



# An Inclusive Approach to Developing Scotland's Net Zero Roadmap

31<sup>st</sup> July 2020

## Scotland's Net Zero Roadmap

The emission of greenhouse gases (GHG) into the atmosphere is the primary cause of climate change. GHG include carbon dioxide (CO<sub>2</sub>), methane and nitrous oxides, mainly produced from transport, energy supply, agriculture, manufacturing and the built environment<sup>1</sup>. CO<sub>2</sub> accounts for over 80% of UK greenhouse gas emissions, and considerable effort is being devoted to reducing or removing these emissions. However, for some sectors, including manufacturing, it will not be possible to avoid CO<sub>2</sub> emissions in the short-term; so the capability to capture, use and / or store these emissions needs to be developed, thus preventing their release to the atmosphere.

In this context, Innovate UK has established an Industrial Decarbonisation Challenge Fund. This is supporting initiatives across six UK regions to develop roadmaps for the decarbonisation of industrial clusters. Scotland's Net Zero Roadmap (SNZR) is one of these, and it has received funding for initial work (Phase 1). The Phase 1 objectives were to understand the scale of industrial CO<sub>2</sub> emissions in Scotland, the options to address these, the barriers to their implementation and the appetite for industry to adopt solutions. Phase 1 took place between April and July 2020 and it has designed the approach for Phase 2, when the actual roadmap will be developed.

In designing our approach to developing the roadmap we believed it was essential that we produce a roadmap that industry and wider stakeholders support and are committed to adopt. Our strategy, therefore, was to be inclusive, building the way forward based on detailed input and discussions with key companies and stakeholders. This report summarises our engagement with the relevant industrial, technology and stakeholder communities in Scotland and the key issues raised in these conversations.

## Industry and Stakeholder Engagement

Our engagement strategy consisted of three complementary activities:

- An initial interview programme with 35 individuals across 19 key companies and stakeholder organisations
- Two small group workshops, to discuss the results of the interview programme, attended by 23 external participants, the majority of which had participated in the interview programme. As such, we built on the interview programme, extending our discussions
- A final webinar, which presented and validated the output from previous activities. 70 external attendees joined during the 2-hour webinar, with good engagement throughout.

The key results from each of these activities can be summarised as follows:

### Interview Programme

The interviews focused on current emissions, drivers for emissions changes, barriers to emissions reductions, the route to Net Zero, technology supply chains, financial implications of industrial decarbonisation, developing the Scottish roadmap and the impact of COVID-19. All interviewees gave substantial levels of information on these topics and the level of engagement was very positive. There were seven broad areas in which there was some commonality in their responses, namely:

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<sup>1</sup> The vast majority of methane and nitrous oxide emissions come from agriculture and waste management

1. Government or institutional support/ guidance
2. Financial hurdles
3. Business models
4. Infrastructure
5. Fuel switching to hydrogen
6. Biomass/ renewables
7. Technology

There were also a number of specific requests for what the roadmap should include.

The common themes were used to construct a SWOT analysis and to plan how the roadmap should develop in response to the interview outputs, which were then tested in the SNZR workshop programme. Crucially, the interviews gave a valuable perspective on what should be included in the roadmap. The key issues that the SNZR project had to address were identified as:

- How the transition could happen in an investible way
- Timelines/ deadlines for implementation of different solutions
- Phases towards decarbonisation
- The range of technologies that could be deployed for decarbonisation
- A range of credible scenarios for decarbonisation to be presented, supported by data driven decision making

Using the discussion and responses from the interview programme, the results were synthesised into a SWOT analysis capturing the key issues (Figure 1).

<p><b>Strengths</b></p> <ul style="list-style-type: none"> <li>• Existing gas infrastructure</li> <li>• Engaged community</li> <li>• Technology is (almost) there</li> <li>• Capacity for CCS in N. Sea</li> <li>• Acorn project</li> <li>• Capacity for renewable electricity generation</li> <li>• Just transition</li> <li>• Supportive government</li> <li>• FEEDER 10 proximity</li> <li>• European demand for resource</li> </ul>	<p><b>Weaknesses</b></p> <ul style="list-style-type: none"> <li>• Costs – 100s £M per 1000s tonnes CO<sub>2</sub> captured per day (needs to reduce)</li> <li>• Focus is on onshore CC and does not include offshore O&amp;G</li> <li>• Too focused on Grangemouth to St Fergus corridor</li> <li>• Too dependent on specific infrastructure (e.g. FEEDER 10)</li> <li>• Covering too many sectors – not all aligned, and some more complex to decarbonise than others</li> </ul>
<p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>• Development of leading CCS cluster in Europe</li> <li>• BECCS</li> <li>• Fuel switching/flexibility – bringing everyone along at manageable speeds</li> <li>• CH<sub>4</sub> reformation with CCS – blue H<sub>2</sub></li> <li>• Surplus renewable electricity – green H<sub>2</sub></li> <li>• Electrification</li> <li>• Net contributor to offsetting UK-wide emissions</li> <li>• Green electricity and H<sub>2</sub> export</li> <li>• Sustainable chemical manufacture based on CCU</li> <li>• Develop expertise in implementing CCUS/fuel switching solutions optimising efficiency and costs</li> <li>• Export capability</li> </ul>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>• Lack of clarity / stability on fiscal and regulatory policy</li> <li>• No viable business model identified due to policy vacuum – difficult to make investment choices</li> <li>• Lack of consensus commitment – loss of level playing field within the UK and within sectors across multiple countries/regions</li> <li>• Market changes affecting future financial viability of CCS, e.g. renewables build and public opinion shift energy mix towards electrification and green H<sub>2</sub> more quickly</li> <li>• Impacts to operations of fitting CCS technologies</li> <li>• Financial burdens push manufacturing overseas</li> </ul>

**Figure 1: SWOT Analysis Capturing Interview Outputs**

To further progress this output into actionable points, the key aspects to be considered in developing the roadmap were captured. These five key aspects were:

1. Fiscal and regulatory policy needs to be better defined to underpin viable business models
2. Flexible fuel / energy solutions and efficiency gains need to be integrated
3. Granularity needs to be provided
4. The optimum decarbonisation strategy for each company will be different, depending on individual business activities
5. The roadmap must be more comprehensive than Project Acorn

A preliminary scope for the roadmap was then developed, as a basis to build the plan for the SNZR project and as a prompt for further discussion with the stakeholders. There were four main technology themes identified, fuel switching, CCUS, zero carbon energy generation and hydrogen manufacture and use. The final elements of the preliminary scope were fiscal models that enable industrial decarbonisation to be delivered in a sustainable way.

The preliminary scope then facilitated the development of requirements from the roadmap and basic scenario planning. Figure 2 shows how the outputs from the interviews have fed into the building of scenarios for the Net Zero roadmap.

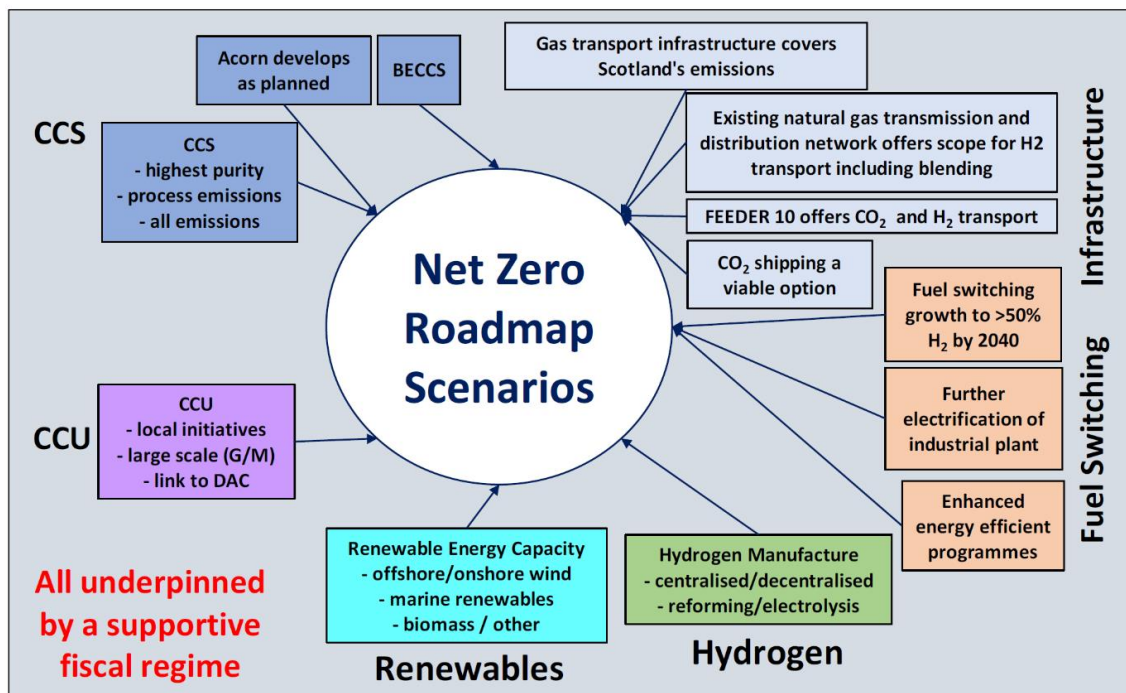
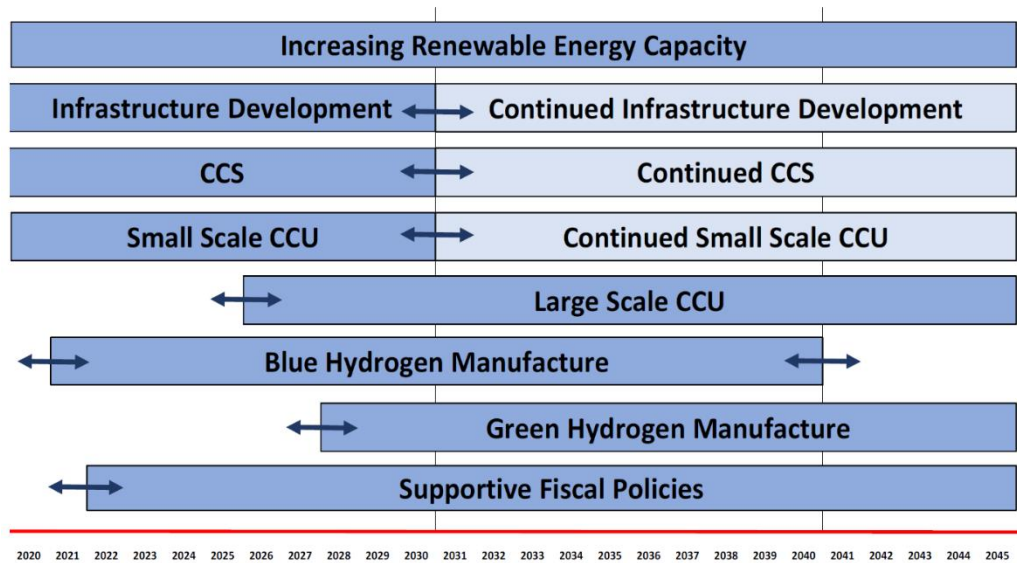


Figure 2: Scenario Building Based on Interview Outputs

### Small Group Workshop Programme

These structured workshops were used to test assumptions, to obtain feedback on the outputs derived from the interviews and to gather further information from industrial emitters, technology providers and stakeholders.

The inputs to the workshop were the SWOT analysis, next steps, resultant requirements and approach to scenario building (as shown above). Alongside this, some proposed timelines were shared to obtain the group's expectation on the delivery time of some key technology and drivers for Net Zero.



**Figure 3: Proposed Timelines for Key Developments Considered as Part of the Roadmap**

Overall, the workshop participants were supportive of the preliminary scope and key inclusions proposed for SNZR. Specific alterations or inclusions were noted and used to guide further refinement of the roadmap. In response to feedback from the participants, several changes were made to refine the scope and specific focus of the roadmap development. This was then fed directly into the proposed plan for the development of the full roadmap. This plan was shared with a wide range of stakeholders at a large group workshop which was held as a webinar event.

## Webinar

The webinar agenda consisted of a number of presentations and polling on key questions, as follows:

### 1. Overview of SNZR

The timings and wider context of the project were outlined, along with a clear definition of the proposed geographical scope of the cluster. The deliverables from the project were then presented, as well as how these would be of benefit to stakeholders.

### 2. Stakeholder Engagement Summary

The SWOT analysis and key aspects of the roadmap were presented. Polling questions were used to determine the relative importance of decarbonisation technologies, the group expectation on the time and investment requirements for key technologies, and the relative importance of the key aspects presented.

### 3. Data and Technologies

The current baseline emissions analysis was presented along with the data requirements for effectively completing the roadmap. The focus of the roadmap, with respect to the baseline emissions analysis, was outlined.

The technology focus areas that would be considered (CCUS, fuel switching, hydrogen generation, and electrification) were then presented. Each technology area in turn was then discussed in some detail and then a description of the proposed high-level activities in phase 2 on the technology was presented. The technology pathways that were felt to be critical for the participants to meet Net Zero objectives were identified through polling.

#### 4. Energy System Modelling

The existing range of energy system modelling tools was outlined before a proposed modular structure for the energy system modelling of the Scottish cluster was presented. Several visualisations of how the outputs from the modelling could work were then shared. Polling was used to determine how much work the participants had done on decarbonisation at their specific site(s) and how useful the webinar participants had found generic/ proxy studies to be. The energy system modelling approach to regional infrastructure was outlined and several illustrative outputs presented.

#### 5. Macroeconomic Modelling

The use of macroeconomic modelling and its specific application to scenarios relating to emissions were illustrated with reference to an example from the chemicals industry. Based on this, the next steps for macroeconomic modelling within the second phase of the SNZR project were detailed. Polling was used to determine at what level the webinar participants felt the economic analysis should be conducted.

#### 6. Scenarios to be Tested in Phase 2

The fundamentals of scenarios and their utility in the SNZR project were initially presented, followed by a presentation of the diverse scenario features that had been highlighted as being of interest to the SNZR stakeholders. An initial set of proposed scenarios were then shared with the webinar participants and polling was used to determine if these were appropriate.

#### 7. Outlook and Concluding Remarks

The expected outputs of the second phase of the SNZR project were summarised and the immediate project timelines were presented. Finally, the level of participant support for the scope proposed for the second phase of the SNZR project was assessed.

### Webinar Outputs

The key outputs from the webinar workshop were the responses to Mentimeter questions and polls, the results of which are summarised below. The responses were anonymised so they can be used to drive engagement with the stakeholder group, and not to proactively engage with specific companies.

#### 1. What does Net Zero mean to you?

Webinar participants were asked to indicate their agreement with the three options shown (on a scale of 1 to 5) as follows:

- |                           |     |
|---------------------------|-----|
| • Environmental necessity | 4.9 |
| • Economic opportunity    | 4.0 |
| • Operational burden      | 2.8 |

In terms of seeing Net Zero as an operational burden, the majority of participants neither agreed nor disagreed with some strongly disagreeing and very few of the opinion that Net Zero was an operational burden.



## 2. Prioritising Decarbonisation Themes

The relative priorities of four decarbonisation themes were defined. There was a good level of support for each of the four themes, but participants highlighted CCS as the most important and CCU as a lower priority. We see this as a qualitative/indicative result that will help drive discussions with stakeholders in phase 2 of the project.

How would you prioritise the following decarbonisation technologies?

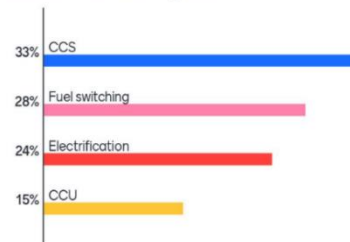


Figure 4: Technology Prioritisation

## 3. Timescale and Investment to Implement Decarbonisation Technologies

It will take a moderate amount of time and investment for all technologies to be developed. As a group, participants considered that no technology would necessarily take longer nor cost more to implement than another. As such, the group did not indicate that there were any low-cost, fast to implement technologies, an important observation for future discussions.

How much time and investment will it take to implement these technologies for the cluster?



Figure 5: Timescale and Investment to Implementation

## 4. Relative Importance of Different Elements to Deliver Net Zero

The need for better defined fiscal and regulatory policies, as was indicated in the interviews and previous workshops, was strongly highlighted. The prioritisation of the need for granular information was relatively low compared to the other options.

How important are the following to realising SNZR?

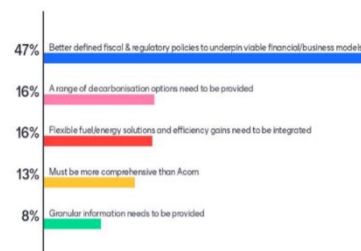


Figure 6: Relative Importance of Different Elements to Deliver Net Zero

## 5. Willingness to Share Data

Following a discussion of the data needs of the SNZR plan, 80% of respondents indicated that they were willing to share data (with some anticipating an NDA may be required). Of the remaining responses, only one indicated this was not possible with the rest indicating that it “Maybe” possible.

## 6. Critical Technologies for Net Zero

In general, CCS was indicated as a critical pathway most often. Electrification, green hydrogen, blue hydrogen, and hydrogen fuel switching were less critical but garnered a broad range of support. Overall, CCU and direct air capture were seen as less critical by participants.

Which technology pathway/s would help meet your organisation's Net-zero objectives?

Mentimeter

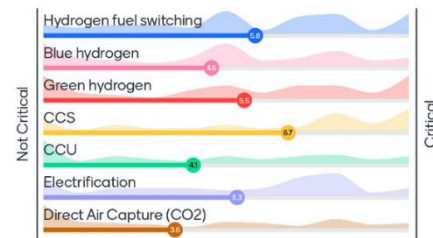


Figure 7: Critical Technologies for Net Zero

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## 7. Work Carried out to date on Net Zero

Among the participants to whom the question was relevant, most had completed some projects at a high level or at an engineering study level. This shows a positive and proactive stakeholder base which may have previous project data that is relevant to the SNZR project.

How much work have you done on decarbonisation projects on your site?

Mentimeter

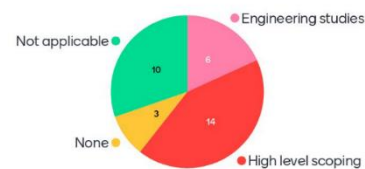


Figure 8: Work Carried out to Date

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## 8. The Role of Proxy / Generic Studies in SNZR

More than half of participants thought that these studies were useful, or could be, in some cases. While a significant number had no experience of these studies or were unsure, the number of participants who thought these studies were not useful was low. This suggests that generic or proxy studies might be appropriate for use in the SNZR plan, where no better data is available, and would be accepted by stakeholders.

## 9. Macro-Economic Analysis

Following a presentation of the macro-economic analysis proposed in the SNZR plan, the webinar participants were asked on what level they thought this analysis should be conducted. While the majority felt this analysis should be carried out at a UK level, a significant number felt that it should be done at a Scottish level. Importantly, no respondents felt that macro-economic analysis was not necessary for the SNZR.

## 10. Scenarios for Roadmap Development

Participants were shown a range of energy systems modelling scenarios that were being considered as part of the plan for phase 2 of the SNZR project (shown below) and were asked to score how appropriate and exhaustive the scenarios were on a scale of 1 to 10.



Scenario	Fuel switching	Efficiency	Process emissions	H <sub>2</sub> Production	CO <sub>2</sub> transport	Non-industry: heat
<b>Baseline</b>	Base	Moderate	CCUS Early	Blue, local, early	Pipeline, early	Electricity, H <sub>2</sub> , heat networks
<b>Soft Start</b>	Biomass, Electricity	High	CCUS Later	Blue, local, early	Pipeline, later	Electricity, H <sub>2</sub> , heat networks
<b>Local H<sub>2</sub> network</b>	Hydrogen	Low	CCUS Later	Blue, local, early	Pipeline, early	Electricity, H <sub>2</sub> , heat networks
<b>H<sub>2</sub> economy</b>	Hydrogen	Low	CCUS Early	Blue, national, early	Pipeline early	H <sub>2</sub>
<b>Renewables Push</b>	Biomass, Electricity, H <sub>2</sub>	Low	CCUS Early	Green, national, early	Pipeline, later	Electricity
<b>CO<sub>2</sub> Shipping</b>	Base	Moderate	CCUS Early	Blue, local, early	Shipping, no Pipeline	Electricity, H <sub>2</sub> , heat networks

**Figure 9: Proposed Scenarios for the Roadmap**

Most respondents considered that the scenarios presented were appropriate and insightful. A smaller number of participants disagreed with the appropriateness of the scenarios. In terms of exhaustiveness, most of the participants indicated a neutral position or slight support. There was very little strong agreement with the exhaustiveness of the scenarios.

Are these scenarios appropriate and exhaustive enough to support Scotland's Net Zero Roadmap? 




**Figure 10: Views on Proposed Scenarios**

These responses will be used as a key discussion point to modify the scenarios for phase 2, so that they meet stakeholder expectations and are designed to deliver positive outcomes for industry.

### 11. Support for Phase 2 – Development of the Roadmap

Levels of support were very high, with the majority of responses indicating they supported the presented scope, and a small group indicating neither support nor lack of support. Only a small number indicated they were unsupportive of the phase 2 plan, as it had been presented.

How supportive are you of the scope for Phase 2? 



**Figure 11: Level of Support for Phase 2** 

Overall, the webinar highlighted that:

- The SNZR stakeholder base is generally engaged, proactive and see Net Zero as an opportunity. Many have carried out studies into decarbonisation and are generally willing to share data with the SNZR project.
- Support for the phase 2 plan presented was very high among respondents at the end of the webinar.

- While support and engagement were good from the participating group, the responses from the webinar group as a whole will be used to continue engagement with emitters and other stakeholders. In particular, careful analysis of the responses will drive discussions to ensure the SNZR project aligns with expectations and can deliver on the anticipated outputs from phase 2.

## Summary

The industrial engagement activity carried out in Scotland's Net Zero Roadmap project was very successful, despite the challenges posed by the COVID-19 pandemic, thanks to the innovative and creative approach taken to build and maintain engagement with key stakeholders.

The initial one-to-one interviews generated a wealth of useful information that helped shape the approach to the roadmap and highlighted the importance of key aspects of the fiscal and regulatory environment, as well as bringing certain technologies, like the use of hydrogen, to the fore.

The open forum, small-group workshops further refined the interview programme outputs to reflect the needs of industry within the cluster. Support from the stakeholder base was good at this stage, with specific key needs identified in the workshops.

The cumulative result of these engagement exercises was a more detailed approach for phase 2 that was shared with a much wider stakeholder base from across the cluster in a large webinar, attended by over 90 delegates. Support for the proposed approach in phase 2 was very high.

The engagement activity has, therefore, been instrumental in shaping the SNZR approach to developing the roadmap. The responses throughout have been used to secure industry support and maintain the relevance of the project to the Scottish cluster. The feedback from the later formal engagement activities will continue to be used to guide the project as the cluster plan develops into phase 2.



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