

# Research Summary

Net Zero: Influencing key audiences in the new and emerging technology space to design in health and safety

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Research conducted by Verian

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# Commissioning

This report summarises the findings of a qualitative research study conducted by Verian between October 2023 and October 2024. The research was commissioned by the Insight and Service Design Team in the Health and Safety Executive. The content of the report, including any opinions and/or conclusions expressed, are the views of the agency alone and do not necessarily represent the views of the Health and Safety Executive.

# Background and objectives

## Policy and research background

The Health and Safety Executive (HSE) is Britain's national regulator for workplace health and safety. They are dedicated to protecting people and places and helping everyone lead safer and healthier lives. They work to ensure people feel safe where they live, where they work, and in their environment.

In May 2022, HSE published a new 10-year strategy (Protecting people and places: HSE strategy 2022 to 2032)<sup>1</sup>. This strategy aimed to create the space for HSE to adapt and respond to a changing world, including to support the delivery of Net Zero HSE's Strategy. This consists of five strategic objectives: the third objective is **to enable industry to innovate safely to prevent major incidents, supporting the move towards Net Zero.**

As part of being an enabling regulator in the Net Zero space, HSE needs to consider if, and how, it invests in influencing different audience groups to design in safety and health considerations from the outset rather than apply a more traditional model of regulating on the back of health and safety failures. This work was commissioned to support delivery of the Net Zero Strategy by understanding how to influence different audience groups to 'design in' health and safety at the initial planning stage of new and emerging technology development.

## Research objectives

Research was commissioned with audiences who are involved in the new and emerging technology space, to understand how HSE could influence them (directly, indirectly or if at all) and what barriers would need to be overcome for them to design in safety and health considerations at an earlier stage of new technology development.

Specific questions the research needed to answer were:

- Who are the Net Zero influencers in each priority technology?
- What is their role and level of influence? What is the impact of that influence? What hierarchies and dependencies exist?
- What are the enablers to designing in health and safety to new and emerging technologies?

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<sup>1</sup> [Protecting people and places: HSE strategy 2022 to 2032](#)

- What are the barriers to designing in health and safety to new and emerging technologies?
- How and where can HSE influence these key audiences (directly, indirectly or if at all)?
- How and where can HSE influence these key audiences to overcome any barriers that have been identified?

## Research approach

Research consisted of 60, one-hour semi-structured interviews with audiences from a range of organisations. All interviews were completed online by video.

The aim was to sample a wide range of audience groups and generate hypotheses. There was a focus on recruiting at least half the sample from audience groups who HSE does **not** historically have an established policy or regulatory relationship with, in the Net Zero area.

- **29 participants** were recruited from a range of Government organisations: ministerial and non-ministerial departments, public bodies, public corporations, devolved administrations, associations, and local authorities.
- **31 participants** were recruited from outside Government covering: investors, insurance companies, academics, consultants, energy companies, and original equipment manufacturers (OEMs).

Individuals were targeted for their experience and expertise across one or a number of the technology areas relevant to Net Zero. These were: Hydrogen; Carbon Capture, Storage and Utilisation; Batteries; Renewables; Alternative Liquid Fuels and Hydrogen Carriers; Bioenergy & Energy from Waste; Electrification, Grid Reinforcement and Electric Vehicle charging.

Interviews took place from December 2023 to March 2024.

# Main findings

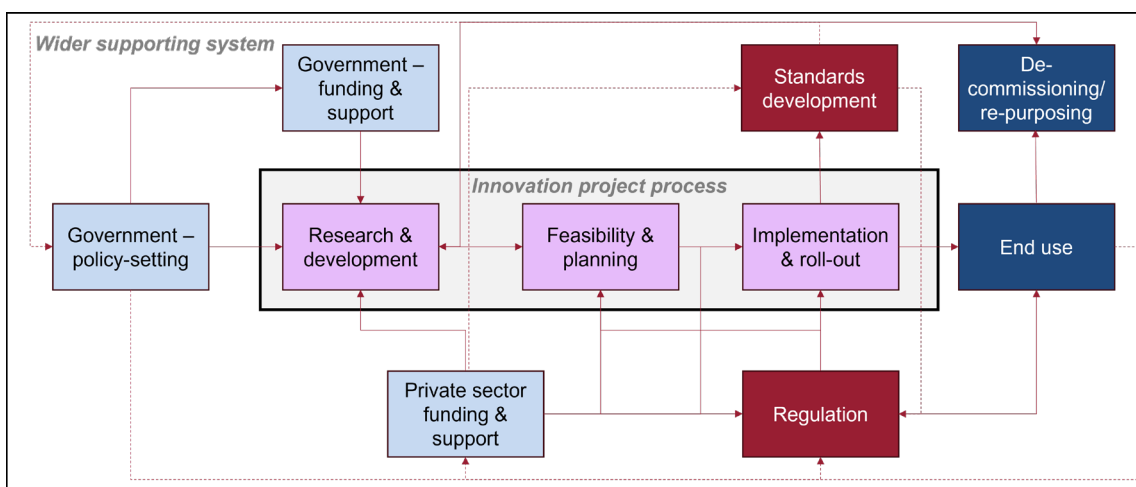
## The Net Zero system

The audiences within this research varied significantly in their remit, role, and overall view of the Net Zero system. However, participants consistently agreed that the current Net Zero context is diverse and complex, and that this creates challenges for organisations focused on these technologies to navigate.

Participants saw the Net Zero system as fragmented and varied, with a broad diversity of projects and technologies. The Net Zero system includes a mix of established legacy organisations and new organisations, with varied levels of experience and attitudes to risk management. Relatedly, rapid developments in Net Zero technologies have led to some uncertainty as to which organisations hold responsibility for understanding the implications of new technologies, including for safety (discussed in the following section).

Another important characteristic of the Net Zero system is the time pressure stemming from the UK’s commitment to achieve Net Zero emissions by 2050<sup>2</sup>. This commitment requires many significant changes to the energy system in the coming years and decades. Although as yet unknown or very early-stage technologies may play a role, participants generally felt that the key technologies required to deliver Net Zero by 2050 already exist, at least at demonstrator level. Rather than the need to develop entirely new technologies, the 2050 target can be achieved by scaling up currently existing technologies.

The diagram below shows how the innovation process sits within a wider supporting Net Zero system.



<sup>2</sup> [Net Zero Strategy: Build Back Greener - GOV.UK](https://www.gov.uk/government/strategies/net-zero-strategy)

Diagram 1 showing the innovation process within the wider Net Zero system.

The innovation process for developing and implementing Net Zero technology was seen as complex, interconnected, and not a single linear process. However, participants generally described a broadly similar process for developing Net Zero technologies which can be simplified into the following stages:

- **Government policy setting**, derived from overarching Net Zero targets and Carbon budgets initially delivered by the Climate Change Committee. These were seen as one 'starting point' for the innovation process, creating the policy context that shapes the direction of many Net Zero technologies (particularly those that won't be commercially viable without Government support).
- **Private and Government funding and support** to progress technologies from early stage theoretical or laboratory phase of development. Public sector funding was seen as 'de-risking' projects that may not be able to attract sufficient private investment.
- **Research & development** to gather and progress ideas, with a primary focus on technical feasibility. (Participants from a range of different audiences described the importance of open-ended thinking and of focusing on possibilities more than managing risk, at this stage).
- **Feasibility and planning**, where commercial viability of a project or development grows as a focus. At this stage, focus moves from possibilities to practical considerations and the implications for other parts of the system (where possible).
- **Implementation and rollout**, broadly encompassing stages of the innovation process after a final investment decision, through to construction (up to end use). Participants saw this as the stage where risk management, including early consideration of safety, gains prominence.
- **Regulation and standards development**: once new technologies are established, organisations must comply with relevant safety standards and regulations. In the case of new uses of technology, organisations must understand and apply whichever current regulations are relevant to their project.
- **End-use** of Net Zero technologies, which may feed back into previous stages of the process as the policy context and regulations are updated.

## Challenges for regulators

This research identified key challenges for regulators, arising both from interviews with other regulators and the views of other audiences in the sample. Participants said they had experienced challenges in understanding or applying established regulations in new and unfamiliar contexts or adapting them for the Net Zero space. This had reportedly caused confusion for organisations who needed to understand which regulations were relevant to them, and how these regulations could be applied in practice.

Participants (again, both from regulators and other audiences) also highlighted how regulation can encourage overly cautious ways of thinking, which can affect the development of new approaches. Relatedly, some participants voiced frustration with regulators not being able to provide an assessment of risk associated with new technologies, due to a perceived lack of confidence or understanding. The inherent time lag involved in developing regulations and standards for new technologies was also seen as a significant challenge, as standards can only be developed once a product proliferates and becomes established.

Some regulations relevant to new Net Zero technologies have been developed to manage established risks in other situations and were seen as outdated, or difficult to apply. For example, regulations relevant to the storage of Carbon Dioxide were seen as relevant to much smaller-scale contexts such as manufacturing, but difficult to apply to the scale required for Carbon Capture and Storage projects.

## Consideration of safety in the Net Zero system

Audiences had experience working with a range of different Net Zero technologies at different stages of development, meaning they varied in their understanding of risks, including safety risks.

There was a consistent sense across audiences that many or most of the key risks for Net Zero are around new applications of existing technologies, rather than completely new risks. However, for early-stage technologies, a lack of examples to learn from (either in the UK or internationally) were seen as limiting the extent that these risks could be predicted.

Participants reported that in some parts of the Net Zero system there is no specific individual organisation that is 'responsible' for safety in the context of partnership working. Collaborations (for example between industry, Government and academia) can arise and dissipate quickly, and contracting is reportedly not always well established. Participants raised examples where they perceived there was ambiguity around accountability for safety risks on major projects, due to the fact there were several partners, consultants and sub-contractors all inputting into design and construction.

Consideration of safety becomes more developed as the stages of the innovation process unfold. Participants reported that innovative ideas are not always developed with 'an end' in mind and innovators sometimes have a view that safety considerations can be considered later in the process of implementing new technologies. Early in the innovation process, technical feasibility was seen as the primary concern, with questions around commercial viability and risk management not coming to prominence until the more detailed feasibility and planning stages (i.e. closer to Final Investment Decisions, or after). Early-stage innovation was seen as inherently uncertain, as projects may not progress onto the next stage, so it may not be relevant to focus on safety if it feels extraneous to the objectives of the project in its early stages.

Three high-level challenges, and related barriers to early consideration of safety, were identified across the research:

- **A lack of systems-level thinking**, leading to unanswered questions about the impact of technologies and how they will interact at scale. This was blamed both on the difficulty of doing so, and the lack of consensus on key risks at a systems level.
- **Difficulty understanding how current regulations and standards apply**, due to either a low awareness or lack of understanding of regulations, or difficulty in applying current regulations to new applications of Net Zero technologies.
- **Poor risk identification and management**: lack of skills, knowledge and competence was seen as an issue, particularly for smaller operators and subcontractors further down the supply chain of Net Zero technologies. Projects may also pass through earlier stages but not consider wider situational safety at application.

Related to all three challenges, but particularly to poor risk identification and management, was a consistent sense across audiences that the cost benefits of early and correct consideration of safety are not fully appreciated. Participants felt that there can be an assumption that safety is challenging and costly to consider early in the design process.

Audiences described several enabling factors which could address these challenges.

The lack of systems-level thinking could be improved by: horizon scanning, more detailed modelling of how different technologies may interact, and the risks this may create. Many audiences felt their own and other organisations were too siloed, with insufficient knowledge sharing around risks. Some participants had examples of where these activities had happened already and felt these could be shared more widely.

Difficulty understanding current regulations and standards could be improved by setting out the current state of play for key Net Zero technologies, with clearer and/or more developed guidance on how these could apply in potential new contexts.

Poor risk identification and management was seen as an especially difficult challenge, requiring a range of solutions across the system. Participants felt these could include:

- **Developing organisational cultures that value accountability**, risk management and competence development.
- **Greater understanding of the business case for risk management**, i.e., guidance with examples of how early consideration of safety reduces costs later on by avoiding retrospective design changes, giving investors/end users more confidence and enabling them to avoid reputational damage.
- **Availability of good practice guidance/evidence relating to** risk and potentially training on risk identification.
- **Specific process requirements**, e.g., risk identification/mitigation in funding applications, requiring greater consideration of safety or even conducting a safety study upfront before requiring applications.

## Key audiences in the new and emerging technology space

Participants saw the different audiences in the system as having varied levels of influence with other organisations, and varied levels of openness to being influenced by others ('influenceability'):

- **'Influence'** in this context refers to the extent each audience has input into and control over safety considerations for other audiences, and other parts of the Net Zero system (such as duty holders and end users) who were not directly engaged in this research.
- **'Influenceability'** in this context refers to the perceived level of influence HSE could have over these audiences, to encourage them to design in health and safety and/or facilitate early consideration of safety in the development of new and emerging technologies, in the Net Zero space.

The diagram below shows the key influencing relationships between different audiences within the sample. More influential audiences are highlighted in yellow, with significant influencing relationships highlighted in blue.

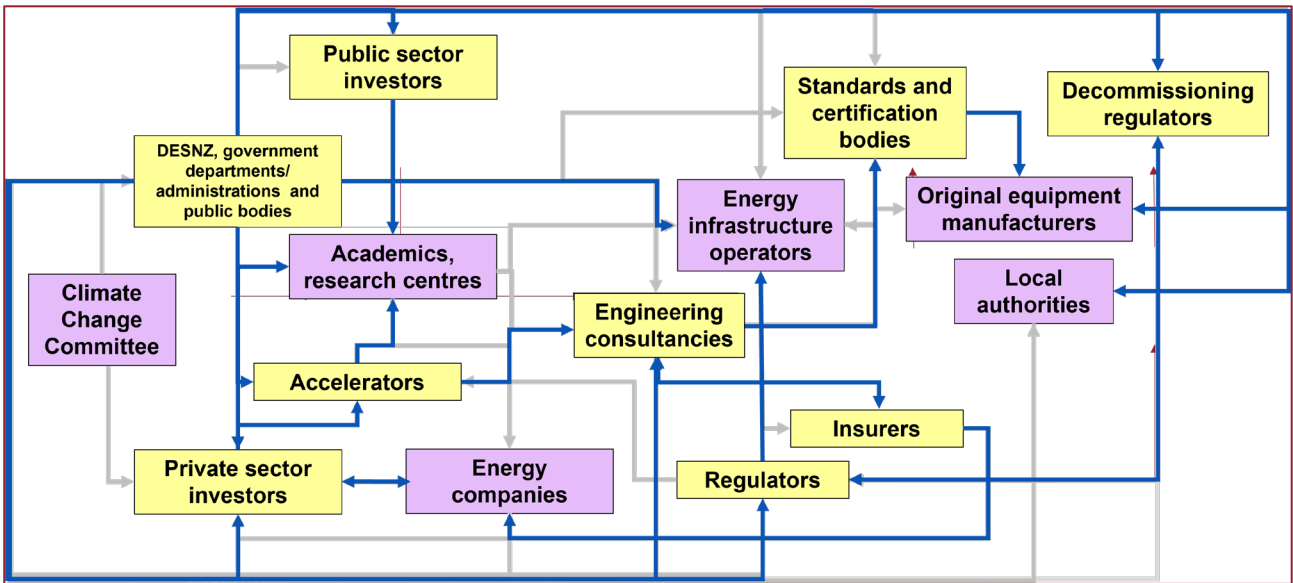


Diagram 2 showing key influencing relationships in the Net Zero system.

A number of factors contributed to each audience’s relative level of influence to promote early consideration of safety. Influence varied according to the nature of their role and remit within the system, the nature and extent of existing relationships, and the focus and value placed on the audience in identifying or avoiding risk. Resource levels were also important in the degree of influence, as audiences with more resource and competence available, were better able to devote time to early consideration of safety, and to developing and maintaining relationships.

Other factors contributed to each audience’s relative level of influenceability and openness to being influenced. These were driven by the extent to which different audiences felt they had accountability, with more accountability being seen as leaving audiences more open to reputational damage. Influenceability was also driven by audiences’ openness to learning and improving practices, the extent to which they have prior objectives set in existing legislation that are not connected to safety, and the nature of the current relationship with HSE.

## Net Zero audience profiles

Audiences varied in their level of influence for safety considerations throughout the Net Zero system, and their potential to be influenced. The diagram below shows the relative level of both, for each audience covered in the research.

Please note: It's important to acknowledge this is a **qualitative assessment** based on an **interpretation of participants' responses**. The positions are a combined reflection of **how audiences perceived their own position and how they were described by others**.

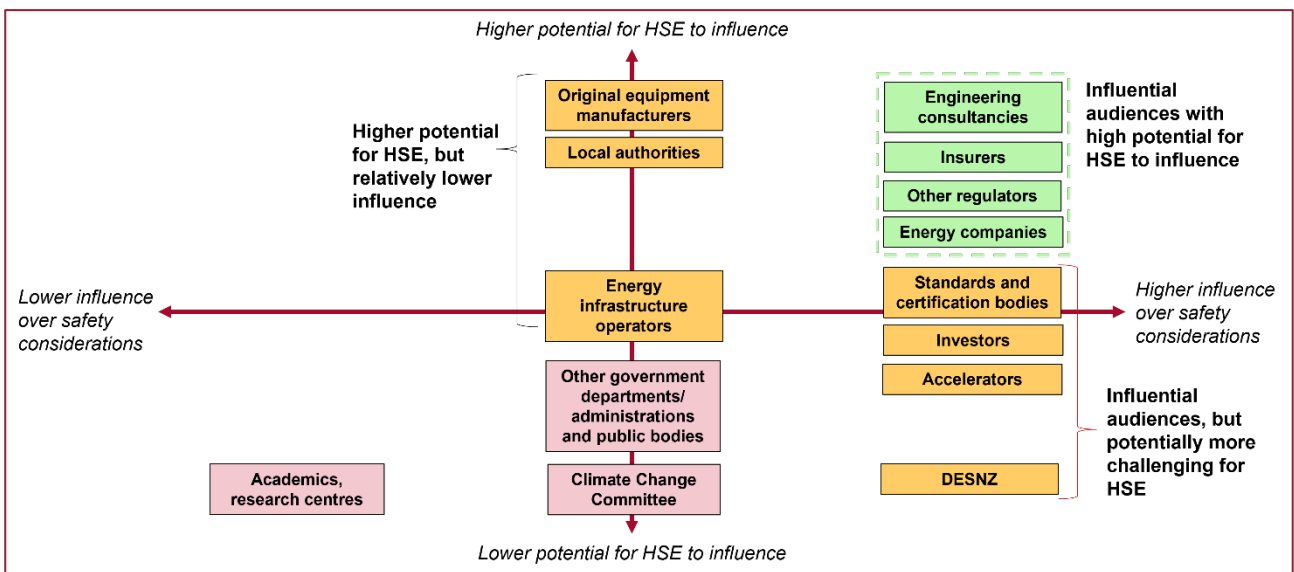


Diagram 3 showing the relative level of influence and potential for HSE to influence of each audience.

## In summary

- **The innovation process for emerging technologies is inherently unpredictable and often based on fluid partnerships:** these qualities can be a barrier to considering safety too far ahead in the process and/or taking accountability for it.
- **The feasibility and planning stage of a project is a key time at which safety needs to be considered but may be sidelined** due to a focus on commercial viability, or it may be difficult to understand the risks created by transposing the technology into a new context; arguably Green Hydrogen, Carbon Capture and Storage and Geothermal projects are most likely to be at this stage now (March 2024).
- **Key audiences who are influential in prompting consideration of safety at feasibility and planning stage are insurers, engineering consultancies, energy companies and**

**other regulators:** it could be beneficial for HSE to engage with them to encourage them to cascade early consideration of safety throughout their networks and learn from their experiences.

- **There was low awareness and understanding of how current regulation can be applied to emerging technologies,** so many audiences welcomed support and direction on what to apply, in what ways.



## Further information

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