; and*
- *The Draft Energy Strategy and Just Transition Plan.*

Annex 1 also provides an overview of each of these main documents.

16. Discussing the extent to which the UK and Scottish Governments are aligned, Cabinet Secretary Michael Matheson MSP said that “officials have a good working relationship and I have a good working relationship with the [ ... ] Minister” adding that “there are a lot of areas of commonality between the Scottish Government’s and the UK Government’s ambitions for hydrogen”.<sup>36</sup> However, we note some differences in the area of export and we cover this in more detail in Chapter 4.

## Effectiveness of UK and Scottish hydrogen policy

### *Strategies, net zero targets and interim targets*

17. Scaling up hydrogen production and demand is essential to meet the UK and Scottish Governments’ net zero targets. The then Department for Business, Energy and Industrial Strategy published the *Hydrogen Investor Roadmap* in April 2022.<sup>37</sup> This showed a sample of potential hydrogen projects across the UK, including Scotland.<sup>38</sup> We heard that the potential of these projects “is enormous”.<sup>39</sup> Will Webster—Energy Policy Manager, Offshore Energies UK—commented about the need for interim targets for hydrogen to

32 The Committee on Climate Change (CCC) recommends a new emissions target for the UK: net-zero greenhouse gases by 2050. The CCC stated “in Scotland, we recommend a net-zero date of 2045, reflecting Scotland’s greater relative capacity to remove emissions than the UK as a whole”; Committee on Climate Change, [Net Zero The UK’s contribution to stopping global warming](#), May 2019

33 [Q195](#)

34 [Q195](#)

35 [Q195](#)

36 [Q199](#)

37 UK Government, [Hydrogen Investor Roadmap](#), April 2022

38 UK Government, [Hydrogen Investor Roadmap](#), April 2022, page 9

39 [Q69](#) [Will Webster]

meet the 2045 and 2050 net zero targets. For CCS, he described the value of “having the 50 million tonnes target by 2035, so the gradient of the S-curve is starting to be looked at. It would be quite useful to have a 2035 target for [blue] hydrogen too, so that the upswing of that S-curve is in mind”.<sup>40</sup> The Climate Change Committee has noted that “by 2050 the hydrogen economy is comparable in scale to existing electricity use”.<sup>41</sup>

18. Clare Jackson—Chief Executive, Hydrogen UK—raised concerns about the preparedness for the jump in production required, saying, “jumping from 5 GW to somewhere in the region of 70 GW between 2030 and 2050 in the UK—2045 in Scotland—is quite a big jump, so 10 GW [the new UK Government target] is a bit more of a platform from which to scale up”.<sup>42</sup> We heard that targets drive industry with Bethan Vasey—Energy Transition Manager, Shell UK Upstream—noting that “climate targets are making the choice for industry imminent and definitive”.<sup>43</sup> Clare Jackson—Chief Executive, Hydrogen UK—also identified targets as a driver for industry.<sup>44</sup>

### **Supply and demand for low carbon hydrogen**

19. The evidence we heard illustrated that both the UK Government and Scottish Government strategies contained a greater focus on production of low carbon hydrogen than encouraging demand for the use of hydrogen: Professor Andy Sloan—Managing Director of COWI, Royal Society of Edinburgh—noted it was key to create “both supply and demand”.<sup>45</sup> Dr Nigel Holmes—Chief Executive Officer, Scottish Hydrogen and Fuel Cell Association—expressed concern that demand will not match supply:

We also need to think about how we build up the demand to match the building up of supply. The business case does not exist without the demand, and we need to find ways of balancing that supply of hydrogen with the demand for hydrogen, either in Scotland or the UK or more widely.<sup>46</sup>

Bethan Vasey—Energy Transition Manager, Shell UK Upstream—said, “we can produce at scale, [ ... ] then the question is how we can secure the demand at scale”.<sup>47</sup>

20. The UK Government Minister, Graham Stuart MP, said the Government’s hydrogen strategy “sets out a good framework” but “the most important thing is to get production”<sup>48</sup> and supporting that using a Contract for Difference approach (a contract between a generator and counterparty to encourage the generation of low carbon electricity), could stimulate the market:

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40 [Q69](#); S-curves can be used to show the progress of a project over time.

41 Climate Change Committee, [Unpacking the Sixth Carbon Budget the transition for energy](#), 14 December 2020, page 12

42 [Q68](#)

43 [Q114](#)

44 [Q65](#)

45 [Q172](#)

46 [Q38](#)

47 [Q132](#)

48 [Q237](#)

If [ ... ] we can provide it, with a bit of support initially, at an affordable price, the uses [demand] will come forward. We think that will be more efficient if we do that than if we go around trying to pick who the demand people are.<sup>49</sup>

21. However, the Minister also told us that the UK Government is working to support the demand side too. He cited the £289 million Energy Transformation Fund, among other measures, and said the UK Government is providing multi million pound support for transport decarbonisation:

I think that our model, focused on production to get [hydrogen] to the right price, is fundamentally the right approach, but we do have a whole series of funds to stimulate demand as well.<sup>50</sup>

### ***Need for urgency with hydrogen projects***

22. While we heard evidence that welcomed the UK and Scottish Governments' respective strategies, there were also concerns expressed over a perceived lack of urgency within them. Will Webster—Energy Policy Manager, Offshore Energies UK—said the UK could fall behind international competitors because “there is no room for slow progress, because other people will jump ahead and get on with it”.<sup>51</sup> Louise Kingham CBE—Senior Vice President Europe and Head of Country, BP—said the UK should “pick up the pace, because of the competition, [ ... ] in Australia and the UAE”. Louise Kingham added that the UK had “started ahead of others, but there is a lot of catch-up in the system now and quick decision making on incentives is required to support the economic case for hydrogen.”<sup>52</sup>

### ***Green Freeports***

23. In January 2023, the UK and Scottish Governments jointly announced that two new Green Freeports will be established in Inverness and Cromarty Firth and Firth of Forth.<sup>53</sup> These are backed up by up to £52 million in UK Government funding with estimates of £10.8 billion of private and public investment and the creation of over 75,000 new, high-skilled jobs.<sup>54</sup> The UK Government announcement said the Inverness and Cromarty Firth Green Freeport aims to create 25,000 jobs and generate £4.8 billion in investment for the area, with a focus on hydrogen (as well as floating offshore wind and nuclear) that will drive a transition to net zero by 2045.<sup>55</sup>

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49 [Q237/Q238](#)

50 [Q238](#)

51 [Q100](#)

52 [Q105](#)

53 UK Government, [Joint cooperation to deliver two new Green Freeports in Firth of Forth and Inverness and Cromarty Firth](#), 13 January 2023

54 UK Government, [Joint cooperation to deliver two new Green Freeports in Firth of Forth and Inverness and Cromarty Firth](#), 13 January 2023

55 UK Government, [Joint cooperation to deliver two new Green Freeports in Firth of Forth and Inverness and Cromarty Firth](#), 13 January 2023

24. However, Scottish Government Cabinet Secretary Michael Matheson MSP told us that the Green Freeports “will not play a key part in helping to deliver and realise our ambitions for the hydrogen economy in Scotland”.<sup>56</sup> Mr Matheson highlighted “over 60 hydrogen projects that are in development or proposed across different parts of Scotland”<sup>57</sup> but noted that only “a limited number of them will fall to areas that are covered by green freeports”.<sup>58</sup> Commenting on the prospects for growth of the hydrogen economy, the Cabinet Secretary added:

I think that the hydrogen economy will develop nevertheless without green freeports or with them. For some businesses that choose to base themselves within a green freeport there may be some tax advantage to them as a result. I don't think it will have a big part to play in helping to realise the extent and opportunity we have in developing the hydrogen economy in Scotland”.<sup>59</sup>

This Committee notes that due to lengthy negotiations, the first freeports in Scotland were announced almost two years later than those in England.

**25. The UK and Scottish Governments have clear strategies and appropriate aspirations for hydrogen, with significant commonality in their ambitions. Overall relations between the UK and Scottish Governments in this area appear to be good with effective official-level and ministerial cooperation.**

**26. The UK and Scottish Governments have different net zero target dates of 2050 and 2045 respectively. *We recommend the UK and Scottish Governments respond to this report explaining how they will work together to ensure respective targets will be met. The Scottish Government should demonstrate how it is engaging with UK Government in reserved areas to ensure net zero is reached in Scotland five years earlier than the rest of the UK.***

**27. The UK and Scottish Governments arrived at their respective 10GW and 5GW by 2030 low carbon hydrogen production targets independently of each other, and we are unclear how the two targets align and whether either is achievable. Clarity on this is vitally important given the targets must be reached in just seven years' time. *We recommend that the UK and Scottish Governments, in response to this report, explain how they arrived at their respective 10GW and 5GW by 2030 low carbon hydrogen production targets and how the two targets align. Furthermore, the two Governments should provide us with a proposed timeline setting out key milestones on the road towards the respective targets to assist us and our successor committees in judging progress and evaluating the achievability of Scotland's hydrogen production targets.***

**28. We conclude that both the UK and Scottish Governments' hydrogen strategies require interim targets to ensure that hydrogen production and net zero commitments are met. *We recommend that both UK and Scottish Governments set such interim targets for hydrogen production, beyond 2030, to reach its net zero targets planned for 2050. In particular, we recommend the Scottish Government expedite their interim target setting due to the more pressing deadline they set of 2045. By the beginning of***

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56 [Q218](#)

57 [Q218](#)

58 [Q218](#)

59 [Q218](#)

*the next parliamentary session, the UK and Scottish Governments should set deadlines for approving a series of steps around hydrogen production and actions to stimulate demand of low carbon hydrogen, as the decisions need to be made without delay to ensure that net zero targets are met, energy security is obtained, job security is provided for workers in Scotland, and cleaner energy production and international competitiveness are realised. By the beginning of the next parliamentary session, the UK and Scottish Governments must publish a timeline of key decisions for projects, with justification of the dates set out in the timeline, as well as interim targets for production and demand of both blue and green hydrogen, and the phasing out of grey hydrogen.*

29. We are concerned that the Scottish Government does not see more potential in Green Freeports to complement Scottish and UK hydrogen policies, despite them being a joint UK and Scottish Government initiative and the Inverness and Cromarty Firth Green Freeport having a hydrogen focus. *We recommend that the Scottish Government explores how to maximise the benefits of Green Freeports for Scottish and UK hydrogen ambitions. Both the UK and Scottish Governments should work together to realise this potential and the opportunities for Scotland.*

30. We acknowledge the concerns raised by our witnesses around slippage in timings for hydrogen projects. This could delay the delivery of low carbon hydrogen projects and result in a failure to meet net zero targets. Urgency is required now; timely decision making will also mean Scotland and the rest of the UK do not get left behind with technology development and hydrogen production when compared to other countries' hydrogen sectors. *We recommend that the UK Government sets out how it will address concerns we have heard around timings of decisions for hydrogen projects, including justification for the timing of decisions and an assessment of the impact the timing of decisions will have for the delivery of low carbon hydrogen projects, net zero targets and Scotland—and the rest of the UK's—international competitiveness in the sector.*

## Planning for hydrogen projects

### *Conversion to hydrogen in rural areas*

31. The Scottish Government estimates 83% of Scotland's households make use of the natural gas network,<sup>60</sup> meaning that a majority will need to be switched to low carbon energy alternatives, potentially incurring higher costs in rural areas. Many of these areas—for example, Campbeltown, Oban, Stornoway, Wick and Thurso—are incorporated within Scotland's five Statutory Independent Undertakings (SIU) which are discrete gas networks, independent of the British gas network, supplied by tankers and fuel storage facilities.<sup>61</sup>

32. Sources of renewable energy such as windfarms often have to be temporarily stopped to prevent overloading of the grid, a process known as curtailment. Windfarms in onshore rural areas in Scotland have the highest rates of curtailment in the UK which fails to make use of the potential energy produced via windfarms and generates additional costs

60 Scottish Government, [A vision for Scotland's electricity and gas networks](#), 12 March 2019, page 24

61 HM Government, [Scotland analysis: Energy, Technical annex](#), April 2014 para 22



to consumers.<sup>62</sup> According to ClimateXChange Scotland’s SIU gas networks which are located in rural areas with significant onshore wind capacity are suitable for curtailed wind energy to be converted to hydrogen.<sup>63</sup>

33. The plans outlined in the SGN and RWE *green hydrogen partnership for domestic heat in Scotland*<sup>64</sup> described how rural communities could be connected to a hydrogen network. This partnership is looking to

investigate the decarbonisation of homes and businesses connected to the networks of Campbeltown, Stornoway, Oban, Thurso and Wick, which are not connected to the mains gas network. These networks are currently supplied by Liquefied Natural Gas (LNG) and Liquefied Petroleum Gas (LPG), which when swapped with hydrogen could save 21,000 tonnes of carbon each year and decarbonise around 9,500 properties.<sup>65</sup>

34. Professor Andy Slone—Managing Director of COWI, Royal Society of Edinburgh—told us that community projects are possible. He said, “remote communities, island communities and rural communities can be supported to grow localised hydrogen economies and promote energy independence—taking the hub concept and looking at that on a smaller scale”.<sup>66</sup> According to the Scottish Government, a Regional Hydrogen Energy Hub is defined as

a geographic location (region, city, island, industrial cluster) that is host to the entire hydrogen value chain, from production, storage and distribution to end-use.

The Scottish Government said that “Regional Hydrogen Hubs will include multiple end-users with applications ideally covering more than one sector”.<sup>67</sup>

### **Planning consent**

35. Planning consent is vital for new hydrogen projects like the one described above. ScottishPower’s Whitelee Farm hydrogen project is an example of a project that is “currently with the local planning authority and has been for some time”.<sup>68</sup> Barry Carruthers—Hydrogen Director, ScottishPower—noted from his past experience that planning consent takes a significant amount of time and it is normal for a “learning cycle with local planners, chief planners leading on to consent and wider aspects”.<sup>69</sup> He said that this learning cycle can be reduced.<sup>70</sup> When asked further about planning matters, he explained the issues ScottishPower and local authorities face:

There is a resourcing issue, but that is not just about hydrogen; it is also about the volume of activity, and not just renewables and hydrogen but

62 Drax, [Renewable curtailment and the role of long duration storage](#), May 2022

63 ClimateXChange, [The potential for hydrogen to reduce curtailment of renewable energy in Scotland](#), November 2022, page 22; In 2019, 97.4% of electricity generation in Scotland was from renewable energy sources. Scottish Government, [Energy Statistics for Scotland Q4 2020 Figures](#), 25 March 2021

64 SGN, [RWE and SGN announce green hydrogen partnership for domestic heat in Scotland](#), 14 June 2022

65 SGN, [RWE and SGN announce green hydrogen partnership for domestic heat in Scotland](#), 14 June 2022

66 [Q187](#)

67 Scottish Government, [Hydrogen Action Plan](#), 14 December 2022, page 19

68 [Q141](#) [Barry Carruthers]

69 [Q141](#)

70 [Q163](#)

non-energy sector applications that must be flooding into local authorities every day. [ ... ] I think there are some things that we can and should be doing collaboratively.<sup>71</sup>

36. Barry Carruthers noted that the learning process for planning hydrogen projects starts again each time an organisation goes to a new local authority, which adds to the time it takes for planning permission. This is because each local authority needs to develop its own expertise in the process which provides consent for these projects.<sup>72</sup>

37. Scottish Government Cabinet Secretary, Michael Matheson MSP, agreed that in rural areas “there is a potential role where hydrogen could play a part in helping to decarbonise energy systems”. However, he added that “because it is a limited market, the technology in that area is still very limited” and highlighted his view that green hydrogen in such localities “is at a very early stage”.<sup>73</sup> On the challenges in the planning system, Mr Matheson told us that the Scottish Government has just completed a review of the National Planning Framework 4,<sup>74</sup> following consultation, and that this has “been broadly welcomed” to “ease some of the planning difficulties that renewable energy projects or net zero-type technologies may have faced in the past”.<sup>75</sup> He also cited an exercise with local authorities that looked specifically at hydrogen and applications.<sup>76</sup>

**38. Better training in the hydrogen project consenting process for both local authorities and private organisations is required to speed up planning decisions for hydrogen projects. We note the actions the Scottish Government has taken in recent months to streamline these planning issues, including its engagement with local authorities on hydrogen planning applications. However, the Scottish Government has an important role to play and this work should be a continuing process. As *planning is a devolved matter, we would ask for an update from the Scottish Government as to how this work is progressing.***

**39. *We recommend that, in order to speed up the planning process and make it more efficient, the Scottish Government should facilitate the necessary knowledge sharing for planning teams in local authorities and private sector organisations. This should focus on the process of obtaining planning consent for hydrogen projects, covering production sites, storage sites and pipelines and the roles different individuals play in determining process and planning outcomes. The Scottish Government should consider the establishment of a dedicated body to deliver this work and implement it as soon as possible in light of the impending 2045 targets.***

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71 [Q163](#)

72 [Q164](#)

73 [Q223](#)

74 Scottish Government, [National Planning Framework 4](#), February 2023

75 [Q200](#)

76 [Q200](#)



### 3 Carbon capture and storage

40. The UK and Scottish Governments have a twin track approach to hydrogen, which supports both electrolytic (green) hydrogen and blue hydrogen, the latter of which is enabled with the use of Carbon Capture Utilisation and Storage (CCUS). During this inquiry, we have taken an interest in the use of CCUS as a means of producing blue hydrogen and achieving net zero targets.

41. The North Sea has an abundance of depleted oil and gas fields, providing the whole UK with secure geological storage for captured carbon. Particularly in Scotland, much of the existing oil and gas infrastructure will also play a significant role in delivery of CCUS. The UK Government recognised the potential of CCUS; Minister Graham Stuart MP told us that “hydrogen and CCUS will be critical to delivering UK energy security, high-skilled jobs and economic growth and will help the UK to reach net zero. [ ... ] the potential is enormous”.<sup>77</sup> The UK Government’s *Ten Point Plan for a Green Industrial Revolution*<sup>78</sup> included “a commitment to deploy [CCUS] in two industrial clusters by the mid-2020s, and a further two clusters by 2030 with an ambition to capture 10 MtCO<sub>2</sub> [Megatons of carbon dioxide] per year by 2030”.<sup>79</sup> This is the equivalent of taking around 4 million cars off the road.<sup>80</sup> Track-1 clusters are due to be operational for CCUS by the mid-2020s. Track-2 clusters will be operational by 2030.<sup>81</sup> In October 2021, the track-1 clusters were announced as HyNet (North West England) and East Coast (Humberside and Teesside), along with the Scottish Cluster as the reserve cluster.<sup>82</sup>

#### CCUS Infrastructure Fund

42. In March 2020, the CCUS Infrastructure Fund announced funding for blue hydrogen carbon capture utilisation and storage; a £1 billion allocation was confirmed in the Spending Review of November 2020.<sup>83</sup> The UK Government has also committed green hydrogen funding with an aim: “to run annual allocation rounds for electrolytic [Green] hydrogen, moving to price competitive allocation by 2025 as soon as legislation and market conditions allow, so that up to 1GW of electrolytic hydrogen is in construction or operational by 2025”.<sup>84</sup> The Hydrogen Business Model and Net Zero Hydrogen Fund<sup>85</sup>

77 [Q230](#)

78 UK Government, [The Ten Point Plan for a Green Industrial Revolution](#), November 2020

79 UK Government, [Cluster Sequencing for Carbon Capture Usage and Storage Deployment: Phase-1](#), May 2021, page 4

80 UK Government, [The Ten Point Plan for a Green Industrial Revolution](#), November 2020, page 23

81 Department for Business, Energy and Industrial Strategy, [October 2021 update: Track-1 clusters confirmed](#), 1 November 2021

82 Department for Business, Energy and industrial Strategy, [October 2021 update: Track-1 clusters confirmed](#), 1 November 2021

83 UK Government, [The Carbon Capture and Storage Infrastructure Fund: an update on its design](#), 8 November 2021

84 UK Government, [British Energy Security Strategy](#), 7 April 2022, page 23

85 UK Government, [Hydrogen Business Model and Net Zero Hydrogen Fund: Electrolytic Allocation Round 2022](#), 20 July 2022

were launched in July 2022.<sup>86</sup> The Hydrogen Business Model will offer revenue support whereas the Net Zero Hydrogen Fund will provide capital expenditure support.<sup>87</sup> Both of these are aimed at “developers and investors in electrolytic hydrogen projects”.<sup>88</sup>

43. These business models were welcomed by our witnesses, with praise especially for aspects relating to production. Sarah Potts—Hydrogen Commercial Specialist, Storegga—noted “the UK hydrogen business model and the net zero hydrogen fund are both critical at supporting that hydrogen investment, particularly in production”.<sup>89</sup> Angus McIntosh—Director of Energy Futures, SGN—told us “those business models are great, in the sense that they are going to stimulate some hydrogen production and that is their design”.<sup>90</sup> However, he also described the models as being “very focused on production”.<sup>91</sup> He went on to describe how infrastructure also needs investment:

Infrastructure suits a regulatory asset base model investment, where you can socialise costs over, say, 40 years between current and future customers. We should be very open to different market mechanisms on how we design and deliver this.<sup>92</sup>

## Cluster sequencing decisions

44. We have heard concerns about the timing of cluster sequencing decisions. Louise Kingham CBE—Senior Vice President Europe and Head of Country, bp—explained that decisions relating to the first clusters, including who the customers are going to be for the pipeline storage and CCUS infrastructure, were delayed from May 2022<sup>93</sup> (a shortlist rather than final decisions were announced in August).<sup>94</sup> She warned that

the delays are slowing things down to such an extent that, from a business point of view, you cannot go to the next stage, you cannot reach out to your supply chains, you cannot issue contracts, and you cannot get into feed, engineering and design stages, because you don’t know who the customers of your facility are going to be or whether your projects are being selected.<sup>95</sup>

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86 UK Government, [Hydrogen Business Model and Net Zero Hydrogen Fund: market engagement on electrolytic allocation](#), 20 July 2022

87 UK Government, [Hydrogen Business Model and Net Zero Hydrogen Fund: market engagement on electrolytic allocation](#), 20 July 2022; Description of the difference between revenue support and capital expenditure can be found here: Local Government Association, [Local Government Finance: key concepts](#), accessed 5 May 2022

88 UK Government, [Hydrogen Business Model and Net Zero Hydrogen Fund: market engagement on electrolytic allocation](#), 20 July 2022

89 [Q172](#)

90 [Q34](#)

91 [Q19](#)

92 [Q19](#)

93 [Q125](#)

94 [Q231](#)

95 [Q125](#)

## The Acorn Project

45. The Acorn Project, led by Storegga, has been set up as a Carbon Capture, Utilisation and Storage (CCUS) and hydrogen project and is sited in St Fergus, Aberdeenshire.<sup>96</sup> St Fergus is

the first landing point for around a third of all the natural gas used across the UK (35%), enabling the Acorn Project Hydrogen component of to take this gas and reform it into clean burning hydrogen with the CO<sub>2</sub> emissions captured, safely removed, and stored using the Acorn CCS infrastructure.<sup>97</sup>

The project has been specifically designed “to overcome one of the acknowledged blockers to CCS deployment in the UK—the high capital costs involved in getting started”.<sup>98</sup>

46. However, as we note above, the Acorn Project (or Scottish Cluster) was not successful and instead was announced as the reserve cluster. Sarah Potts—Hydrogen Commercial Specialist, Storegga—told us about the reserve cluster decision and the effect on the Acorn Project:

Acorn was very disappointed to not get Track-1 status. Therefore, being a reserve cluster has meant a significant amount of timing uncertainty in terms of how the project progresses. Uncertainty is never good for investment decisions. [ ... ] We understand that soon there is going to be an announcement around the Track-2 status and timing very shortly and that will give us more confidence to continue along that path. Clearly, further timing uncertainty would result in more delays to the project and the abilities to come onstream.<sup>99</sup>

Storegga also told our inquiry that it “continues to support the UK Government to progress its transport and storage network business model and regulatory framework”.<sup>100</sup> It said that “all parties are fully committed to the Cluster and would like to see both the Reserve Cluster status and the Track-2 [ ... ] Sequencing timeline be accelerated by the UK Government”.<sup>101</sup> “We would clearly like it to go faster and further than the current timelines and scale of the opportunities on the table”,<sup>102</sup> Sarah Potts said. She also explained that while they “are nervous about the Track-2 timeline and potential further delays”,<sup>103</sup> “we are still hopeful that even with Track-2, we can still deliver our first hydrogen in 2027”.<sup>104</sup>

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96 Storegga, Scottish Cluster ([HCC0025](#))  
 97 Storegga, Scottish Cluster ([HCC0025](#))  
 98 The Acorn Project, [About](#), accessed 28 September 2022  
 99 [Q175](#)  
 100 Storegga, Scottish Cluster ([HCC0025](#))  
 101 Storegga, Scottish Cluster ([HCC0025](#))  
 102 [Q178](#)  
 103 [Q177](#)  
 104 [Q180](#)

47. Scottish Government Cabinet Secretary, Michael Matheson MSP, shared his view that

the sector recognises there is a missed opportunity with the Acorn project and the Scottish cluster. The UK Government can't meet their net zero targets without the Scottish cluster; Scotland can't meet its targets without the Scottish cluster. It is mission critical.<sup>105</sup>

48. Mr Matheson also told us that “the failure to award the Scottish CCUS cluster track 1 status in the cluster sequencing process was illogical”,<sup>106</sup> adding that “delay to the development of the Scottish cluster, while unlikely to halt the cluster, will significantly slow the development of the key technologies and infrastructure, including the production of low-carbon hydrogen”. He called on the UK Government “to accelerate the deployment of carbon capture and storage in Scotland by providing clarity on the criteria and timing for awarding the Scottish cluster”.<sup>107</sup> He warned that any further delay could risk

a situation where other countries will overtake us in the development of this technology. That would be a catastrophe for us all and it would be a disaster for those in the industry. If anything, I think now that getting clarity on the timeline is the most important thing for all the stakeholders.<sup>108</sup>

49. The Scottish Government told us that it has made £80 million available for the Acorn Project “to try to help support some of the early financing of it and some of the technology around it”.<sup>109</sup> We heard that this funding cannot be taken forward

until they get clarity on the track 2 status, what the timeline for that project will be. Until they have clarity on the track 2 timeline, they don't know what investments they need to make and over what period. They also don't know what the market mechanism will be for the obligation of the cluster until the track 2 process has been completed.<sup>110</sup>

We note recent media reports that have said the £80 million Scottish Government investment has now been repurposed “due to delays”<sup>111</sup> and we have contacted the Scottish Government to clarify this. At the time of publication, we have not had a response.

50. UK Government Minister, Graham Stuart MP, sought to provide reassurance on cluster sequencing decisions. He told us that CCUS “is a priority for the Government and we are progressing at pace”.<sup>112</sup> Describing the Acorn Project as being part of the reserve cluster, he said “should either of the track 1 clusters not be able to deliver, we would call on the Scottish cluster instead”.<sup>113</sup> Stefanie Murphy—Director of Hydrogen and Industrial Carbon Capture Directorate at the then Department for Business, Energy and Industrial Strategy—explained the rationale for the reserve cluster:

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105 [Q199](#)

106 [Q195](#)

107 [Q195](#)

108 [Q204](#)

109 [Q205](#)

110 [Q206](#)

111 Scottish Daily Mail, [£80m carbon capture programme shelved](#), 21 January 2023

112 [Q231](#)

113 [Q231](#)

Should we encounter an issue with delivery in either of the two selected clusters, then there is a cluster that is warm and waiting and can be accelerated on to track 1 in the place of one of the existing track 1 clusters, rather than having to go back to the drawing board.<sup>114</sup>

51. Referring to the Acorn Project, the Minister said, “the idea that [it] is not going to be part of [decarbonisation of the economy] seems highly unlikely. We are moving at speed so being in track 1 or track 2 will, I think, in the longer term seem immaterial”.<sup>115</sup> He said that “further detail on the track 2 process will be set out in the spring”.<sup>116</sup>

**52. Scotland and the rest of the UK will not be able to deliver on their net zero commitments without carbon capture and storage (CCUS): a factor that is critical to the success of the hydrogen industry in Scotland. Carbon capture and storage and hydrogen production will both be required, in conjunction with other renewables, to achieve a just transition from oil and gas.**

**53. Delays to decision making around cluster sequencing and the Acorn Project are disappointing. But we noted the positive comments on CCUS from the UK Minister. Furthermore, such delays lead to an even further deficit in carbon capture facilities in Scotland and the ultimate result is a prolonged period when carbon continues to be released at avoidable levels.**

***54. We recommend that the UK Government accelerates the deployment of carbon capture and storage in Scotland and sets out, in its response to this report, how it intends to do so. Furthermore, in Minister Stuart’s response, he stated that the Scottish Cluster project had already received “£40 million plus”. The UK Government should provide details of how precisely they have funded the Scottish Cluster so far. We hope that the UK Government provides details for funding for the Acorn Project in the upcoming Budget.***

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114 [Q259](#)

115 [Q260](#)

116 [Q231](#)

## 4 Export of low carbon hydrogen

55. According to the International Energy Agency global hydrogen review, an estimated 12 million tonnes of low emission hydrogen per year could be exported by 2030 based solely on the export-orientated projects currently under development across the globe.<sup>117</sup> Most of these have been announced within the past two years and are at early stage development, but it is estimated that nearly 60% of proposed hydrogen projects are located in the Middle East and Australia, principally targeting markets in Europe and North East Asia. Saudi Arabia, Brazil, Chile, Oman and Kazakhstan have also all announced mega projects targeting the export market, indicating a rapidly growing landscape for hydrogen trade.<sup>118</sup>

56. The evidence we received illustrated that low carbon hydrogen has a large export potential from Scotland due to the abundance of renewable energy.<sup>119</sup> Clare Jackson—Chief Executive, Hydrogen UK—said that the EU “has explicitly stated that it wants to import at least 10 million tonnes of green hydrogen by 2030, which is [ ... ] equivalent to about 40GW” and therefore a “market is definitely there for the export of green hydrogen”.<sup>120</sup> The Scottish Government said, in its Scottish Hydrogen: Assessment Report,<sup>121</sup> that in its most ambitious export scenario

Green Hydrogen production in Scotland (supported from our strong offshore wind resources) could produce up to 126TWh of hydrogen per year by 2045, with up to 96TWh of hydrogen available to export to Europe.<sup>122</sup>

The Committee notes that in the Scenarios section of the Scottish Hydrogen: Assessment Report, the authors state of the scenarios discussed that

They are not intended to be accurate predictions of the future. The actual outcomes are more likely to be somewhere between these scenarios.<sup>123</sup>

And that,

In all scenarios [ ... ] a significant amount of energy will be needed from other low carbon sources, principally electricity. The amount of electricity that would be required has not formed part of the analysis.<sup>124</sup>

117 International Energy Agency, [Global Hydrogen Review 2022](#), September 2022, page 162

118 Wood Mackenzie, [Major energy exporters race to lead in global hydrogen trade](#), 28 October 2021

119 Assystem Energy & Infrastructure ([HCC0002](#)), Scottish Renewables ([HCC0007](#)), Shetland Island Council ([HCC0010](#)), Wood plc ([HCC0011](#)), National Manufacturing Institute Scotland ([HCC0013](#)), Scottish Hydrogen and Fuel Cell Association ([HCC0015](#)), Hydrogen UK ([HCC0016](#)), Comhairle nan Eilean Siar ([HCC0017](#)), ScottishPower ([HCC0018](#)), Net Zero Technology Centre ([HCC0019](#)), National Grid Electricity System Operator ([HCC0021](#)), Storegga, Scottish Cluster ([HCC0025](#)), SSE ([HCC0027](#)), GMB Scotland ([HCC0028](#)), Scottish Carbon Capture & Storage ([HCC0029](#)), Offshore Renewable Energy Catapult ([HCC0030](#)), Centre for Energy Policy, University of Strathclyde ([HCC0034](#)), bp ([HCC0036](#)), Department for Business, Energy and Industrial Strategy ([HCC0038](#)), European Marine Energy Centre (EMEC) Ltd ([HCC0039](#)), Forth Ports Group ([HCC0041](#)), Scottish Government ([HCC0042](#))

120 [Q97](#)

121 Scottish Government, [Scottish Hydrogen: Assessment Report](#), December 2020

122 Scottish Government ([HCC0042](#))

123 Scottish Government, [Scottish Hydrogen: Assessment Report](#), December 2020, Page 64

124 Scottish Government, [Scottish Hydrogen: Assessment Report](#), December 2020, Page 75



This export potential is likely to support potential job growth. The Scottish Government concluded in its *Hydrogen Policy Statement*: “If Scotland exported green energy to Europe it could result in over 300,000 jobs by 2045”.<sup>125</sup>

57. The UK Government *Hydrogen Strategy*,<sup>126</sup> published in August 2021, focused on exporting goods (fuel cells & electrolyzers) and expertise in the short term, whilst looking to export hydrogen in the longer term.<sup>127</sup> However, the *Hydrogen Strategy Update to the Market*, published in July 2022, noted:

Since publication of the UK Hydrogen Strategy, there has been a rapid increase in global interest and investment concerning the development of an international market for low carbon hydrogen [ ... ] The UK is keen to play a leading role in developing the global market for low carbon hydrogen and we are focused on working with others to ensure it is underpinned by effective common standards.<sup>128</sup>

The UK Government *Hydrogen Sector Development Action Plan*<sup>129</sup> included commentary on the export potential of hydrogen “while maintaining secure supplies for domestic use”. It said that the UK Government realises “the greatest opportunities for the UK, in terms of both carbon reduction and economic growth”.<sup>130</sup> Furthermore, the UK Government said it “will collate this intelligence in a Global Market Intelligence Tracker (GMIT)” with the purpose of “ensuring policy teams are cognisant of opportunities and risks, while developing relationships with future trading partners”.<sup>131</sup>

58. The UK Government’s *Hydrogen Strategy update to the market* of December 2022 said that activity is currently underway to explore “opportunities to export hydrogen, including from the UK to continental Europe”.<sup>132</sup> The UK Government has committed “to setting up a hydrogen certification scheme by 2025 to demonstrate high-grade British hydrogen for export and ensure any imported hydrogen meets the same high standards that UK companies expect”.<sup>133</sup> Acknowledging the balance between export opportunities and domestic resilience, the UK Government said it is “carefully considering the international developments and emerging evidence” to ensure its “approach to hydrogen trade realises the greatest opportunities for the UK while maintaining sufficient supplies for domestic use”.<sup>134</sup>

### **Export of low carbon hydrogen to Europe**

59. The global energy crisis has led to demand from Europe for green hydrogen.<sup>135</sup> The European Commission published the REPowerEU plan in May 2022. The plan “sets a target of 10 million tonnes of domestic renewable hydrogen production and 10 million

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125 Scottish Government, [Hydrogen Policy Statement](#), 21 December 2020, page 4

126 UK Government, [UK Hydrogen Strategy](#), 17 August 2021

127 UK Government, [UK Hydrogen Strategy](#), 17 August 2021, pp 96–97

128 UK Government, [Hydrogen strategy update to the market, July 2022](#), 20 July 2022, page 24

129 UK Government, [Hydrogen Sector Development Action Plan](#), 20 July 2022

130 UK Government, [Hydrogen Sector Development Action Plan](#), 20 July 2022, page 34

131 UK Government, [Hydrogen Sector Development Action Plan](#), 20 July 2022, page 35

132 UK Government, [Hydrogen Strategy update to the market: December 2022](#), 1 December 2022, page 12

133 UK Government, [Hydrogen Strategy update to the market: December 2022](#), 1 December 2022, page 12

134 UK Government, [Hydrogen Strategy update to the market: December 2022](#), 1 December 2022, pp 12–13

135 International Energy Agency, [Global Hydrogen Review 2022](#), September 2022

tonnes of renewable [green] hydrogen imports by 2030”.<sup>136</sup> Germany had looked into demand and production of low carbon hydrogen and in 2020 published its *Hydrogen Strategy*.<sup>137</sup> The document said that: “The Federal Government considers only hydrogen that has been produced using renewable energy [green hydrogen] to be sustainable in the long term”.<sup>138</sup> In 2022, the new German Government confirmed that it would not fund fossil gas-based hydrogen [blue hydrogen].<sup>139</sup>

60. We heard that Germany and other European countries are already speaking with Scottish companies about the export of green hydrogen. Barry Carruthers—Hydrogen Director, ScottishPower—told us that German and Dutch delegations “have all been asking about the interchange of green hydrogen across borders and how we can export”.<sup>140</sup> He went on to explain the amount of demand that could come through from Germany and Europe: “60% to 70% of their future hydrogen demand would have to be imported”.<sup>141</sup>

61. To understand better what was going on in Germany, in June 2022 we undertook a visit to the REFHYNE project in the Shell Rhineland Energy and Chemicals Park in Wesseling, Germany.<sup>142</sup> The REFHYNE project began in January 2018 and was due to run for 5 years to December 2022.<sup>143</sup> The €16 million 10MW REFHYNE PEM electrolyser was built by ITM Power and began producing green hydrogen in July 2021. Using renewable electricity, this electrolyser can produce 1,300 tonnes of green hydrogen a year, making it the largest of its kind in Europe to be deployed on a major scale.<sup>144</sup> This project showcased the possibilities of green hydrogen in a refinery setting, but it only covered a small amount of the energy requirements of the refinery. There are plans to build REFHYNE 2 at a cost of €200 million; it will be a 100MW capacity electrolyser.<sup>145</sup> The REFHYNE 2 project aims to produce approximately up to 15,000 tonnes of green hydrogen per year.<sup>146</sup> This is estimated to provide 10% of the total hydrogen demand on the site, which currently uses grey hydrogen.<sup>147</sup>

62. It was explained to us that Germany does not produce sufficient levels of renewable energy to be able to make sufficient green hydrogen for the whole country.<sup>148</sup> We heard how Germany is expecting to import renewable electricity, and green hydrogen, and are in the planning stages for pipelines to transport green hydrogen from places of import on the coast to industrial areas.<sup>149</sup>

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136 European Commission, [REPowerEU Plan](#), 18 May 2022, page 7

137 Federal Ministry for Economic Affairs and Climate Action, [The National Hydrogen Strategy](#) (English version) 10 June 2020

138 Federal Ministry for Economic Affairs and Climate Action, [The National Hydrogen Strategy](#) (English version) 10 June 2020, page 3

139 Euraciv, [German government disavows blue hydrogen](#), 17 January 2022

140 [Q154](#)

141 [Q158](#)

142 REFHYNE, [Clean Refinery Hydrogen for Europe](#), accessed 25 May 2022

143 REFHYNE, [Clean Refinery Hydrogen for Europe](#), accessed 25 May 2022

144 ITM power, [REFHYNE](#), accessed 25 May 2022

145 REFHYNE, [REFHYNE 2](#), accessed 27 September 2022

146 REFHYNE, [REFHYNE 2](#), accessed 27 September 2022

147 [Note of visit to Cologne, Germany, 7–8 June 2022](#), page 4

148 [Note of visit to Cologne, Germany, 7–8 June 2022](#), page 6

149 [Note of visit to Cologne, Germany, 7–8 June 2022](#), page 6



### Action on exporting low carbon hydrogen

63. We heard that, in order to establish an export market, quick action on behalf of the UK Government is required. Dr Nigel Holmes—Chief Executive Officer, Scottish Hydrogen and Fuel Cell Association—was concerned that Scotland and the rest of the UK may be left behind in the low carbon hydrogen export market:

The danger is that if we are not quick to act—in the same way that we missed the opportunity with onshore wind—we may start to miss some opportunities with building up the position of Scotland, the North Sea as a major producer of hydrogen for not just UK and Scotland but also for the whole of Europe.<sup>150</sup>

The Scottish Government echoed this concern, arguing that, “to the detriment of the Scottish and UK economies”, the “hydrogen export market will already be agreed and secured with other potential partner countries” should the UK not be agile enough “in securing exporting trade agreements or MOU’s [memorandum of understanding] for the supply of hydrogen particularly to Europe”.<sup>151</sup>

64. Once the UK Government makes a decision on the export of hydrogen, speed of action will be critical. Dr Jillian Couto-Phoenix—Programme Manager, National Manufacturing Institute Scotland—explained that

if this is how we are going to go, if this is that purpose, we need to drive that forward because there is so much that would need to be done in terms of the early technology as well as how we roll it out and scale it up in order to be able to export hydrogen.<sup>152</sup>

65. Hydrogen UK highlighted that investment in infrastructure is not in place for hydrogen storage or export and neither is there a “mechanism that enables networks to invest in hydrogen infrastructure”.<sup>153</sup> They argued for a regulatory regime that

supports first-of-a-kind hydrogen infrastructure and creates successful commercial models to support the storage that will be required if Scotland and the UK are to lead in the use and export of hydrogen.<sup>154</sup>

Bethan Vasey—Energy Transition Manager, Shell UK Upstream—described the international challenges of export infrastructure, noting “limited co-operation and co-ordination” in relation to infrastructure and highlighted fundamental barriers such as the lack of an agreement on the best way to transport hydrogen over long distances.<sup>155</sup> She concluded that “agreement and co-operation would be required in the short term to enable the fluid market that we feel would be beneficial globally, and to really start the piloting and the supply chain pivots now”.<sup>156</sup> Ms Vasey also noted that exporting green

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150 [Q42](#)

151 Scottish Government ([HCC0042](#))

152 [Q42](#)

153 Hydrogen UK ([HCC0016](#))

154 Hydrogen UK ([HCC0016](#))

155 [Q119](#)

156 [Q119](#)

hydrogen “is going to require the unlocking of a transport and storage system, as well as investments in large-scale storage infrastructure”.<sup>157</sup> We discuss storage of hydrogen in more detail in the next chapter.

66. We questioned both the Scottish and UK Government Ministers on export of low carbon hydrogen. The Scottish Government Cabinet Secretary, Michael Matheson MSP, told us that they have had “very extensive” discussions with the Länder in Germany and now have “a very strong relationship with a number of the states within Germany”.<sup>158</sup> He added that they have a memorandum of understanding in place with several states “specifically on hydrogen” and have letters of intent which they have also “recently put in place with Bavaria”.<sup>159</sup> He cited engagement between the Scottish Government’s Berlin Hub and the German Federal Government and outlined the Scottish Government’s hope for a joint event with a number of German states on hydrogen later this year.<sup>160</sup> We note his comments that the Scottish Government is currently carrying out a piece of work looking at different options for transportation of hydrogen—and hydrogen derivatives—from Scotland. This is due to be completed later this year.<sup>161</sup>

67. The Scottish Government has said that by 2045 the hydrogen industry could generate a £25 billion annual gross contribution to Scotland’s Gross Value Added (GVA) and support 300,000 jobs,<sup>162</sup> whereas in 2021 the UK Government offered a more conservative estimate that the UK hydrogen economy could support over 9,000 jobs by 2030 potentially growing to 100,000 jobs by 2050.<sup>163</sup> We were concerned by the Cabinet Secretary’s comment that, in his view, the Scottish Government sees “much more” potential for growing the hydrogen export market than the UK Government,<sup>164</sup> which, he said, is “much more focused on meeting domestic needs”.<sup>165</sup> However, the Cabinet Secretary also said the UK Government increasingly recognises “the potential for export of hydrogen and we are continuing to engage with them to make sure that they work with us to try to realise the opportunities [ ... ] on the export market”.<sup>166</sup> UK Government Minister Graham Stuart MP conceded they are still “at pretty early stages” and that currently there is more of a domestic focus in order to decarbonise the economy but he recognised the “big potential going forward”:<sup>167</sup>

Ideally, we would be potentially bringing in the carbon from our European partners and storing it, and a pipeline will be going the other way with hydrogen going out.<sup>168</sup>

Whilst not being able to give a timeline for hydrogen export,<sup>169</sup> the UK Government Minister acknowledged that the Government must not “miss any of the decision points that would allow us to be a major exporter going forward [ ... ]. There could be a big economic

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157 [Q104](#)

158 [Q226](#)

159 [Q226](#)

160 [Q226](#)

161 [Q228](#)

162 Scottish Government ([HCC0042](#))

163 Scottish Government ([HCC0042](#))

164 [Q199](#)

165 [Q229](#)

166 [Q199](#)

167 [Q278](#)

168 [Q278](#)

169 [Q280](#)

benefit to Scotland and the rest of the UK”.<sup>170</sup> Alison Conboy, the UK Government’s Deputy Director for Hydrogen Production, told us that the UK Government, like the Scottish Government, has had conversations with the Federal Government in Germany about exports.<sup>171</sup>

68. **The evidence we have received demonstrates that there is vast potential for the export of low carbon hydrogen and expertise from Scotland, which could generate significant economic benefits to the economy. We welcome some recent policy updates and note the UK Government’s focus on domestic decarbonisation as it strives towards net zero. However, if Scotland—and the UK as a whole—is to become a significant exporter of hydrogen, both governments need to work together.**

69. *We recommend that the UK and Scottish Governments work more closely to ensure the achievability of their respective ambitions for hydrogen exports, and that the economic benefits are realised. In its response to this report, the UK Government should continue to update this committee on progress over its timeframe for securing an export market and current progress in assessing the opportunities and risks, as well as addressing the challenges we have described, including around infrastructure and balance between export and domestic consumption. As international trade is reserved, we recommend that the UK Government outlines what it is doing to make hydrogen export more commercially attractive and how the UK Government plans to bring in investors while engaging with the Scottish Government and hydrogen industry.*

70. *Furthermore, we recommend that the UK Government publish modelling to quantify in more detail the long-term investment required to secure an export market and the potential economic benefits that could accrue to the UK, from such a market. The Government must identify markets and establish a presence within them before other countries do.*

71. *We recommend that the UK Government highlight its potential for export to overseas markets immediately. This is to ensure that companies in Scotland can benefit from global hydrogen export markets and opportunities and not be left behind.*

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170 [Q278](#)

171 [Q280](#)

## 5 Storage of hydrogen

72. During this inquiry, we have heard that Scotland has the potential to produce a “significant quantity” of low carbon hydrogen.<sup>172</sup> However, for this potential to be realised, particularly around green hydrogen production, storage of hydrogen will be necessary. Oonagh O’Grady—Head of Hydrogen Development at SSE—explained that hydrogen storage is required “to enable the scaling up of a hydrogen economy”.<sup>173</sup> The Royal Society of Edinburgh’s evidence said that “Scotland has the potential to become a storage powerhouse, which could bring considerable benefit to Scotland’s economy”.<sup>174</sup> The British Geological Survey wanted to encourage “assessing the storage of hydrogen [in Scotland] in depleted hydrocarbon reservoirs or porous rock”<sup>175</sup>.

73. Storage is necessary for green hydrogen as the process uses renewable energy and there is very often a mismatch between renewable energy generation and demand. Renewable energy is inherently intermittent—the sun does not always shine, and the wind does not always blow; some days are very sunny, and some are very windy. This intermittency means that when there is too much renewable energy being produced, due to a lack of demand for the electricity, the wind turbines need to be stopped temporarily, or curtailed, to balance the electricity grid or the grid could become overloaded.<sup>176</sup> This curtailment of renewable energy was explained by National Grid:

When there are physical constraints on the network (i.e. the network cannot physically transfer the power from one region to another), we ask generators to reduce their output to maintain system stability and manage the flows on the network. Generators are then compensated via a constraint payment.<sup>177</sup>

74. Bethan Vasey—Energy Transition Manager, Shell UK Upstream—explained that when renewable energy would otherwise be curtailed, the electricity could instead be used to produce green hydrogen because “electrolysis can provide an outlet for renewable electricity that is not yet connected to the grid, or may not be able to be connected to the grid for a long time”.<sup>178</sup>

75. Hydrogen UK said long-term storage for green hydrogen will be important “at times of high renewable and nuclear electricity output which would otherwise be curtailed” and to manage “both daily and seasonal demand variation”.<sup>179</sup> With renewable energy production increasing curtailment will become important; Clare Jackson—Chief Executive, Hydrogen UK—said “to deploy more offshore wind, then we effectively need hydrogen to make that economically viable”.<sup>180</sup> The economic viability of producing green

172 For example: Assystem Energy & Infrastructure ([HCC0002](#)), Peel L&P ([HCC0005](#)), RWE Generation ([HCC0006](#)), Scottish Renewables ([HCC0007](#)), SGN ([HCC0008](#)), Shetland Island Council ([HCC0010](#)), Wood plc ([HCC0011](#)), Scottish Hydrogen and Fuel Cell Association ([HCC0015](#)), ScottishPower ([HCC0018](#)), Net Zero Technology Centre ([HCC0019](#)), Storegga, Scottish Cluster ([HCC0025](#)), SSE ([HCC0027](#)), GMB Scotland ([HCC0028](#)), Offshore Renewable Energy Catapult ([HCC0030](#)), PlusZero ([HCC0031](#)), ETZ Ltd ([HCC0033](#)), European Marine Energy Centre (EMEC) Ltd ([HCC0039](#)), Forth Ports Group ([HCC0041](#)), Scottish Government ([HCC0042](#)), PA Consulting ([HCC0048](#)), Comhairle nan Eilean Siar (Western Isles Council) ([HCC0054](#))

173 [Q157](#)

174 Royal Society of Edinburgh ([HCC0044](#))

175 British Geological Survey ([HCC0001](#))

176 National Grid ESO, [How do we balance the grid?](#), accessed 3 October 2022

177 National Grid ESO, [What are constraints payments?](#), accessed 26 September 2022

178 [Q104](#)

179 Hydrogen UK ([HCC0016](#))

180 [Q73](#)

hydrogen with curtailed energy was highlighted by Oonagh O’Grady—Head of Hydrogen Development, SSE—who said that “locating the electrolyser behind the meter—utilising that curtailed energy—allows us to produce a lower cost of hydrogen production”.<sup>181</sup> Dr Nigel Holmes—Chief Executive Officer, Scottish Hydrogen and Fuel Cell Association—told us that storage allows a decoupling of “when you produce the hydrogen to the time when you need the hydrogen”.<sup>182</sup>

### Security of supply

76. We heard evidence that the energy security of the UK could be reliant on storage of hydrogen. Oonagh O’Grady said that “storage will be critical with regard to the security of supply for hydrogen” and therefore “investment in storage and the progression of storage projects will be key to ensuring year-round security of supply”.<sup>183</sup> Bethan Vasey acknowledged that, dependent on infrastructure investment, green hydrogen could reduce reliance on imports and create exports and noted that “[h]ydrogen can play a really valuable role in inter-seasonal storage of green electrons, so that should be at the heart of the UK’s response to energy security issues at the moment”.<sup>184</sup> SGN said that the resilience of the energy system relies on UK Government support calling for the UK Government to “ensure that the legislative, regulatory and support frameworks are in place to deliver large scale hydrogen storage, which will ensure the UK and Scotland has a resilient energy system”.<sup>185</sup>

### Current hydrogen storage

77. Energy companies told us how low carbon hydrogen is currently produced to meet demand. Barry Carruthers—Hydrogen Director, ScottishPower—said: they “would drive our storage demands based on customer demands [ ... ] it is very much a customer and use-driven conversation”.<sup>186</sup> This view was supported by Oonagh O’Grady who said that “[s]torage solutions will be very specific to the projects”.<sup>187</sup> Ms O’Grady went on to say that this will change over time and explained the urgency of organising storage of hydrogen within the appropriate timescales:

As the hydrogen economy develops, centralised storage will be required as the economy develops out. In that regard, there will be a need to look at revenue business models for those types of storage as well as the connecting infrastructure to be able to get the hydrogen to the stores. Considering the long lead times for storage development, it will be important that there is urgent action on those elements to allow a scaling up beyond these initial projects.<sup>188</sup>

78. Green hydrogen production, which demands storage, could be constrained if the infrastructure is not in place to connect new wind farms to the grid and therefore move the energy to where it is needed. Angus McIntosh—Director of Energy Futures, SGN—

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181 [Q141](#)  
 182 [Q40](#)  
 183 [Q159](#)  
 184 [Q104](#)  
 185 [SGN \(HCC0008\)](#)  
 186 [Q142](#)  
 187 [Q142](#)  
 188 [Q142](#)

explained that “some of the transmission assets through both the process of conversion and connecting the new sources of hydrogen would be additional infrastructure”.<sup>189</sup> Barry Carruthers—Hydrogen Director, ScottishPower—added that grid infrastructure

is a barrier if we don’t invest further, but it is an enabler if we invest. [ ... ] It is a benefit to everyone interested in hydrogen to have greater enabling infrastructure in renewable energy [ ... ] we need the investment in the electrical infrastructure.<sup>190</sup>

### Storage development

79. We were told that more work needs to be undertaken to develop initial plans for the development of the storage and transport of low carbon hydrogen. Will Webster—Energy Policy Manager, Offshore Energies UK—said “the storage and networks part is still a little bit more work in progress than the production models” and added that there “is a strategic element to primary energy storage generally, which is now a big question”.<sup>191</sup> Sarah Potts—Hydrogen Commercial Specialist, Storegga—made it clear that to drive investment in the hydrogen sector “we must make sure that the demand and the market can be connected. Without that transportation and storage infrastructure, and policies to support that and support that investment, it might not all hang together”.<sup>192</sup>

80. The urgency of starting storage projects was a theme throughout our evidence. Scottish Carbon Capture and Storage said that “we need to get a demonstration project for hydrogen storage in porous rocks underground operational as soon as possible” because “permitting a site for storage can take many years”.<sup>193</sup> Oonagh O’Grady said that, because of “the long lead times for storage development, it will be important that there is urgent action on those elements to allow a scaling up beyond these initial projects”.<sup>194</sup> Hydrogen UK were also concerned about the speed at which storage decisions will be made and said the priority should be the development of “support mechanisms that enable investment in storage” which would require “bespoke economic regulation” for large-scale hydrogen storage.<sup>195</sup>

81. Storage of hydrogen could become a matter of central national concern if low carbon hydrogen becomes established as a central component of the energy mix of the UK. Scotland could be an exporter of low carbon hydrogen to the rest of the UK, with one study suggesting “that there are 180GW of recoverable installed capacity in Scottish waters, which vastly exceeds both Scotland and largely the UK’s requirements”.<sup>196</sup>

82. We asked witnesses about making hydrogen storage a national asset, whereby it is considered necessary for the country to function and upon which daily life depends.<sup>197</sup> Sarah Potts—Hydrogen Commercial Specialist, Storegga—said that in relation to energy security “hydrogen assets will need to be considered a national asset”,<sup>198</sup> while Will

189 [Q9](#)

190 [Q169](#)

191 [Q66](#)

192 [Q172](#)

193 Scottish Carbon Capture & Storage ([HCC0029](#))

194 [Q142](#)

195 Hydrogen UK ([HCC0016](#))

196 [Q14](#) [Angus McIntosh]

197 Centre for the Protection of National Infrastructure, [Critical National Infrastructure](#), 20 April 2021

198 [Q191](#)



Webster—Energy Policy Manager, Offshore Energies UK—suggested that “there will certainly be a lot more Government involvement in the storage of gases than there has been in the last 10 or 20 years”.<sup>199</sup> Oonagh O’Grady said that separate business models for the storage and transport of hydrogen are required “because they will need to grow simultaneously to develop a wider hydrogen economy”.<sup>200</sup>

### Government action on storage

83. The UK Government’s written evidence to the inquiry said it is reviewing hydrogen storage options:

The UK Government is [ ... ] undertaking a review of systemic network and storage requirements in the 2020s and beyond, including need for economic regulation in funding, to understand how this infrastructure can support the growth in hydrogen demand.<sup>201</sup>

84. The *Hydrogen Sector Development Action Plan*, published in July 2022, contained a focus on the storage of hydrogen and reiterated the ongoing review. It set out a broad timeframe and established that the “Government will design new business models for Transport and Storage Infrastructure by 2025”.<sup>202</sup>

85. The UK Government’s *Hydrogen Strategy update to the market* (December 2022) contained further updated information about actions taken relating to transport and storage (T&S). It said that “[i]n the second half of 2022 we have moved to the next stage in delivering our Hydrogen Strategy and British Energy Security Strategy commitments on hydrogen T&S”.<sup>203</sup> The key developments are:

- The publication, on 31 August 2022, of a consultation on hydrogen T&S infrastructure, which closed on 22 November 2022. The UK Government states that this was consistent with its earlier commitment to design new business models by 2025;
- Alongside the update, the UK Government published an independent consultancy study which it commissioned as part of its review of hydrogen T&S infrastructure requirements up to 2035;
- The first meeting of the hydrogen T&S infrastructure Working Group under the Hydrogen Advisory Council took place on 10 October 2022, with the Working Group set to meet on a regular basis. The initial focus of the Working Group is to explore the immediate barriers to the development of hydrogen T&S infrastructure and consider how these might be addressed; and
- On 28 November 2022, the UK Government announced the 5 winners of the Longer Duration Energy Storage Demonstration Programme, Stream 2 Phase 2, including one hydrogen storage project, which will now build and demonstrate the technology prototype.<sup>204</sup>

199 [Q66](#)

200 [Q143](#)

201 Department for Business, Energy and Industrial Strategy ([HCC0038](#))

202 UK Government, [Hydrogen Sector Development Action Plan](#), 20 July 2022, page 10

203 UK Government, [Hydrogen Strategy update to the market: December 2022](#), 1 December 2022, page 6

204 UK Government, [Hydrogen Strategy update to the market: December 2022](#), 1 December 2022, page 6

86. In December 2022, the UK Government published the *Hydrogen transportation and storage external research study*.<sup>205</sup> This highlighted the significant uncertainty in the cost predictions for transport and storage infrastructure up to 2035 as a result of the combination of three factors: the variability in the overall demand for hydrogen, difficulty in accurately predicting the hydrogen and storage requirements on an individual archetype level and variability in the unit costs in storage and transport. Recommendations from this study included considering an early, interim or innovation funding model for trial large-scale salt cavern storage projects and accelerating the deployment of hydrogen blended into the current UK gas network.<sup>206</sup>

87. We questioned the UK and Scottish Government ministers on current actions and issues relating to hydrogen storage and transport. Michael Matheson MSP—the Scottish Government Cabinet Secretary—warned of “a lack” of storage capacity “not just in Scotland but across the UK in general” which “needs to be addressed”, although he acknowledged work published by the then Department for Business, Energy and Industrial Strategy (BEIS) which looked at domestic infrastructure and how that could be repurposed for hydrogen.<sup>207</sup> He described the use of the domestic network and how domestic storage can be used to supply local and national demand through the energy system: “for example, instead of storing natural gas, storing hydrogen that can be used for generating electricity”. He highlighted the need for storage at ports for export purposes, saying: “we are carrying out a piece of work looking at some of the opportunities to see what further infrastructure needs to be put in place at our ports to help to store and transport hydrogen”.<sup>208</sup>

88. Graham Stuart MP, the UK Government Minister, reiterated that the Government is “working on the transport and storage business models [ ... ] and looking to bring that forward”. He told us he would favour the private sector leading the development of storage infrastructure, with the UK Government looking to incentivise it. Stefanie Murphy—Director of Hydrogen and Industrial Carbon Capture Directorate at BEIS—added to this by citing the UK Government’s 2022 consultation “that looked into some of the issues around hydrogen transportation and storage”.<sup>209</sup> It covered the business models committed to in the Government’s Energy Security Strategy as well as the strategic need for storage, how much is required, and where.<sup>210</sup> She said the UK Government is talking to developers “frequently” and that if they can get the policy and financial frameworks for investment right, then projects will come forward. She told us that legislation is likely to form part of the next steps to be taken by the UK Government.<sup>211</sup>

**89. With the vast renewable energy resources it has available, Scotland can play a vital role in green hydrogen production for the UK and for export to Europe. However, secure hydrogen storage is essential to ensure hydrogen can become central to the energy mix of the UK. Without robust hydrogen storage infrastructure, Scotland will not be able to meet its hydrogen production potential.**

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205 UK Government, [Hydrogen Transportation and Storage Infrastructure, Assessment of Requirements up to 2035](#), December 2022

206 UK Government, [Hydrogen Transportation and Storage Infrastructure, Assessment of Requirements up to 2035](#), 13 December 2022

207 [Q197](#)

208 [Q198](#)

209 [Q276](#)

210 [Q276](#)

211 [Q276](#)



90. *We recommend that the UK Government alongside the Scottish Government moves quickly to develop hydrogen storage, to meet increasing demand, help Scotland and the rest of the UK enhance energy security and meet net zero targets.*

91. *The UK Minister told us that the UK Government's preference is for the private sector to lead the development of storage infrastructure. For businesses to lead the way in such a crucial aspect of Scotland and the UK's net zero and energy security ambitions, a clear set of regulatory conditions and economic incentives will be required to encourage development at the pace needed. Therefore, we recommend that in response to this report the UK Government establish an action plan to identify and address economic and regulatory barriers for hydrogen storage to ensure that, once large-scale hydrogen production becomes possible, appropriate storage is in place.*

92. *We recommend that the UK Government should examine how storage of low carbon hydrogen could be made a national infrastructure asset as this could help guarantee energy security for the UK.*

## 6 Jobs and skills training

93. Throughout our inquiry, we examined the work undertaken to develop skills and jobs in the hydrogen sector, including whether policies are sufficiently focused on keeping high-skilled oil and gas workers in Scotland to work on low carbon hydrogen. We put this challenge to both the Scottish Government Cabinet Secretary, Michael Matheson MSP, and UK Government Minister, Graham Stuart MP. Michael Matheson said that Scotland is already in “a very strong position”<sup>212</sup>, compared to other countries that are looking to develop hydrogen, because they “do not have the same oil and gas sector that we have and the skillsets that go alongside that”.<sup>213</sup> He summed up the Scottish Government’s overall approach:

As we see that decline in oil and gas taking place, it is about supporting the transfer of those already in our energy sector into the new, clean technologies.<sup>214</sup>

94. In his evidence, Graham Stuart MP highlighted the work of the Green Jobs Delivery Group, a recommendation of the Green Jobs Taskforce, covered further below, which continues to “work at pace to develop a programme of work across government, industry and the further education sector to address the skills challenges to deliver net zero”.<sup>215</sup> He stressed the need to prevent workers in the oil and gas sector from going abroad for employment during the transition.<sup>216</sup> On skills and jobs specifically, the Minister said:

I think the Scottish Government and ourselves would see things exactly the same way, a recognition of the challenge and a desire to do something together.<sup>217</sup>

95. Both the UK Government and the Scottish Government have outlined how many jobs are likely to be introduced, should hydrogen become part of the UK’s energy mix. The UK Government’s *Hydrogen Strategy*,<sup>218</sup> published August 2021, said “developing a UK hydrogen economy could also support over 9,000 jobs by 2030—and up to 100,000 jobs by 2050—across our industrial heartlands and across the UK”.<sup>219</sup> The Scottish Government’s *Scotland’s Hydrogen Assessment Report*,<sup>220</sup> published in December 2020, outlined three scenarios—hydrogen economy, green export and focused hydrogen—where the potential for jobs created by hydrogen could range from 70,000 to 300,000 by 2045.<sup>221</sup>

96. We heard about the types of jobs that will need to be created around a hydrogen economy. Dr Nigel Holmes—Chief Executive Officer, Scottish Hydrogen and Fuel Cell Association—explained that it is

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212 [Q225](#)

213 [Q225](#)

214 [Q225](#)

215 [Q265](#)

216 [Q265](#)

217 [Q265](#)

218 UK Government, [UK Hydrogen Strategy](#), 17 August 2021

219 UK Government, [UK Hydrogen Strategy](#), 17 August 2021, page 8

220 Scottish Government, [Scottish Hydrogen: Assessment Report](#), 21 December 2020

221 Scottish Government, [Scottish Hydrogen: Assessment Report](#), 21 December 2020, page 8

key that we have the people who can manufacture the equipment, who can deploy it, design it, all these good things. However, we need the people who can also use it, maintain it, respond safely and, at the end of the day, take it away and recycle it.<sup>222</sup>

The Scottish Government said, “there is expected to be significant potential for a transition of workers from oil and gas industries and, more widely, process engineering and installation and retrofit of existing technology”.<sup>223</sup> However, Dr Jillian Couto-Phoenix—Programme Manager, National Manufacturing Institute Scotland—was concerned about the speed of the transition of a hydrogen workforce, saying: “we cannot transition a workforce if there are no jobs for them”.<sup>224</sup>

97. We have heard about the efforts that both the UK and Scottish Governments are putting into workforce transition. As touched upon above, the UK Government set up the Green Jobs Taskforce that was announced in November 2020.<sup>225</sup> The Green Jobs Delivery Group, one of its recommendations, is made up of leaders from business, industry, trade unions and academia and met for the first time on 11 May 2022 to support the delivery of up to 480,000 skilled green jobs by 2030.<sup>226</sup> The Hydrogen Sector Development Action Plan<sup>227</sup> stated that the UK Government would, on a cross-UK basis

work with industry and education providers to explore what high-intensity up-skilling and re-training opportunities could be provided to support this transition, and ensure the workforce is equipped with the transferable skills to thrive in the net zero era.<sup>228</sup>

98. The July 2022 UK Government *Hydrogen Sector Development Action Plan* contained a commitment to co-hosting an “International Green Skills Conference [ ... ] to exhibit the best of UK green skills and education opportunities at these levels, including hydrogen”.<sup>229</sup> The UK Government also said that it

will continue to work with the devolved administrations to support the implementation of Skills Action Plans to maximise the benefits from new job and skills opportunities that will arise from the hydrogen economy right across the UK.<sup>230</sup>

99. The Scottish Government described the investment that is being made to develop jobs in the sector, stating that the:

£75m Energy Transition Fund and £100m Green Jobs Fund, our £500m Just Transition Fund will support the North East of Scotland and Moray Council areas to become one of Scotland’s centres of excellence for the transition to a net zero economy.<sup>231</sup>

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222 [Q50](#)

223 Scottish Government ([HCC0042](#))

224 [Q44](#)

225 [Q265](#)

226 UK Government, [Green jobs delivery steps up a gear](#), 11 May 2022

227 UK Government, [Hydrogen Sector Development Action Plan](#), 20 July 2022

228 UK Government, [Hydrogen Sector Development Action Plan](#), 20 July 2022, page 28

229 UK Government, [Hydrogen Sector Development Action Plan](#), 20 July 2022, page 30

230 UK Government, [Hydrogen Sector Development Action Plan](#), 20 July 2022, page 33

231 Scottish Government ([HCC0042](#))

## Skills training

100. In July 2021, the Green Jobs Taskforce report recommended that “to ensure they support a diverse, inclusive and net zero-aligned workforce across the UK” the UK Government “should map, review and enhance other training pathways (for example, traineeships, T-levels, internships and skills bootcamps)”.<sup>232</sup> When developing the *Hydrogen Development Sector Action Plan*, the UK Government incorporated the Green Jobs Taskforce into its plans and said that it would

continue to work with industry and education providers to explore what high-intensity up-skilling and re-training opportunities could be provided to support this transition, and ensure the workforce is equipped with the transferable skills to thrive in the net zero era.<sup>233</sup>

101. The UK Government published the *North Sea Transition Deal*<sup>234</sup> on 24 March 2021. The *North Sea Transition Deal* sets out a “plan for how the UK’s offshore oil and gas sector and the UK Government will work together to deliver the skills, innovation and new infrastructure required to meet stretching greenhouse gas emissions reduction targets”.<sup>235</sup> It noted that the deal: “could support up to 40,000 high quality direct and indirect supply chain jobs including in Scotland, generate up to £14–16bn of investment to 2030 and deliver new business and trade opportunities while supporting the transition”.<sup>236</sup> Part of this deal focuses on skills and aims to: “achieve a managed energy transition [ ... ] by harnessing the industry’s existing capabilities, infrastructure and private investment potential to exploit new and emerging technologies, such as hydrogen production, in order to meet our net zero goals”.<sup>237</sup> When we questioned the UK Government about cooperation with the Scottish Government on jobs and skills training, Alison Conboy—Deputy Director for Hydrogen Production at the then Department for Business, Energy and Industrial Strategy—cited as an example “[t]he Energy Skills Alliance [ ... ] which has a joint programme of work and recently published an integrated people and skills strategy”.<sup>238</sup>

102. The Scottish Government published the *Climate Emergency Skills Action Plan 2020–2025* (CESAP) in December 2020<sup>239</sup> (with an update expected during 2023).<sup>240</sup> The Scottish Government said that the CESAP “sets out the government’s plan to maximise the transition to net-zero for Scotland, ensuring that Scotland’s workforce has the skills required to make the transition to net-zero a successful one”.<sup>241</sup> However, Dr Jillian Couto-Phoenix—Programme Manager, National Manufacturing Institute Scotland—said in June 2022 “I do not think we have a framework for transition”.<sup>242</sup>

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232 Green Jobs Taskforce, [Report to Government, Industry and the Skills sector](#), 14 July 2021, page 60

233 UK Government, [Hydrogen Sector Development Action Plan](#), 20 July 2022, page 28

234 UK Government, [North Sea Transition Deal](#), 24 March 2021

235 UK Government, [North Sea Transition Deal](#), 24 March 2021

236 Written evidence from the Department for Business, Energy and Industrial Strategy ([RE50026](#)), to the Scottish Affairs Committee in relation to Fourth Report of Session 2021–22, *Renewable Energy in Scotland*, HC51

237 Department for Business, Energy and Industrial Strategy ([HCC0038](#))

238 [Q266](#)

239 Scottish Government, [Climate Emergency Skills Action Plan 2020–2025](#), December 2020

240 Scottish Government, [Draft Energy Strategy and Just Transition Plan](#), 10 January 2023, page 32

241 Scottish Government ([HCC0042](#))

242 [Q49](#)

103. The Scottish Government published its *Draft Energy Strategy and Just Transition Plan* in January 2023.<sup>243</sup> This is an update to the *2017 Energy Strategy*.<sup>244</sup> As the Scottish Government outlined in advance of its publication, the *Draft Energy Strategy and Just Transition Plan* provided a “whole-system vision and route map for Scotland’s future energy system”<sup>245</sup> and it outlined the overall vision and current policy for jobs and skills in the energy sector. With specific reference to hydrogen, the strategy said that the Scottish Government “will work with key partners to provide targeted support to develop skills programmes and to help people, companies and communities to connect to the opportunities created by the growing hydrogen economy”.<sup>246</sup>

### **Role of industry**

104. Clare Jackson—Chief Executive, Hydrogen UK—told us, “[t]he risk associated with not transitioning [ ... ] jobs well is that it will constrain the sector’s ability to deliver”.<sup>247</sup> Louise Kingham CBE—Senior Vice President Europe and Head of Country, bp—described an existing “workforce with capability that can be readily redeployed” due to there being “quite a lot of crossover, and [with] some light-touch skills development [we] will be able to build upon that readily”.<sup>248</sup> We heard in our evidence how industry needs to be leading workforce reskilling and training. Bethan Vasey—Energy Transition Manager, Shell UK Upstream—said, “there is a role for industry on the skills side”.<sup>249</sup> Clare Jackson said it was important to for industry “to identify where the gaps are [ ... ] what kind of jobs will we need”. She added that

[a]t the moment, we are looking at where are the cracks: are we in danger of certain areas falling through the cracks and not being looked at? The first thing is to identify where exactly those constraints might be. Then we can look, as an industry, at how we transition and train people into those specific roles or try to bring new people into those roles.<sup>250</sup>

**105. Scotland is in a very strong position compared to many other countries wanting to develop their hydrogen industry, in part because it already has a large relevant skills base in the oil and gas sector that has the potential to be redeployed. The work the UK and Scottish Governments have been doing on skills and jobs for people to work in the hydrogen sector should be applauded, but further progress needs to be made urgently to ensure that Scotland continues to provide vital workers for the low carbon energy industry. The industry needs to take a leading role in working with both governments to identify gaps in the workforce and the skills that are needed as well as deciding how to transition and re-train people.**

**106. We recommend that the cooperative approach between the UK and Scottish Governments on skills training and jobs continues, not least because of the mixture of reserved and devolved competencies when it comes to energy, education and skills. On at least a biannual basis, the UK and Scottish Governments should jointly set out work**

243 Scottish Government, [Draft Energy Strategy and Just Transition Plan](#), 10 January 2023

244 Scottish Government, [Scottish Energy Strategy: The future of energy in Scotland](#), 20 December 2017

245 Scottish Government, [Energy Strategy and Just Transition Plan \(ESJTP\)](#), accessed 22 August 2022

246 Scottish Government, [Draft Energy Strategy and Just Transition Plan](#), 10 January 2023, page 55

247 [Q88](#)

248 [Q109](#)

249 [Q109](#)

250 [Q91](#)

*they are undertaking to ensure that colleges, training providers and businesses within the hydrogen and CCUS sectors are able to offer appropriate routes into employment and training, and providing this information should be viewed as a priority. Incorporated into this analysis, both the UK and Scottish Governments should also provide regular updates on progress against their estimated jobs forecasts in the medium term.*

*107. We recommend that the UK and Scottish Governments work in tandem with industry in identifying the jobs and skills gaps in the existing workforce. Industry should work in cooperation with the UK Government to ensure their policies and initiatives are complementary. Industry alongside the Scottish Government should develop and implement a clear plan for transition and re-training its workforce—in light of the Scottish Government’s presumption against further oil and gas exploration and no nuclear in Scotland—and this could be supported by organisations such as Hydrogen UK.*

## 7 Hydrogen for homes

108. The UK Government’s *Ten Point Plan for a Green Industrial Revolution*, published in November 2020, outlined its ambitions for hydrogen for households.<sup>251</sup> Point 2 of the Plan focused on driving the growth of low carbon hydrogen and noted that hydrogen could be used to heat households.<sup>252</sup> The UK Government’s *Heat and Buildings Strategy* said:

Our ambition is to phase out the installation of natural gas boilers beyond 2035. [ ... ] we will continue to invest in hydrogen heating through the neighbourhood and village trials, and the plan for the town pilot.<sup>253</sup>

109. The UK Government’s *Heat and Buildings Strategy*, published in October 2021<sup>254</sup>, said that decisions around the use of hydrogen in heating will be made “by 2026” and established that hydrogen could be part of the mix for heating households:

The future is likely to see a mix of low-carbon technologies used for heating: electrification of heat for buildings using hydronic (air-to-water or ground-to water) heat pumps, heat networks and potentially switching the natural gas in the grid to low-carbon hydrogen”.<sup>255</sup>

The Scottish Government had a target for domestic heat to be 11% renewable by 2020.<sup>256</sup> For 2020, the actual figure was 6.2%.<sup>257</sup>

110. If a decision is taken to incorporate hydrogen into the gas network, the boilers that heat people’s homes will need to be replaced to cope with 100% hydrogen fuel. The Royal Society Edinburgh explained that hydrogen “is safe to inject into the natural gas grid at proportions of up to 20% and is compatible with existing cookers, boilers and heating systems”.<sup>258</sup> Clare Jackson—Chief Executive, Hydrogen UK—said that “what we need is a mandate on hydrogen-ready boilers, which is a no-regrets, no-brainer policy that would significantly decrease the cost of conversion when that actually comes about”.<sup>259</sup> She explained there are “1.6 million boiler retrofits” in the UK each year and with “23 million homes in the UK, it would take 15 years to get that stock into homes”.<sup>260</sup> As hydrogen is expected to be part of a mix of heating solutions, it is likely that the timeframe could be reduced as some households convert to heat pumps. To assist with this transition, the largest four boiler manufacturers in the UK have stated that hydrogen-ready boilers will cost the same as a natural gas boiler.<sup>261</sup>

251 UK Government, [The Ten Point Plan for a Green Industrial Revolution](#), November 2020

252 UK Government, [The Ten Point Plan for a Green Industrial Revolution](#), November 2020, page 10

253 UK Government, [Heat and Buildings Strategy](#), October 2021, page 10

254 UK Government, [Heat and Buildings Strategy](#), October 2021

255 UK Government, [Heat and Buildings Strategy](#), October 2021, page 13

256 Scottish Government, [Renewable Heat Action Plan](#), 4 November 2009, page 7

257 Scottish Government, [Scottish Energy Statistics Hub](#), accessed 31 August 2022

258 Royal Society of Edinburgh ([HCC0044](#))

259 [Q78](#)

260 [Q79](#)

261 Energy & Utilities Alliance, [The Upfront Cost of Decarbonising Your Home](#), November 2021, page 8; Professional Builders Merchant, [‘Big Four’ manufacturers make hydrogen-ready boiler price-promise](#), 29 July 2021



## Safety of hydrogen in homes

111. To ensure hydrogen is safe to transport to—and be used in—homes, Ofgem launched the H21-Network Innovation Competition (H21) project in January 2018.<sup>262</sup> The H21 project is a suite of gas industry projects, carrying out work to prove that the gas network can safely transport hydrogen in the future.<sup>263</sup> This project was set up to “provide quantified safety-based evidence to confirm the gas distribution networks of Great Britain are suitable to transport 100% hydrogen”.<sup>264</sup> As part of the H21 project, the safety of hydrogen in households has been tested on Hy Street at the DNV GL’s specialist test site at Spadeadam in Cumbria.<sup>265</sup> The site has been used to complete over 200 tests, researching and proving the safety of converting households and gas networks to hydrogen.<sup>266</sup> By May 2022, the project had shown that it is safe to use 100% hydrogen in domestic settings.<sup>267</sup> The results of these tests are going to feed into the UK Government’s decision on the gas distribution network, which it will make by 2026.<sup>268</sup> However, we have nonetheless received evidence outlining safety concerns with hydrogen being used in a domestic setting.<sup>269</sup>

112. In May 2022, we visited the site of the H100 Fife project. This project is part of hydrogen heating trials outlined in the UK Government’s *Ten Point Plan for a Green Industrial Revolution*, starting with a Hydrogen Neighbourhood.<sup>270</sup> SGN explained that “the project will provide 100% green hydrogen for heating up to 300 domestic [properties] in Fife. Green hydrogen will be produced by a dedicated electrolysis plant, powered by a nearby offshore wind turbine”.<sup>271</sup> It will begin providing green hydrogen to households in 2023. The project will provide data to UK Government “to thoroughly assess the feasibility, safety, consumer experience and other costs and benefits, of hydrogen as an option for heating our homes and workplaces”.<sup>272</sup> Angus McIntosh—Director of Energy Futures, SGN—described the time scales for scalability of this project: “we would estimate that it would be approximately a 12-year programme [to get to 100% hydrogen], which could be expedited”.<sup>273</sup> This is the first in a group of stages, the UK Government aims for a “hydrogen village trial by 2025 and potential pilot hydrogen town by the end of the decade”.<sup>274</sup>

## Government perspective

113. Scottish Government Cabinet Secretary, Michael Matheson MSP, warned that there is “still a lot of uncertainty around the role that hydrogen will play in supporting the decarbonisation of domestic heating”,<sup>275</sup> and he attributed this to the “lack of clarity

262 Ofgem, [H21, Network Innovation Competition](#), January 2018, page 1

263 H21 Green, [About H21](#), accessed 4 May 2022

264 Ofgem, [H21, Network Innovation Competition](#), January 2018, page 1

265 DNV, [Heating homes with hydrogen: proving the safety case](#), 8 July 2020

266 Registered Gas Engineer, [First hydrogen boiler demo under way in homes](#), 13 November 2020

267 DNV, [Switching a city from natural gas to hydrogen](#), accessed 4 May 2022

268 UK Government, [Heat and Buildings Strategy](#), October 2021, page 13

269 Tom Baxter (Consultant Chemical Engineer at PDB); David Cebon (Professor of Mechanical Engineering at Cambridge University); Bernard van Dijk (Airplane performance lecturer at University of Amsterdam); Jochen Bard (Director of Energy Process Technology Division at Fraunhofer IEE); Paul Martin (Chemical Engineer and Process Development Expert at Spitfire Research) ([HCC0004](#))

270 UK Government, [The Ten Point Plan for a Green Industrial Revolution](#), November 2020, page 10

271 SGN ([HCC0008](#))

272 UK Government, [UK Hydrogen Strategy](#), 17 August 2021, page 146

273 [Q11](#)

274 UK Government, [UK government launches plan for a world-leading hydrogen economy](#), 17 August 2021

275 [Q222](#)



about the timeline for when we will start to move away from using natural gas in the existing domestic system”.<sup>276</sup> He said he felt that things were moving more towards greater electrification of domestic heating and shared heating sources, as well as district heating systems as part of meeting future domestic heating needs.<sup>277</sup> As a result, he said “it is very difficult to say accurately whether we will see wholesale replacement of a natural gas domestic system with hydrogen”,<sup>278</sup> although he could see it being used in rural areas, despite the technology still being limited.<sup>279</sup>

114. UK Government Minister, Graham Stuart MP, said he had less of an overall view, added that the UK Government continues to do “a lot of work” in this area and re-iterated the commitment to make a decision by 2026.<sup>280</sup> On whether the UK Government intends to mandate hydrogen-ready boilers as soon as possible, he told us that “work is going on to assess these matters” and that “there is a lot to decide on going forward”.<sup>281</sup> He cited the falling price of heat pumps, the UK Government’s ambition to see 600,000 installed by 2028 and that 90% of homes could be suitable for heat pumps.<sup>282</sup> On whether it is still the UK Government’s ambition to phase out the installation of new natural gas boilers beyond 2035, he indicated that there could be further announcements on this in March 2023.<sup>283</sup>

### Science and Technology Committee

115. We note the evidence and conclusions of the Science and Technology Committee in its report, *The role of hydrogen in achieving Net Zero*,<sup>284</sup> published on 14 December 2022 concerning hydrogen for homes. That Committee’s report referenced a mix of conflicting evidence for and against its use for domestic heating. They concluded that hydrogen could play a role in domestic heating, but the extent of its potential remains uncertain and looks likely to be limited rather than widespread. Their report added that the Committee is unconvinced its deployment will become economically viable by the time the Government has said it will determine the role of hydrogen in heating by 2026.<sup>285</sup>

**116. We recognise there is a mix of evidence on the role hydrogen can play in the decarbonisation of domestic heating and there is still a substantial amount of work being done that will determine its eventual use. However, in the meantime, the evidence in favour of mandating hydrogen-ready boilers in all suitable properties at the earliest opportunity is convincing, no matter what decision is eventually made on the blend of hydrogen in the system, or whether the system becomes a 100% hydrogen gas network. Assurances from the largest four boiler manufacturers indicate that hydrogen-ready boilers will be the same price as standard boilers, removing a key obstacle in rolling them out across UK households. It means millions more properties would be ready**

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276 [Q222](#)

277 [Q222](#)

278 [Q222](#)

279 [Q223](#)

280 [Q252](#)

281 [Q254](#)

282 [Q254](#)

283 [Q255](#)

284 Science and Technology Committee, Fourth Report of Session 2022–23, [The role of hydrogen in achieving Net Zero](#), HC 99

285 Science and Technology Committee, Fourth Report of Session 2022–23, [The role of hydrogen in achieving Net Zero](#), HC 99 pp 43–47

and able to switch to hydrogen sooner rather than later and with lower conversion costs, if required, should the UK Government opt for a low carbon hydrogen-based gas network.

*117. We recommend that, in anticipation of a decision around the use of hydrogen in heating by 2026, the UK Government should mandate hydrogen-ready boilers for all suitable new or replacement installations as soon as practicable and at least introduce that decision, with clear timescales, into the statute book by the end of the next parliamentary session.*

# Annex 1: List of Scottish and UK Government Hydrogen Policies & Initiatives

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## UK Government Hydrogen Policy

### *Ten Point Plan for a Green Industrial Revolution & Net Zero Hydrogen Fund*

In November 2020, the UK Government launched the *Ten Point Plan for a Green Industrial Revolution*.<sup>286</sup> Point two of the plan outlined the UK Government’s aim “for the UK to develop 5GW [gigawatts] of low carbon hydrogen production capacity by 2030”,<sup>287</sup> and noted the £240 million *Net Zero Hydrogen Fund* to support this aim.<sup>288</sup>

### *UK Hydrogen Strategy*

The publication of the *UK Hydrogen Strategy* followed the *Ten Point Plan*, and was published on 17 August 2021.<sup>289</sup> The *UK Hydrogen Strategy* outlined the need for the ‘twin-track’ approach and “the key steps we need to take in the coming months and years to deliver against the promise that hydrogen presents”.<sup>290</sup> It also set out “almost £1 billion of UK Government funding for hydrogen and other low carbon technologies, including a £240 million Net Zero Hydrogen Fund”.<sup>291</sup>

Since the *UK Hydrogen Strategy* was published, the UK Government has published periodic updates. The latest, *UK Hydrogen Strategy update to the market: December 2022*, summarised the UK Government’s action to advance the hydrogen economy since the previous UK Hydrogen Strategy update in July 2022. The strategy update stated the UK Government’s position that the UK is well placed to participate in global trade of hydrogen. It covered activities and opportunities relating to the export of hydrogen, including from the UK to continental Europe, and how this can help to meet increasing hydrogen demand alongside established energy trading and interconnection with the UK. The UK Government has also committed to setting up a hydrogen certification scheme by 2025 to demonstrate high-grade British hydrogen for export and ensure any imported hydrogen meets the same high standards that UK companies expect.<sup>292</sup>

### *North Sea Transition Deal*

The *North Sea Transition Deal*, published March 2021, (with the *One year On* paper published March 2022) is a partnership between the UK Government and the UK’s offshore oil and gas sector.<sup>293</sup> The *One Year On* paper notes that “a key element” of the

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286 UK Government, [The Ten Point Plan for a Green Industrial Revolution](#), November 2020

287 UK Government, [The Ten Point Plan for a Green Industrial Revolution](#), November 2020, page 10

288 UK Government, [The Ten Point Plan for a Green Industrial Revolution](#), November 2020, page 10

289 UK Government, [UK Hydrogen Strategy](#), 17 August 2021

290 UK Government, [UK Hydrogen Strategy](#), 17 August 2021, page 2

291 [PQ 119890](#), 14 February 2022

292 UK Government, [Hydrogen Strategy update to the market: December 2022](#), 13 December 2022

293 UK Government, [North Sea Transition Deal](#), March 2021; UK Government, [North Sea Transition Deal: One Year On](#), March 2022

Deal is “active participation by the oil and gas industry in developing Carbon Capture, Usage and Storage (CCUS)” alongside UK Government commitments to “invest in CCUS to support the net zero strategy commitments”.

In addition, the Deal “committed Government and industry to supporting the deployment of hydrogen production capacity in the UK” with further information on plans and funding provided via the UK Hydrogen Strategy and funding schemes such as the Net Zero Hydrogen Fund.<sup>294</sup>

### **British Energy Security Strategy and Hydrogen Sector Development Action Plan**

The *British Energy Security Strategy* was published in April 2022. The strategy doubled the UK ambition for hydrogen; up to 10GW of low carbon hydrogen production capacity by 2030 “with at least half of this from electrolytic hydrogen [green hydrogen]”.<sup>295</sup> In July 2022, the UK Government launched the *Hydrogen Sector Development Action Plan* which aims to

highlight the nature and scale of opportunities across the hydrogen economy in the UK. It focuses on four key areas: investment; supply chains; jobs and skills; and exports. The *Action Plan* sets out actions in those areas being taken by UK Government and industry to maximise the benefits from scaling up the UK hydrogen economy.<sup>296</sup>

### **Hydrogen Champion**

In July 2022, the UK Government announced the appointment of a Hydrogen Champion, Jane Toogood, Chief Executive of FTSE 250 company Catalyst Technologies at Johnson Matthey, which is involved in “the research and development of technologies to accelerate the transition towards net zero”.<sup>297</sup> The role was described by the UK Government as helping to “drive industry investment and deployment at this critical stage in the early development of the UK hydrogen economy”, as well as identifying current barriers and “creative solutions” to deliver on UK Government commitments.<sup>298</sup>

### **Other announcements**

At the time of publication, the UK Government had also recently announced its plans to introduce a reliable method to demonstrate the emissions credentials of hydrogen, with the intention of introducing a globally recognised certification scheme by 2025. It is hoped that this will play “a vital role in decarbonising the hydrogen sector, promoting trade, whilst stimulating growth and jobs in green hydrogen”.<sup>299</sup> The UK Government has also opened the consultation process for the Low Carbon Hydrogen Certification Scheme -

294 UK Government, [UK Hydrogen Strategy](#), August 2021; UK Government, [Net Zero Hydrogen Fund strand 1 and strand 2](#), published May 2022

295 UK Government, [British Energy Security Strategy](#), 7 April 2022, page 22

296 UK Government, [Hydrogen Sector Development Action Plan](#), 20 July 2022, page 4

297 UK Government, [Hydrogen Champion appointed as government accelerates UK hydrogen investment](#), 20 July 2022

298 UK Government, [Hydrogen Champion appointed as government accelerates UK hydrogen investment](#), 20 July 2022

299 UK Government, [New UK certification to boost British hydrogen sector](#), 9 February 2023

with a deadline of late April 2023. There is currently no recognised way for UK producers of low-carbon hydrogen to prove the credentials of their product. A globally recognised certification scheme is intended to help verify the sustainability of low carbon hydrogen, giving consumers the confidence to invest in cleaner energy.<sup>300</sup>

The Environment Agency, on behalf of the UK environmental regulators, has recently published guidance on emerging techniques for hydrogen production with carbon capture together with a supporting evidence review of blue hydrogen production with carbon capture. The guidance details the key environmental issues to address and information about best practice available for blue hydrogen production with carbon dioxide capture, covering options which operators are most likely to apply for.<sup>301</sup>

## Scottish Government hydrogen policy

### *Hydrogen Policy Statement*

In December 2020, the Scottish Government published *its Hydrogen Policy Statement*.<sup>302</sup> The statement sets out how Scotland’s natural resources, skills and supply chain may offer the potential for large-scale hydrogen production, with a £100 million commitment in funding for research and innovation development between 2021 and 2026. The *Hydrogen Policy Statement* stated that “in the most ambitious scenario, establishing Scotland as an exporter of green hydrogen to Europe, where there is already growing demand, could result in a £25 billion annual gross contribution to Scotland’s Gross Value Added (GVA) with over 300,000 jobs supported by 2045”.<sup>303</sup>

### *Hydrogen Assessment Report*

The Scottish Government commissioned a *Hydrogen Assessment Report*, published in December 2020. The report “engaged extensively with industry to develop three distinct and viable scenarios by which the Scottish hydrogen economy could develop out to 2045”.<sup>304</sup> One of the aims outlined in the report was “an initial ambition of generating 5GW of renewable and low-carbon hydrogen by 2030”,<sup>305</sup> and 25GW by 2045.<sup>306</sup>

### *Hydrogen Action Plan*

The draft *Hydrogen Action Plan* was published alongside the *Hydrogen Policy Statement* by the Scottish Government in November 2021. It aimed to outline “the actions that will be taken over the next five years to support the development of a hydrogen economy to further our efforts to reduce greenhouse gas emissions from Scotland’s energy system

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300 UK Government, [UK Low Carbon Hydrogen Certification Scheme](#), 9 February 2023

301 Environment Agency, [Emerging techniques for hydrogen production with carbon capture](#), 3 February 2023; Environment Agency, [Review of emerging techniques for hydrogen production from methane and refinery fuel gas with carbon capture](#), 3 February 2023

302 Scottish Government, [Hydrogen Policy Statement](#), 21 December 2020

303 Scottish Government, [Hydrogen Policy Statement](#), 21 December 2020, page 4

304 Scottish Government, [Scottish Hydrogen: Assessment Report](#), 21 December 2020, page 7

305 Scottish Government, [Scottish Hydrogen: Assessment Report](#), 21 December 2020, page 4

306 Scottish Government, [Scottish Hydrogen: Assessment Report](#), 21 December 2020, page 7

while ensuring a just transition”.<sup>307</sup> The term “just transition” refers to the Scottish Government’s commitment to “ending our contribution to climate change in a way that is fair and leaves no one behind”.<sup>308</sup>

The final *Hydrogen Action Plan* was published in December 2022. It detailed 33 actions that will be taken over the next five years to support the development of a hydrogen economy to further reduce greenhouse gas emissions from Scotland’s energy system while ensuring a just transition. The *Hydrogen Action Plan* also highlighted the Scottish Government’s intention to get as much renewable hydrogen into the energy system as quickly as possible in order to meet climate targets. The Plan reconfirmed the ambition for 5GW of installed renewable and low-carbon hydrogen production capacity by 2030 and 25GW by 2045. It is supported by a capital funding programme that will make £100m available up to 2025/26 to accelerate and maximise the production of renewable hydrogen in Scotland.<sup>309</sup>

### ***Draft Energy Strategy and Just Transition Plan***

In January 2023, the Scottish Government published its *Draft Energy Strategy and Just Transition Plan*, which draws upon many of the existing policies and announcements. It placed strong emphasis on both renewable energy and hydrogen as one of its key ambitions and detailed the role hydrogen can play in sectors that have been difficult to decarbonise. According to the Scottish Government Cabinet Secretary, Michael Matheson MSP, the strategy “maps out the future of our energy sector and sets out an ambitious suite of actions for the Scottish Government, along with actions for industry, the regulator and UK Government”.<sup>310</sup>

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307 Scottish Government, [Draft Hydrogen Action Plan](#), 21 November 2021

308 Scottish Government, [Climate Change, Just transition](#), accessed 20 February 2023

309 Scottish Government, [Hydrogen Action Plan](#), 14 December 2022, page 50

310 Scottish Government, [Scotland’s Energy Strategy and Just Transition Plan: Ministerial statement](#), 10 January 2023

# Conclusions and recommendations

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## Hydrogen Strategies

1. The UK and Scottish Governments have clear strategies and appropriate aspirations for hydrogen, with significant commonality in their ambitions. Overall relations between the UK and Scottish Governments in this area appear to be good with effective official-level and ministerial cooperation. (Paragraph 25)
2. The UK and Scottish Governments have different net zero target dates of 2050 and 2045 respectively. We recommend the UK and Scottish Governments respond to this report explaining how they will work together to ensure respective targets will be met. The Scottish Government should demonstrate how it is engaging with UK Government in reserved areas to ensure net zero is reached in Scotland five years earlier than the rest of the UK. (Paragraph 26)
3. The UK and Scottish Governments arrived at their respective 10GW and 5GW by 2030 low carbon hydrogen production targets independently of each other, and we are unclear how the two targets align and whether either is achievable. Clarity on this is vitally important given the targets must be reached in just seven years' time. We recommend that the UK and Scottish Governments, in response to this report, explain how they arrived at their respective 10GW and 5GW by 2030 low carbon hydrogen production targets and how the two targets align. Furthermore, the two Governments should provide us with a proposed timeline setting out key milestones on the road towards the respective targets to assist us and our successor committees in judging progress and evaluating the achievability of Scotland's hydrogen production targets. (Paragraph 27)
4. We conclude that both the UK and Scottish Governments' hydrogen strategies require interim targets to ensure that hydrogen production and net zero commitments are met. We recommend that both UK and Scottish Governments set such interim targets for hydrogen production, beyond 2030, to reach its net zero targets planned for 2050. In particular, we recommend the Scottish Government expedite their interim target setting due to the more pressing deadline they set of 2045. By the beginning of the next Parliamentary session, the UK and Scottish Governments should set deadlines for approving a series of steps around hydrogen production and actions to stimulate demand of low carbon hydrogen, as the decisions need to be made without delay to ensure that net zero targets are met, energy security is obtained, job security is provided for workers in Scotland, and cleaner energy production and international competitiveness are realised. By the beginning of the next Parliamentary session, the UK and Scottish Governments must publish a timeline of key decisions for projects, with justification of the dates set out in the timeline, as well as interim targets for production and demand of both blue and green hydrogen, and the phasing out of grey hydrogen. (Paragraph 28)
5. We are concerned that the Scottish Government does not see more potential in Green Freeports to complement Scottish and UK hydrogen policies, despite them being a joint UK and Scottish Government initiative and the Inverness and Cromarty Firth Green Freeport having a hydrogen focus. We recommend that the Scottish



Government explores how to maximise the benefits of Green Freeports for Scottish and UK hydrogen ambitions. Both the UK and Scottish Governments should work together to realise this potential and the opportunities for Scotland. (Paragraph 29)

6. We acknowledge the concerns raised by our witnesses around slippage in timings for hydrogen projects. This could delay the delivery of low carbon hydrogen projects and result in a failure to meet net zero targets. Urgency is required now; timely decision making will also mean Scotland and the rest of the UK do not get left behind with technology development and hydrogen production when compared to other countries' hydrogen sectors. We recommend that the UK Government sets out how it will address concerns we have heard around timings of decisions for hydrogen projects, including justification for the timing of decisions and an assessment of the impact the timing of decisions will have for the delivery of low carbon hydrogen projects, net zero targets and Scotland—and the rest of the UK's—international competitiveness in the sector. (Paragraph 30)
7. Better training in the hydrogen project consenting process for both local authorities and private organisations is required to speed up planning decisions for hydrogen projects. We note the actions the Scottish Government has taken in recent months to streamline these planning issues, including its engagement with local authorities on hydrogen planning applications. However, the Scottish Government has an important role to play and this work should be a continuing process. As planning is a devolved matter, we would ask for an update from the Scottish Government as to how this work is progressing. (Paragraph 38)
8. We recommend that, in order to speed up the planning process and make it more efficient, the Scottish Government should facilitate the necessary knowledge sharing for planning teams in local authorities and private sector organisations. This should focus on the process of obtaining planning consent for hydrogen projects, covering production sites, storage sites and pipelines and the roles different individuals play in determining process and planning outcomes. The Scottish Government should consider the establishment of a dedicated body to deliver this work and implement it as soon as possible in light of the impending 2045 targets. (Paragraph 39)

### Carbon Capture and storage

9. Scotland and the rest of the UK will not be able to deliver on their net zero commitments without carbon capture and storage (CCUS): a factor that is critical to the success of the hydrogen industry in Scotland. Carbon capture and storage and hydrogen production will both be required, in conjunction with other renewables, to achieve a just transition from oil and gas. (Paragraph 52)
10. Delays to decision making around cluster sequencing and the Acorn Project are disappointing. But we noted the positive comments on CCUS from the UK Minister. Furthermore, such delays lead to an even further deficit in carbon capture facilities in Scotland and the ultimate result is a prolonged period when carbon continues to be released at avoidable levels. (Paragraph 53)

11. We recommend that the UK Government accelerates the deployment of carbon capture and storage in Scotland and sets out, in its response to this report, how it intends to do so. Furthermore, in Minister Stuart's response, he stated that the Scottish Cluster project had already received "£40 million plus". The UK Government should provide details of how precisely they have funded the Scottish Cluster so far. We hope that the UK Government provides details for funding for the Acorn Project in the upcoming Budget. (Paragraph 54)

### Export of low carbon hydrogen

12. The evidence we have received demonstrates that there is vast potential for the export of low carbon hydrogen and expertise from Scotland, which could generate significant economic benefits to the economy. We welcome some recent policy updates and note the UK Government's focus on domestic decarbonisation as it strives towards net zero. However, if Scotland—and the UK as a whole—is to become a significant exporter of hydrogen, both governments need to work together. (Paragraph 68)
13. We recommend that the UK and Scottish Governments work more closely to ensure the achievability of their respective ambitions for hydrogen exports, and that the economic benefits are realised. In its response to this report, the UK Government should continue to update this committee on progress over its timeframe for securing an export market and current progress in assessing the opportunities and risks, as well as addressing the challenges we have described, including around infrastructure and balance between export and domestic consumption. As international trade is reserved, we recommend that the UK Government outlines what it is doing to make hydrogen export more commercially attractive and how the UK Government plans to bring in investors while engaging with the Scottish Government and hydrogen industry. (Paragraph 69)
14. Furthermore, we recommend that the UK Government publish modelling to quantify in more detail the long-term investment required to secure an export market and the potential economic benefits that could accrue to the UK, from such a market. The Government must identify markets and establish a presence within them before other countries do. (Paragraph 70)
15. We recommend that the UK Government highlight its potential for export to overseas markets immediately. This is to ensure that companies in Scotland can benefit from global hydrogen export markets and opportunities and not be left behind. (Paragraph 71)

### Storage of hydrogen

16. With the vast renewable energy resources it has available, Scotland can play a vital role in green hydrogen production for the UK and for export to Europe. However, secure hydrogen storage is essential to ensure hydrogen can become central to the energy mix of the UK. Without robust hydrogen storage infrastructure, Scotland will not be able to meet its hydrogen production potential. (Paragraph 89)

17. We recommend that the UK Government alongside the Scottish Government moves quickly to develop hydrogen storage, to meet increasing demand, help Scotland and the rest of the UK enhance energy security and meet net zero targets. (Paragraph 90)
18. The UK Minister told us that the UK Government's preference is for the private sector to lead the development of storage infrastructure. For businesses to lead the way in such a crucial aspect of Scotland and the UK's net zero and energy security ambitions, a clear set of regulatory conditions and economic incentives will be required to encourage development at the pace needed. Therefore, we recommend that in response to this report the UK Government establish an action plan to identify and address economic and regulatory barriers for hydrogen storage to ensure that, once large-scale hydrogen production becomes possible, appropriate storage is in place. (Paragraph 91)
19. We recommend that the UK Government should examine how storage of low carbon hydrogen could be made a national infrastructure asset as this could help guarantee energy security for the UK. (Paragraph 92)

### Jobs and skills training

20. Scotland is in a very strong position compared to many other countries wanting to develop their hydrogen industry, in part because it already has a large relevant skills base in the oil and gas sector that has the potential to be redeployed. The work the UK and Scottish Governments have been doing on skills and jobs for people to work in the hydrogen sector should be applauded, but further progress needs to be made urgently to ensure that Scotland continues to provide vital workers for the low carbon energy industry. The industry needs to take a leading role in working with both governments to identify gaps in the workforce and the skills that are needed as well as deciding how to transition and re-train people. (Paragraph 105)
21. We recommend that the cooperative approach between the UK and Scottish Governments on skills training and jobs continues, not least because of the mixture of reserved and devolved competencies when it comes to energy, education and skills. On at least a biannual basis, the UK and Scottish Governments should jointly set out work they are undertaking to ensure that colleges, training providers and businesses within the hydrogen and CCUS sectors are able to offer appropriate routes into employment and training, and providing this information should be viewed as a priority. Incorporated into this analysis, both the UK and Scottish Governments should also provide regular updates on progress against their estimated jobs forecasts in the medium term. (Paragraph 106)
22. We recommend that the UK and Scottish Governments work in tandem with industry in identifying the jobs and skills gaps in the existing workforce. Industry should work in cooperation with the UK Government to ensure their policies and initiatives are complementary. Industry alongside the Scottish Government should develop and implement a clear plan for transition and re-training its workforce—in light of the Scottish Government's presumption against further oil and gas exploration and no nuclear in Scotland—and this could be supported by organisations such as Hydrogen UK. (Paragraph 107)

## Hydrogen for homes

23. We recognise there is a mix of evidence on the role hydrogen can play in the decarbonisation of domestic heating and there is still a substantial amount of work being done that will determine its eventual use. However, in the meantime, the evidence in favour of mandating hydrogen-ready boilers in all suitable properties at the earliest opportunity is convincing, no matter what decision is eventually made on the blend of hydrogen in the system, or whether the system becomes a 100% hydrogen gas network. Assurances from the largest four boiler manufacturers indicate that hydrogen-ready boilers will be the same price as standard boilers, removing a key obstacle in rolling them out across UK households. It means millions more properties would be ready and able to switch to hydrogen sooner rather than later and with lower conversion costs, if required, should the UK Government opt for a low carbon hydrogen-based gas network. (Paragraph 116)
24. We recommend that, in anticipation of a decision around the use of hydrogen in heating by 2026, the UK Government should mandate hydrogen-ready boilers for all suitable new or replacement installations as soon as practicable and at least introduce that decision, with clear timescales, into the statute book by the end of the next parliamentary session. (Paragraph 117)

# Formal minutes

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**Monday 6 March 2023**

## **Members present**

Pete Wishart, in the Chair

Deidre Brock

Wendy Chamberlain

David Duguid

Sally-Ann Hart

Christine Jardine

Douglas Ross

Andrew Western

Draft Report (*Hydrogen and carbon capture in Scotland*), proposed by the Chair, brought up and read.

*Ordered*, That the draft Report be read a second time, paragraph by paragraph.

Paragraphs 1 to 117 read and agreed to.

Annex agreed to.

*Resolved*, That the Report be the Sixth Report of the Committee to the House.

*Ordered*, That the Chair make the Report to the House.

*Ordered*, That embargoed copies of the Report be made available, in accordance with the provisions of Standing Order No. 134.

## **Adjournment**

Adjourned till Monday 13 March at 11.30 a.m.

## Witnesses

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The following witnesses gave evidence. Transcripts can be viewed on the [inquiry publications page](#) of the Committee's website.

### Monday 16 May 2022

**Angus McIntosh**, Director of Energy Futures, SGN; **David Wallace**, Senior Strategy Manager, Offshore Renewable Energy Catapult [Q1–34](#)

**Dr Nigel Holmes**, Chief Executive Officer, Scottish Hydrogen and Fuel Cell Association; **Dr Jillian Couto-Phoenix**, Programme Manager, National Manufacturing Institute Scotland [Q35–59](#)

### Monday 04 July 2022

**Clare Jackson**, Chief Executive, Hydrogen UK; **Will Webster**, Energy Policy Manager, Offshore Energies UK [Q60–101](#)

**Bethan Vasey**, Energy Transition Manager, Shell UK Upstream; **Louise Kingham CBE**, Senior Vice President Europe and Head of Country at bp [Q102–139](#)

### Monday 18 July 2022

**Barry Carruthers**, Hydrogen Director, ScottishPower; **Oonagh O'Grady**, Head of Hydrogen Development, SSE [Q140–170](#)

**Sarah Potts**, Hydrogen Commercial Specialist, Storegga; **Professor Andy Sloan FRSE**, Managing Director of COWI, Royal Society of Edinburgh [Q171–194](#)

### Monday 16 January 2023

**Michael Matheson MSP**, Cabinet Secretary for Net Zero, Energy and Transport, Scottish Government; **Susan Stirling**, Carbon Capture, Utilisation and Storage Team Leader, Energy Industries Division, Scottish Government; **Stuart McKay**, Head of Hydrogen Policy, Scottish Government [Q195–229](#)

**Rt Hon Graham Stuart MP**, Minister of State (Minister for Energy and Climate), Department for Business, Energy and Industrial Strategy; **Stefanie Murphy**, Director of Hydrogen and Industrial Carbon Capture Directorate, Department for Business, Energy and Industrial Strategy; **Alison Conboy**, Deputy Director, Hydrogen Production, Department for Business, Energy and Industrial Strategy [Q230–281](#)

## Published written evidence

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The following written evidence was received and can be viewed on the [inquiry publications page](#) of the Committee's website.

HCC numbers are generated by the evidence processing system and so may not be complete.

- 1 AMP Clean Energy ([HCC0040](#))
- 2 Aberdeen City Council ([HCC0026](#))
- 3 Alstom UK & Ireland ([HCC0014](#))
- 4 Assystem Energy & Infrastructure ([HCC0002](#))
- 5 Baxter, Tom (Consultant Chemical Engineer, PDB); Cebon, David (Professor of Mechanical Engineering, Cambridge University); van Dijk, Bernard (Airplane performance lecturer, University of Amsterdam); Bard, Jochen (Director of Energy Process Technology Division, Fraunhofer IEE); and Martin, Paul (Chemical Engineer and Process Development Expert, Spitfire Research) ([HCC0004](#))
- 6 Bell, Ms Rebecca ([HCC0012](#))
- 7 bp ([HCC0036](#))
- 8 British Geological Survey ([HCC0001](#))
- 9 Carbon Engineering ([HCC0032](#))
- 10 Centre for Energy Policy, University of Strathclyde ([HCC0034](#))
- 11 Comhairle nan Eilean Siar ([HCC0017](#))
- 12 Comhairle nan Eilean Siar (Western Isles Council) ([HCC0054](#))
- 13 Department for Business, Energy and Industrial Strategy ([HCC0038](#))
- 14 ETZ Ltd ([HCC0033](#))
- 15 European Marine Energy Centre (EMEC) Ltd ([HCC0039](#))
- 16 Forth Ports Group ([HCC0041](#))
- 17 GMB Scotland ([HCC0028](#))
- 18 Hydrogen UK ([HCC0016](#))
- 19 ITM Power ([HCC0049](#))
- 20 MCS Charitable Foundation ([HCC0009](#))
- 21 Mineral Products Association ([HCC0051](#))
- 22 Mineral Products Association Scotland ([HCC0024](#))
- 23 NECCUS ([HCC0003](#))
- 24 National Grid Electricity System Operator ([HCC0021](#))
- 25 National Manufacturing Institute Scotland ([HCC0047](#))
- 26 National Manufacturing Institute Scotland ([HCC0013](#))
- 27 Net Zero Technology Centre ([HCC0019](#))
- 28 OEUK ([HCC0023](#))
- 29 OPITO ([HCC0022](#))
- 30 Offshore Renewable Energy Catapult ([HCC0030](#))
- 31 PA Consulting ([HCC0048](#))



- 32 Peel L&P ([HCC0005](#))
- 33 PlusZero ([HCC0031](#))
- 34 RWE Generation ([HCC0006](#))
- 35 Royal Society of Edinburgh ([HCC0053](#))
- 36 Royal Society of Edinburgh ([HCC0044](#))
- 37 SGN ([HCC0045](#))
- 38 SGN ([HCC0008](#))
- 39 SSE ([HCC0027](#))
- 40 Scottish Carbon Capture & Storage ([HCC0029](#))
- 41 Scottish Government ([HCC0042](#))
- 42 Scottish Hydrogen and Fuel Cell Association ([HCC0015](#))
- 43 Scottish Renewables ([HCC0007](#))
- 44 ScottishPower ([HCC0018](#))
- 45 Shell ([HCC0043](#))
- 46 Shetland Island Council ([HCC0010](#))
- 47 Storegga, Lead Developer of the Acorn Project and the Scottish Cluster ([HCC0052](#))
- 48 Storegga; and Scottish Cluster ([HCC0025](#))
- 49 UK H2Mobility ([HCC0020](#))
- 50 Wood plc ([HCC0011](#))
- 51 ZeroAvia ([HCC0037](#))

## List of Reports from the Committee during the current Parliament

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All publications from the Committee are available on the [publications page](#) of the Committee's website.

### Session 2022–23

Number	Title	Reference
1st	Defence in Scotland: military landscape	HC 82
2nd	Access to cash in Scotland	HC 80
3rd	Firearms licensing regulations in Scotland	HC 710
4th	Defence in Scotland: military shipbuilding	HC 1096
5th	Public Broadcasting in Scotland	HC 1048
1st Special	Immigration and Scotland: Government Response to the Committee's Fourth Report of Session 2017–19	HC 84
2nd Special	Airports in Scotland: Government Response to the Committee's Fifth Report of Session 2021–22	HC 303
3rd Special	Defence in Scotland: military landscape: Government Response to the Committee's First Report	HC 674
4th Special	Access to cash in Scotland: Government Response to the Committee's Second Report	HC 695

### Session 2021–22

Number	Title	Reference
1st	Universities and Scotland	HC 54
2nd	Welfare policy in Scotland	HC 55
3rd	The UK Shared Prosperity Fund and Scotland	HC 52
4th	Renewable energy in Scotland	HC 51
5th	Airports in Scotland	HC 601
1st Special	Welfare policy in Scotland: UK and Scottish Government Responses to the Committee's Second Report	HC 790
2nd Special	The UK Shared Prosperity Fund and Scotland: Government Response to the Committee's Third Report	HC 791
3rd Special	Renewable energy in Scotland: Government Response to the Committee's Fourth Report	HC 901
4th Special	Universities and Scotland: Government Response to the Committee's First Report	HC 1252

**Session 2019–21**

<b>Number</b>	<b>Title</b>	<b>Reference</b>
1st	Coronavirus and Scotland: Interim Report on Intergovernmental Working	HC 314
2nd	Coronavirus and Scotland	HC 895
1st Special	Problem drug use in Scotland: Government Response to the Committee's First Report of Session 2019	HC 698
2nd Special	Coronavirus and Scotland: Government Response to the Committee's First and Second Reports	HC 1118