



# Net Zero Challenges and Digital ClimateTech Opportunities Study

Summary Report



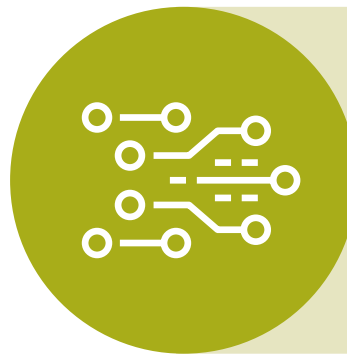


# Study Objectives

Identifying and prioritise specific Net Zero challenges with scope to be addressed by digital ClimateTech solutions



**To support  
the shift to  
Net Zero**



**To support the growth  
of the Scottish digital  
technology supply chain**

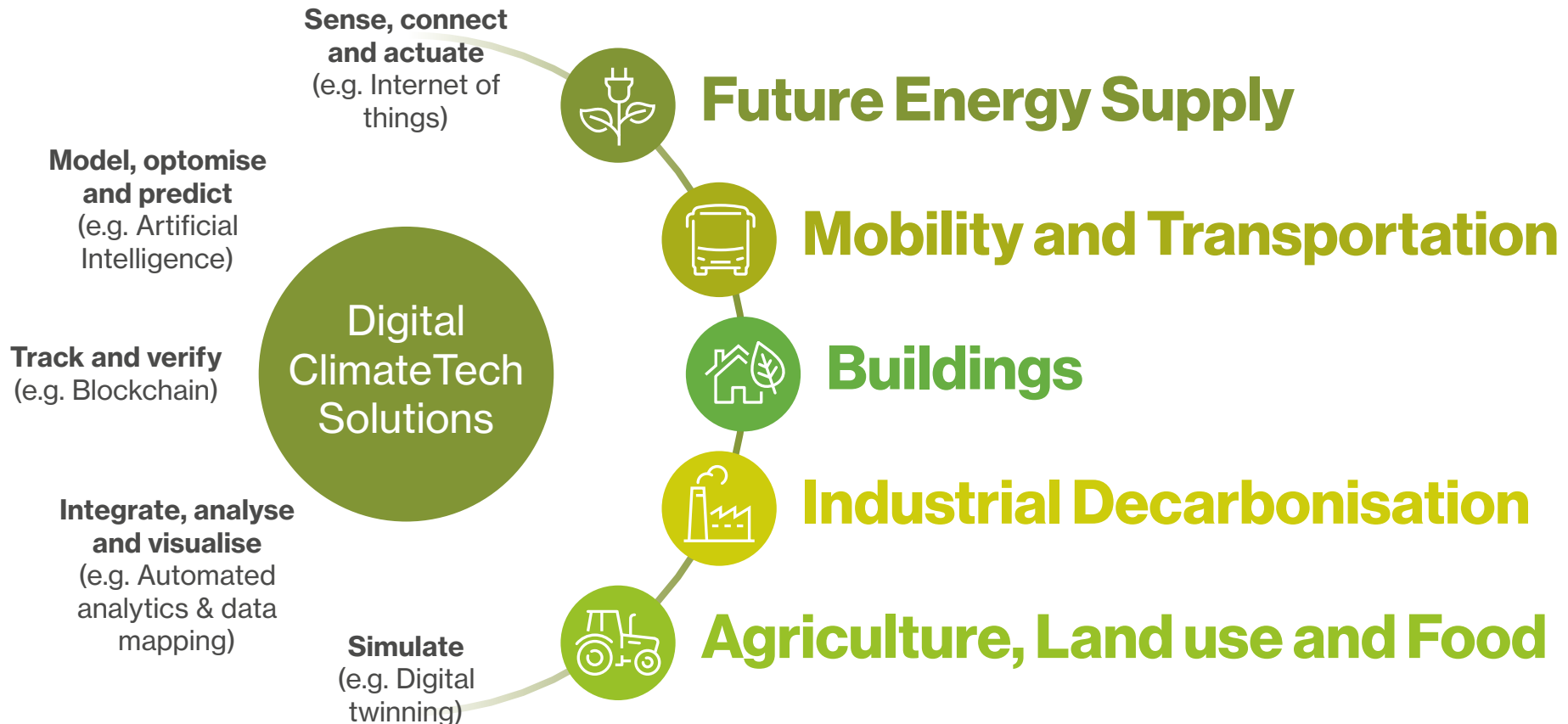
Understand the existing activities/ facilities already in place to support aspects of challenge-based innovation

Understand how the public sector could best support both companies who own the challenges and technology developers








# Scope of the study

Specific Net Zero challenges with opportunities for digital ClimateTech solutions identified across five themes





# Scope of the study

-  **Future Energy Supply**
  - Electricity grid network operation
  - Energy retailers
  - Offshore wind
  - Other renewable energy generators
  - Hydrogen
  - Other energy storage
  - Other renewable energy generators/developers
-  **Mobility and Transportation**
  - Fleet owners (passenger and freight)
  - Bus and coach operators
  - Port operators
  - Airport operators/air traffic control
  - Rail (passenger and freight) and light rail
  - Car share clubs
  - Vehicle hire
  - Cycle hire
-  **Buildings**
  - Building owners and occupiers
  - Construction material and product manufacturers
  - Construction engineers
  - Architects
  - Contractors
  - Facilities management companies
  - Energy service companies
-  **Industrial Decarbonisation**
  - Oil & gas exploration, production and refining
  - Chemical manufacturers
  - Cement producers
  - Paper mills
  - Engineering
  - Glass manufacture
  - Energy from waste plants
  - Water/wastewater processing
  - Other manufacturing
-  **Agriculture, Land use and Food**
  - Farmers and growers
  - Forestry owners and managers
  - Food and drink producers
  - Food and drink wholesalers and retailers
  - Other land owners (including peatlands)



# Study inputs



Desk research



**56**  
interviews across  
five themes



**49**  
participants across  
five workshops



**80**  
organisations  
contributing to  
the study

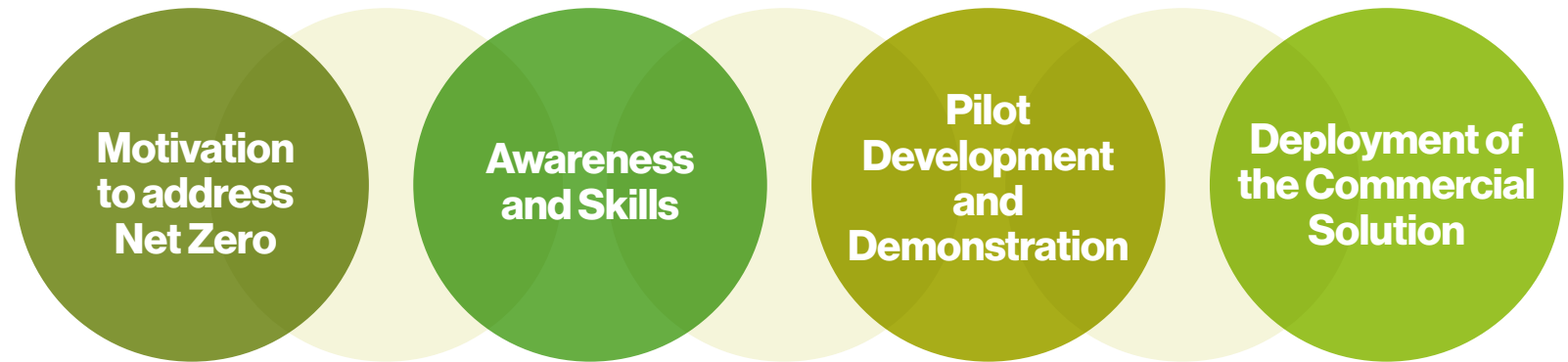
(note: some organisations participated in both interviews and workshops)



# The Net Zero Challenge Journey

Across all five themes, companies are at different stages of addressing Net Zero challenges. For some companies there are strong drivers present which provide a clear motivation to justify investment in addressing Net Zero challenges. For others, they are aware of the trend towards Net Zero but the drivers are not sufficiently strong to motivate companies to act on the challenges now. Even where companies are motivated to act there can be a lack of awareness and skills to enable them to identify specific Net Zero challenges with opportunities to address using digital technologies. At this stage, a company may be able to find a digital ClimateTech solution already on the market and decide whether the cost of this is justified by the investment required. If there are no ClimateTech solutions already on the market then the company may decide to proceed with a pilot development and demonstration project and this may present an opportunity for digital technology providers. The final step in the process is to commercially deploy the solution across the company's operations and the wider market.

## Stages of the Net Zero challenge-based innovation process



- Regulation/ clear policy
- Cost savings
- End customer/supply chain pressure
- Business opportunity
- Purpose-led leaders
- Wider societal pressure

- Company's own carbon footprint
- Net Zero business opportunities
- Articulating Net Zero challenges
- Digital tech - art of the possible

- Identifying digital tech providers
- Specifying an innovation project
- Funding and managing an innovation project
- Access to test and demonstration facilities

- Risk mitigation
- Overcoming procurement barriers
- Issue for Challenge owners and tech providers



Net Zero Challenges and Digital ClimateTech Opportunities Study

# Specific Net Zero Challenges by theme





# Future Energy Supply



## How to increase grid flexibility to minimise investment in new capacity

This challenge includes how digital solutions could enable incorporation of private renewable energy networks into the grid and also facilitate domestic customer participation in demand side response programmes. This activity would mainly be driven by cost savings arising from avoided investment in new grid infrastructure. The challenge is applicable across all electricity distribution network companies. Addressing this challenge enables the shift to Net Zero, rather than producing direct impact on carbon emission reduction. There are already examples of pilot demonstrations of digital solutions, such as the [Kaluza Flex](#) product that uses artificial intelligence to enable shifting of demand for electricity in response to price signals and solutions from [Smarter Grid Solutions](#) that support capacity management, flexible interconnection, virtual power plant, microgrid, fleet energy asset operations, energy as a service and local energy applications.



## How to reduce the levelised cost of renewable energy

This challenge includes how digital solutions could increase efficiency across the different contributors to the levelised cost of energy including development of new generation devices, operation and maintenance activities. This activity would mainly be driven by cost reduction to improve the investment case for renewable energy deployment. The challenge is applicable to renewable generation project developers and companies involved in operation and maintenance of the renewable assets. It is also applicable to developers of new renewable devices such as tidal and wave devices. Addressing this challenge would lead to a direct impact on Net Zero as it would increase the likelihood of renewable generation deployment. There are already examples of digital solutions being developed in this area using the [Offshore Renewable Energy Catapult's Operation and Maintenance Centre of Excellence](#).



## How to avoid curtailment of renewable energy generation

This challenge includes how digital solutions could help reduce curtailment of renewable energy generation. For example, this could include focusing on providing cheaper electricity to customers reliant on, typically more expensive, electric heating and/or digitally optimising local energy systems involving renewables generation, battery storage and hydrogen production. This activity would mainly be driven by cost reductions through lower payments for curtailment. The challenge would need to involve electricity network operators, electricity retailers (to develop appropriate time-of-use tariffs), domestic customers that use electric heating. Addressing this challenge would have a direct impact on Net Zero as it would optimise use of renewable electricity displacing some use of more carbon intensive electricity during periods of curtailment. Although the issue of curtailment is well understood, no evidence was identified of using digital technology to link addressing this to benefiting specific groups of consumers. There is an existing project being led by the European Marine Energy Centre that uses artificial intelligence to control the storage of hydrogen to optimise integration of renewable energy into the grid - [HyAI](#)





# Future Energy Supply



## How to reduce barriers to renewable energy deployment

This challenge includes how digital solutions could speed up regulatory/standards development in marine renewable device development, increase efficiency of the planning and consenting process for renewables, enable peer to peer trading between energy consumers and renewable energy generators, identify grid connection opportunities/ risks, better estimate grid connection costs at an early stage of project planning and identify/manage cyber security risks. This challenge could involve renewable energy developers, project engineers, planning and consenting advisors, regulatory bodies, energy users. This activity would be driven by cost savings achieved through quicker, more streamlined deployment. Addressing this challenge directly impacts on the shift to Net Zero through additional renewable energy generation. Some examples of digital solution development relevant to this challenge have been identified, including [Enian](#) which is working with the University of Edinburgh and The Data Lab to automatically predict the cost of connecting a new energy generation source to the grid.



## How to improve digital communications infrastructure to remote locations (onshore/offshore)

This challenge includes how digital infrastructure improvements could help remote communities with local energy systems and remote offshore renewable generation assets. The challenge could involve existing digital networking companies, operators of local energy systems, owners of renewable generation assets. This activity would be driven by indirect cost savings that could be achieved through facilitating the use of digital solutions using the communications infrastructure. Addressing this challenge would have an indirect impact on the shift to Net Zero through helping to reduce the cost of renewable generation deployment. Some examples of digital solutions identified include [Citymesh and Nokia](#) collaborating to establish digital communications infrastructure in offshore wind farms to facilitate the deployment of an AI based solution for predictive maintenance of wind turbine blades.



## How can the process of reporting greenhouse gas emissions be made more efficient and transparent

This challenge includes how digital solutions could support companies to define and measure their greenhouse gas emissions. This challenge is applicable to all companies but the drivers to adopt such solutions are strongest with a small number of very large emitters that are required by regulations to report emissions and participate in an Emissions Trading Scheme. For most companies the drivers are consumer, supply chain and wider societal pressure to move to Net Zero. Addressing this challenge indirectly impacts the shift to Net Zero as it relates to understanding the organisational footprint (and potentially supply chain and downstream greenhouse gas emissions) and would require further work on developing a roadmap to Net Zero and taking action to reduce emissions. Example solutions already developed include the [Wood ENVision](#) real-time carbon emissions monitoring solution.



# Future Energy Supply



## How to link voluntary carbon markets to consumer demand side response

This challenge focuses on how to enable energy consumers to benefit financially from the carbon reductions arising from demand side response programmes as well as benefiting from the potential energy price reductions from shifting timing of demand. This activity would mainly be driven by a combination of wider societal pressure for action on climate change and a potential business opportunity in the voluntary carbon market. One company stakeholder highlighted an interest in this challenge but it is likely that others would be interested as it has the potential to contribute to grid flexibility (i.e. likely that electricity network operators would be interested). Companies with an understanding of voluntary carbon markets would also have to be involved. Addressing this challenge would have a direct impact on the shift to Net Zero with consumer participation in demand side response driven by carbon reduction objectives as well as financial savings. No digital solutions were identified that enable consumers to participate in voluntary carbon markets via demand side response activities.





# Mobility & Transportation



## How to enable transport users to plan, find, book and pay for multi-modal journeys involving different service providers

This challenge relates to the use of Mobility as a Service (MaaS), where users can identify and pay for a journey involving several modes of transport and pay for it in a single booking. This challenge relates to how this could be made available to a wider geographical base of transport users. There is clear Government policy support for MaaS but the drivers for individual transport users to engage are limited. A combination of companies and support organisations are interested in addressing this challenge and willing to engage further. Addressing this challenge would have a direct impact on the shift to Net Zero by making it easier for transport users to identify alternatives to travelling by private passenger vehicle. A small number of regional MaaS pilot apps were identified during the research including the [HITRANS GoHi app](#) and the [Tactran Enable Platforms](#). However, these are limited in the geographic area they cover.



## How to educate, inform and influence the public about the true cost (economic, environmental and social) of different modes of transport

This challenge relates to how the true economic, environmental and social costs of different journey options could be communicated to transport users. This would enable more informed decision making about journey modes and, in the longer term, could provide the basis to apply incentives (e.g. price subsidies) or disincentives (e.g. carbon taxation). There are currently limited drivers to motivate transport users to consider factors beyond financial cost. This challenge is of interest to several companies consulted and would require data to be provided by many more stakeholders. No existing digital solutions were identified that address this challenge.



## How to identify energy efficiency opportunities for building stock

This challenge has been raised across different thematic areas. It refers to the buildings that mobility and transportation companies operate from and the identification of opportunities to reduce carbon related to energy use. The key driver for action in this challenge is the potential for cost savings. This challenge is applicable to a wide range of companies with a stock of buildings. A limited number of challenge owners were identified as being interested in this challenge and willing to engage further although there is more demand when considering similar feedback in other themes. Addressing this challenge would have a direct impact on the shift to Net Zero through identifying and supporting the business case for building energy efficiency improvements. A number of solutions were identified that partially address this challenge including [Virtual Environment](#) from Integrated Environmental Solutions which is a suite of integrated analysis tools for design and retrofit of buildings, including energy modelling.



# Mobility & Transportation



## How to support transport users who identify as experiencing accessibility issues

This challenge relates to ensuring equitable access to different transport modes so that transport users experiencing accessibility issues are able to use shared public transport options. Drivers to address this challenge include Government policy to support accessibility. There is also the scope for cost reduction, in the case where transport users currently use more expensive forms of transport, such as taxis. One of the stakeholders highlighted this challenge but, given the Government policy driver to support accessibility in public transport, it is likely that a wider group of challenge owners may be interested and willing to engage. Addressing the challenge would have a direct impact on the shift to Net Zero through enabling users who experience accessibility issues to use less carbon intensive forms of transport. SEStran is developing a digital solution to address this challenge, [Thistle Assistance](#) that uses artificial intelligence combined with augmented reality to help make public transport more accessible.



## How to track emissions from different modes of transport (vessels, freight, aircraft) in real time

This challenge can include monitoring and reporting of emissions but can also involve the use of real-time data to optimise movements to reduce fuel use and, therefore, emissions. The benefits of addressing the challenge accrue to both the transport hub operators (in terms of better monitoring and reporting of carbon emissions) and to transport operators (via reduced fuel costs). A limited number of challenge owners were identified as being interested in this challenge. Addressing this challenge would have a direct impact on the shift to Net Zero if the functionality to optimise fuel efficiency was included. A limited number of digital solutions were identified during the research. For example, [Cisco has collaborated with the Port of Rotterdam](#) to implement a system that gathers data using IoT sensors and analyses it using AI.



## How to reduce carbon emissions from freight, including repeated courier visits to residential locations

The scope of this challenge includes how to reduce greenhouse gas emissions from first mile/ last mile freight deliveries to/from businesses and multiple courier journeys to residential locations. The main driver for commercial freight and courier operators is cost savings. No freight/courier companies were directly consulted during the research. However, feedback from other stakeholders identified the difficulty in engaging these companies in projects to investigate the role of consolidation centres/logistics hubs. Addressing this challenge could have a direct impact on the shift to Net Zero through effective implementation of logistics hubs/ consolidation centres capable of reducing transport journeys and associated emissions. Examples of pilot projects in this area have been identified with SEStran being a partner in the [Interreg North Sea Surfloogh project](#) that is piloting a logistics hub in Edinburgh to explore different commercial approaches to logistics in a crowded urban environment.



# Mobility & Transportation



## How to support the shift to zero emission vehicles

This challenge relates to how the transition from internal combustion engines to zero emission vehicles can be supported by digital technology. There are strong Government policy drivers, at both UK and Scottish level, to support the shift to electric vehicles with the UK Government setting a target to end the sale of new petrol and diesel cars by 2030. However, for individual vehicle owners the drivers are less clear in the short term. This challenge was identified via desk research only. Addressing this challenge would have a direct impact on the shift to Net Zero. There are already a number of digital solutions being developed to address this challenge. For example, [Power My Hub](#) is leading a project to further develop an existing data driven comparison site that helps consumers understand electric vehicle options and green energy supplier options.



## How to avoid travel whilst maintaining equity amongst users

This challenge relates to how travel be avoided using digital technology and, in the case of remote service provision, how can equity be maintained between service users regardless of their geographical location. The current pandemic has been a key recent driver in the use of digital solutions to avoid travel. Avoided travel also provides the potential for cost reduction through not having to pay for transport costs. This challenge was identified during the desk research and a small number of challenge owners confirmed that it was a priority in the hierarchy of sustainable travel. Addressing this challenge would have a significant and direct impact on the shift to Net Zero through avoided emissions. There are widely adopted existing digital solutions to avoid travel, including Microsoft Teams, Zoom and FaceTime.



## How to define scope of emission sources and measure/report

This challenge has been identified across several themes. It relates to how digital technology can be used to help companies define the scope of carbon emissions to be addressed and the subsequent measurement and reporting. Wider societal pressure is likely to be a driver for action, as is pressure from transport users for more sustainable options. However, only a minority of transport users currently consider relative greenhouse gas emissions when deciding between modes. The challenge owners and support organisations consulted in the Mobility and Transportation theme are more focused on the potential of digital solutions to reduce wider societal emissions via modal shift in transport than focusing on their own operational emissions. Addressing this challenge would have an indirect impact on the shift to Net Zero as further action would be required to achieve emissions reductions. There are examples of digital solutions already developed to monitor and report greenhouse gas emissions including Microsoft's [Cloud for Sustainability Software as a Service tool](#).



# Buildings



## How to minimise embodied carbon & reduce emissions across a building's lifecycle

This challenge includes how digital solutions could measure and optimise building occupancy and energy usage across building portfolios, as well as how to minimise embodied carbon stemming from the materials and processes used in construction. This challenge is applicable to all companies in the theme, in particular manufacturers, engineers, contractors, building owners and building occupiers. This activity is driven by Scottish building standards to reduce operational carbon emissions, as well as the cost savings generated from reducing operational emissions. Addressing this challenge would directly impact the shift to Net Zero by helping reduce the 40% contribution to the UK's total carbon footprint. An example of digital solutions developed to address this challenge are **Key FM's** sensor-based building performance monitoring solutions which monitor occupancy rates, optimise energy consumption, alert to flooding, and much more.



## How to capture and analyse data across a building's lifecycle

This challenge includes how digital solutions could better support the integration of stakeholders across the built environment, identify cost savings when reducing GHG emissions, capture data across a building's lifecycle, and analyse data across a building's lifecycle. It could include all stakeholders involved in a project including architects, engineers, contractors and operators. Key drivers for this activity are potentially greater for a smaller pool of large companies, those with adequate resources and the data skills necessary. Also collaboration is understood to be somewhat limited across the sector. Without accurate data collection and provision of data across a building's lifecycle, then the true carbon impact of a building may not be robustly calculated. The Net Zero impact of addressing this challenge is therefore significant. Innovation is required to develop data rich models that can help solve this challenge.



## How to reduce the carbon impact of cities' building stock

This challenge includes how digital solutions could help reduce the carbon impact of infrastructure programmes, accelerate the decarbonisation of building stock, and create cost-effective and efficient city district cooling and heating systems. This challenge is particularly applicable to planners, local authorities, and organisations involved in the design, development and maintenance of communities. Key drivers include government policies and strategies, e.g., Energy Efficient Scotland, Low Carbon Infrastructure Transition Programme, Heat in Buildings Strategy, and District Heating Scotland, as well as the "green" business opportunities that emerge as a result of decarbonising a city's building stock. There would be a significant impact on the shift to Net Zero if this challenge was addressed. Examples of digital solutions developed to address this challenge include **Schneider Electric's** ultra-efficient office development which included the installation of 1,000 IoT devices to optimise energy consumption.



# Buildings



## How to calculate the embodied carbon in a building

This challenge includes how digital could be used to enable the adoption of a data framework and standards to support the calculation of emissions associated with construction, including those emissions that arise from the extraction, transportation, manufacturing and installation of building materials on site, as well as the operational and end of life emissions associated with materials. This challenge is applicable to companies across a building's lifecycle, in particular those involved in materials manufacture, design and construction of a building. Key drivers include professional bodies publishing guidance and planning documents to help calculate embodied carbon, however there are understood to be no widely adopted standards or methodologies to do this. Addressing this challenge would have a significant impact on Net Zero. Digital calculator solutions exist, therefore the need for innovation is not substantially high, it is more the frameworks, standards, methodologies, etc, which are required to enable the robust calculation of embodied carbon, as well as a shift in Scottish Government policy objectives to focus on embodied carbon reduction.



## How to assess buildings for re-use/retrofit opportunities and measure efficiency gains

This challenge includes how digital solutions could be used to assess building re-use opportunities, retrofit opportunities, and to measure the energy efficiency gains of “green” building renovation projects. It is a challenge particularly applicable to building owners / occupiers, local authorities, housing associations, and organisations with building stock that is highly inefficient. Key drivers for this challenge include the policy objective of reducing operational carbon across building portfolios which will necessitate retrofit of existing building stock. There are also the wider societal problems, such as fuel poverty, which can be addressed by solving this challenge. Despite these drivers, governments have typically focused on addressing low carbon new build by offering, e.g., tax incentives, which makes new build projects much more attractive. The scale of Net Zero impact is, however, significant due to the proportion of ageing buildings in Scotland and the low number of disposals/demolitions which take place. An example of a digital solution developed to address this challenge is **IES's** suite of integrated analysis tools for design & retrofit, leveraging cutting-edge simulation technology.



# Industrial Decarbonisation



## How to measure and monitor fugitive emissions from processes (e.g. methane, nitrous oxide, etc.)

This challenge focuses on greenhouse gas emissions that are not connected to the generation of onsite energy or use of grid electricity but, instead, arising from the industrial processes themselves. At COP 26, over 100 countries (including the UK) signed the Global Methane Pledge to reduce methane emissions by 30% by 2030. North Sea oil & gas operators have launched a plan to reduce methane emissions by 50% by 2030. There are some early stage solutions emerging in this area. For example Stanford University ran a **Mobile Monitoring Challenge** to detect methane leaks and several different digital technologies were demonstrated. The Net Zero Technology Centre is actively investigating methane reduction in the oil & gas sector.



## How to support new business models that reduce carbon emissions (e.g. packaging/asset tracking, reverse logistics, refurb/reman)

This challenge relates to the use of digital solutions (e.g. blockchain) to track and trace either products and/or packaging to enable them to be returned for reuse or refurbishment/remanufacturing. The main driver to use digital solutions to support a circular economy business model is the potential business opportunity it represents. The adoption of circular economy business models is still at an emerging stage of development. Addressing this challenge would have a direct impact on the shift to Net Zero. There were a limited number of existing digital solutions identified for this challenge. One example is Scottish based company, **Reath**, which has developed a digital solution to enable companies to track reusable items or packaging, reducing reverse logistics challenges and enabling circular economy business models.



## How to define, measure and report carbon emissions (operational and lifecycle)

This challenge has been identified across a number of themes. It relates to the company's ability to set boundaries around the carbon emissions it is responsible for and then measure, monitor and report. For companies not covered by the mandatory carbon emission trading and reporting schemes, there are typically limited drivers to measure and report carbon emissions, although feedback from stakeholders indicates this is expected to increase through more scrutiny within supply chains. Consultations revealed interest in this challenge from both large companies and representatives of smaller companies. Addressing this challenge would have an indirect impact on the shift to Net Zero as it would require further action to establish roadmap to Net Zero and then implement measures identified. Several examples of digital solutions addressing this challenge were identified. For example, the Carbon Trust offers a cloud-based reporting tool called **Footprint Manager**.





# Industrial Decarbonisation



## How to identify building energy efficiency opportunities and provide data for investment cases

This challenge has been identified across a number of themes. It relates to a company's ability to review its' operational building stock, identify opportunities to reduce carbon emissions and establish costed plans to improve energy efficiency. The key driver for action in this challenge is the potential for cost savings. This challenge is applicable to a wide range of companies with a stock of buildings. A limited number of challenge owners were identified as being interested in this challenge and willing to engage further although there is additional interest across other themes. Addressing this challenge would have a direct impact on the shift to Net Zero. Examples of emerging solutions in this area were identified, including The **University of Northumbria and partners** developing, validating and demonstrating an operational interface with augmented intelligence (AI) and an occupant-centred approach that will streamline and facilitate the whole lifecycle of building renovation (planning-design, retrofitting, monitoring).



## How to find and fix water/wastewater leaks

This challenge is faced by water utilities and their Tier 1 supply chain. Leaks in the pipework system of mains water supply and wastewater result in additional carbon emissions treating and pumping water that is not used. The drivers for action include potential cost savings related to reductions in energy use and alignment with water utility carbon reduction targets. On average, across the UK, 20% of water supply is lost through leakage. Addressing this could result in reduced energy required to deliver the required amount of water. There are some examples of digital solutions for leak detection already being developed. For example, **Xylem Water Solutions** has worked with South East Water to use digital water meters, sensors, data loggers and advanced analytics using artificial intelligence.



## How to engage domestic water users in water efficiency

Unlike other areas of the UK, residential water supply is typically not metered in Scotland. It can therefore be difficult to engage consumers in water efficiency behaviour change. The drivers for action include potential cost savings related to reductions in energy use and alignment with Scottish Water's carbon reduction targets. The potential demand from challenge owners in engaging is this challenge includes Scottish Water with any solution being potentially relevant to other water utilities. Addressing this challenge would have a direct impact on reducing carbon emissions as lower residential consumption would result in lower energy use at treatment and distribution stages. No examples of digital innovation to address this challenge were identified during the research.



# Industrial Decarbonisation



## How to gain further efficiencies in process control to reduce emissions

This challenge relates to the use of digital technology to improve a company's processes. Typically this involves identifying and implementing process changes to reduce energy use and/or reduce process emissions of greenhouse gases. The main driver for action in this challenge is potential cost savings from avoided energy use. Heavy emitting companies, that are already operating under the UK Emissions Trading Scheme are likely to already operate advanced control systems but feedback suggests there is a view that further efficiency savings can be made by implementing additional digital solutions. A number of solutions are already available

to address this challenge. For example, **Intelligent Plant** provide a range of apps via its Industrial App Store. These apps cover different solutions for performance monitoring of equipment and processes through analysis and visualisation of real time data, and in the management of alarm data.





# Agriculture, Land use and Food



## How to make the process of reporting GHG emissions more efficient and transparent

This challenge includes how digital solutions could accurately report on emissions and adapt to a common framework, calculate the impacts of carbon intensive processes, and track scope 3 emissions efficiently. It is perhaps more applicable to large emitters but was expressed as a key challenge by different types of businesses and representative organisations across the theme (e.g., farmers and producers, food and drink manufacturers, etc). The key drivers include Scottish Government emissions targets set out in the Climate Change Plan 2018-2032 (agriculture - reduce to 5.3MT CO<sub>2</sub>e; land use change and forestry - increase to 2.3MT CO<sub>2</sub>e). The scale of Net Zero impact is significant, particularly as 95% of some manufacturers' emissions are generated in scope 3 which means reporting is essential to evidence this. However, better data, frameworks, and solutions for tracking emissions across the supply chain are required.



## How to assess land use and restoration opportunities

This challenge includes how digital solutions could help determine opportunities for restoration / “greening” in land use. It is applicable to a range of organisations including farmers, private land owners, public bodies (e.g., Forestry and Land Scotland), and third sector organisations (e.g., Scottish Wildlife Trust). The key drivers to address this challenge include the Scottish Government's targets to increase woodland creation and restore peatlands over the next 10 years. In addition, business opportunities are generated from land use change, and the wider societal pressures to keep people on suitable land to produce food strengthen the drivers for action. The scale of Net Zero impact is significant, particularly because 80% of Scotland's peatlands are degraded and much of the country's woodlands and grasslands have become unnaturally nutrient-rich and acidic. Forests, woodlands and peatlands will play an integral role in achieving Net Zero (e.g., through carbon sequestration). Capturing and accessing quality data about our land, soils, etc, is a major challenge that requires digital innovation.



## How to improve agricultural practices

This challenge includes how digital solutions could help measure, monitor and analyse growing conditions in crop farming, collect data on crop and soil health and model real-time recommendations, optimise crop irrigation, and enable regenerative farming through monitoring and verification models. It is a challenge directly faced by farmers and producers but also affects the carbon credentials of food manufacturers and retailers. Drivers include pressure from customers, e.g., retailers that only source from carbon-friendly farms/producers, and government policies to support reduction of emissions in agriculture. The scale of Net Zero impact is significant - agriculture accounted for 20% (7.5Mt CO<sub>2</sub>) of Scotland's total emissions in 2019, therefore any interventions to support significant reduction of emissions could have a major impact. There is evidence of digital solutions supporting the improvement of agricultural practices, for example, [\*\*Intelligent Growth Solutions\*\*](#) develops vertical farms, leveraging smart technologies such as IoT and AI to provide optimal growing conditions for crops.



# Agriculture, Land use and Food



## How to monitor waste and improve resource management

This challenge includes how digital solutions could monitor asset performance in food & drink manufacturing processes, embed circular packaging models, and enhance transparency in waste and resource management. It is a challenge particularly relevant to food and drink manufacturers that generate a lot of waste and utilise a lot of resources. A key driver is the Waste (Scotland) Regulations 2016 which requires all food businesses generating more than 5kg in non-rural areas to recycle their food waste. The Scottish Government's Climate Change Plan committed to reduce food waste by 33% by 2025, demonstrating the Net Zero impact addressing this challenge could have. An example of a digital solution identified during the research is [Topolytics](#), which aggregates and analyses waste and resource data using machine learning and mapping technologies, helping optimise resources and reduce the amount of waste entering landfills and potentially leaking into the environment.



## How to monitor environmental impacts and habitat conditions

This challenge includes how digital solutions could help monitor habitat conditions, assess fish health and identify diseases, assess the impact of storms and minimise threat to stocks, and capture data on weather patterns. A key driver is the Scottish Government Action Programme for Nitrate Vulnerable Zones (Scotland) Regulations to meet Scotland's legal and environmental obligations for NVZ (i.e., crop fertiliser use). The scale of Net Zero impact is significant as nitrogen deposition (a result of crop fertiliser usage) is one of the key drivers of change in semi natural habitats across Scotland. Wider pressures to restore biodiversity and protect habitats (land and marine) also drive the motivation to address this challenge. An example of efforts to develop solutions is the [MarPAMM](#) project funded by the EU's INTERREG VA Programme, which aims to develop environmental monitoring tools for protected coastal marine habitats in Scotland, Ireland, Northern Ireland and Wales.



## How to create accountability across supply and value chains

This challenge includes how digital solutions could help collect accurate data across the supply chain, and create traceability across food value chains. This challenge relates predominantly to food and drink manufacturers trying to collect data across their supply chains to calculate their scope 3 emissions. Key drivers include pressure from customers to produce food & drink products in a sustainable way, such as Morrisons supermarket's commitment to only source products and ingredients from net zero certified farms. An example of a digital solution is [Morrisons' emissions-tracking software platform](#) which it will roll out to suppliers producing its own-brand products with the aim of reducing its supply chain emissions by 30% by 2030.



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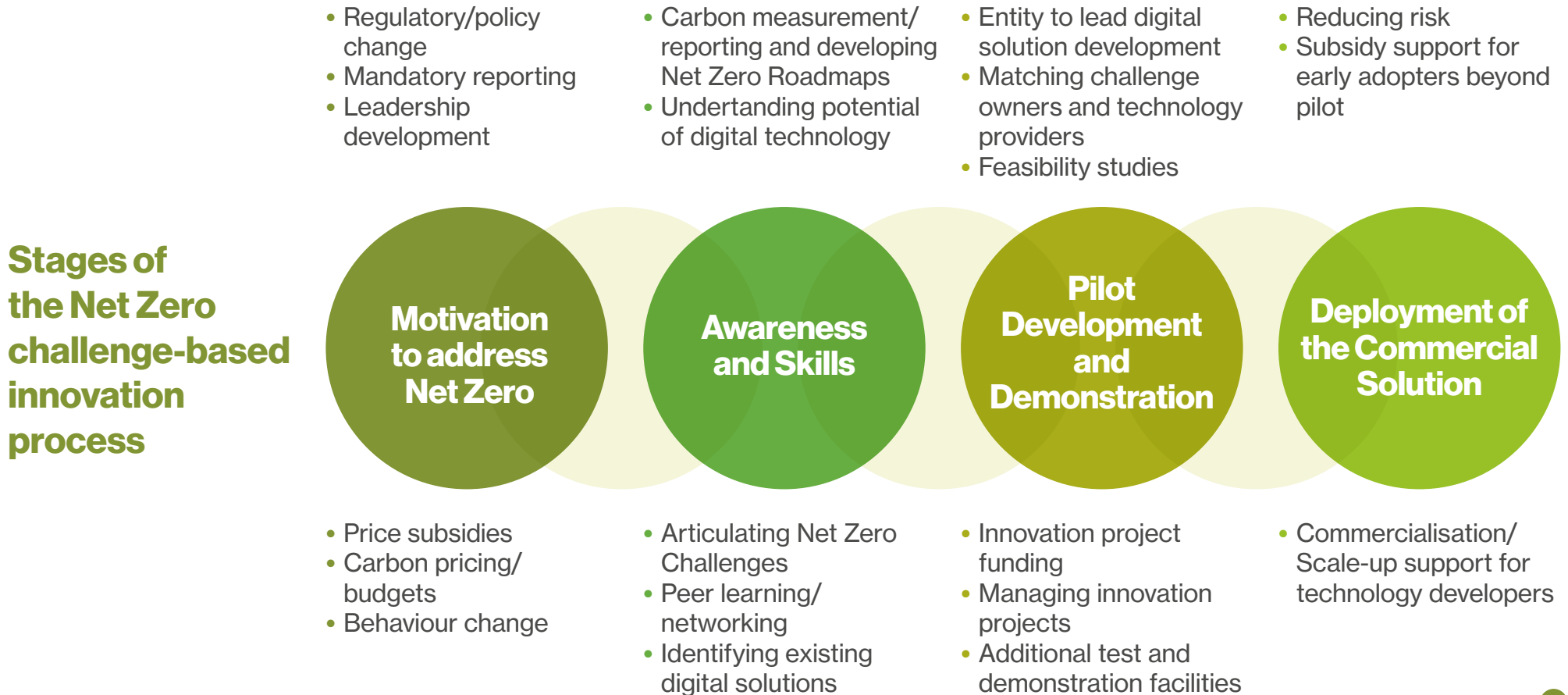
# Feedback on potential support measures





# Support needs overview

Support to increase the motivation for companies to take action on Net Zero was highlighted, in addition to support at other stages of the Net Zero challenge-based innovation process. Increasing motivation for action makes the opportunity for digital solutions to Net Zero challenges more attractive.





# Motivation to address Net Zero

## Regulation and policy

Across all themes the lack of incentive and/or penalty for companies to act on Net Zero was identified. Unless the company is a very large emitter and/or a quoted company there is no regulatory driver to measure, monitor and report greenhouse gas emissions. Without a mandatory price of carbon being applied to a company's decision making process, then the businesses seeking to develop digital solutions to Net Zero challenges will likely experience a lower level of market demand. Regulation and policy changes are also an important driver of consumer behaviour change in areas such as moving from private vehicle use to public and shared forms of transport, for example. This could take the form of price subsidies, personal carbon budgets, etc. The need for support in changing electricity market regulations was also highlighted. This relates to changes required to overcome some of the barriers identified to optimal operation of digital solutions for grid flexibility, within the Future Energy Supply theme.

Several stakeholders identified the need for mandatory data provision to support the use of digital applications. For example, in the Mobility and Transportation theme, stakeholders highlighted that MaaS solutions would be more successful if transport service providers were required to supply data.

To support the shift from private vehicles to public and shared transport, stakeholders identified that changes to land use planning were required to support the development of shared mobility hubs (e.g. locations where bus services connected with car share, bike hire, etc.). It was also highlighted that support was required to change regulations to prioritise more road space for public and shared transport to improve speed and reliability of services.

## Leadership development

Several stakeholders highlighted the need to support development of company leadership as a route to increasing the motivation to shift to Net Zero. This could involve the use of case studies and peer learning to motivate (e.g. about cost savings, new business opportunities, commercial advantage with customers from taking an active approach to Net Zero). There are already some examples of business groupings focused on Net Zero such as the [Scottish Business Climate Collaboration](#) and the [Scottish Net Zero Business Community](#).



# Awareness and Skills



## Measure, monitor and report a company's own emissions

Once a company is motivated to act on shifting to Net Zero, the first step is to identify the nature and scale of the greenhouse gas emissions they are responsible for. Stakeholders report that a significant number of companies can lack the ability to establish the boundaries around the activities that should be included in their greenhouse gas emissions calculation. Even larger emitters report experiencing difficulty going beyond measuring their Scope 1 and Scope 2 emissions into Scope 3 emissions, which includes supply chain and downstream emissions.



## Developing Net Zero Roadmaps

Once a baseline of greenhouse gas emissions has been established then there is a need for companies to set out how they will shift to Net Zero. This process will help identify the challenges in achieving Net Zero. Stakeholders report a lack of skills to develop Net Zero Roadmaps within some companies. Again, this can include larger emitters where consideration is given to how to support the supply chain to shift to Net Zero. In addition to developing skills in this area, stakeholders have also highlighted the potential to provide a shared resource to help companies through this process. It should be noted that the Carbon Trust has recently launched a [Route to Net Zero Standard](#). This is a three tiered system that enables organisations to be badged as either 'taking action', 'advancing' or 'leading', with progression between tiers built into the standard.



## Articulating Net Zero challenges

As previously noted, the process of establishing a Net Zero Roadmap will highlight some of the challenges in achieving this objective. Stakeholders have identified that there is a support need in articulating Net Zero challenges to a detailed level.



## Understand the potential of digital technologies in addressing Net Zero challenges

Once a company's Net Zero challenges have been identified then it is possible that a subset of these challenges may have the potential to be addressed using digital solutions. Several company stakeholders (large and smaller companies) stated that they needed support in identifying what digital technologies are capable of doing: the 'art of the possible'.



## Support to identify digital solutions already on the market

Several company stakeholders highlighted a preference to adopt digital technology solutions that have already been developed and are commercially available on the market. This is due to the risk involved in deploying newly developed solutions, particularly where this involves application to critical processes within the business. The support sought here, therefore, is to help identify existing digital solutions to address Net Zero challenges.





# Pilot Development and Demonstration



## Identifying a lead organisation to develop and operate digital ClimateTech solutions

Several stakeholders highlighted that support was required from a lead organisation to enable some specific Net Zero challenges to be addressed. For example, the development of a digital solution to enable a Scotland wide Mobility as a Service application needs a single organisation to lead on both the development and operation. This is due to the large number of, sometimes competing, companies that would need to collaborate to enable such a solution.



## Identify potential digital technology solutions providers

Several company stakeholders identified that they would need support to identify which digital technology developers to engage with about developing a solution to their Net Zero challenge. This could include working with existing digital technology developers, start-ups and academia.



## Establishing the feasibility of potential innovation projects

Several company stakeholders highlighted the requirement for support for feasibility studies to help further define the scope of challenges and potential innovation projects. This would be helpful in understanding whether high level digital technology ideas offer a reasonable route to a solution for Net Zero challenges and also provide data to support the development of business cases that may be required to justify company investment in an innovation project.



## Access to test and demonstration facilities

Feedback identified a need for additional test and demonstration facilities for digital solutions enabling involvement of domestic electricity consumers in demand side response programmes. The recently announced **Whole Energy Systems Accelerator** (WESA) may address all or part of this need. WESA is an energy innovation test facility, enabling interactions between homes, energy networks, and market and policy frameworks to be tested in real-time and across a range of potential future energy system and market scenarios. It is a partnership between the Energy Systems Catapult's Living Lab and the University of Strathclyde's PNDC with £2.5 million funding from the Scottish Governments' Green Jobs Fund.



## Accessing innovation funding and managing innovation projects

Company stakeholders identified evidence of market failure driven by internal investment rules, such as a short (e.g. 2 year) payback period. These stakeholders highlighted their view that financial support for innovation projects is important to reduce risk and meet internal investment hurdles. Stakeholders also highlighted that it is helpful if funded projects can be of duration that enables collaborative partnerships to be established and provide sufficient time at the demonstration phase.



# Deployment of the Commercial Solution



## Overcoming risk in commercial deployment of new technology solutions

Stakeholders identified that there can be a high degree of perceived risk with new technology solutions, especially in circumstances where they will need to be incorporated into business-critical systems. It is essential to demonstrate the reliability and robustness as much as possible to reduce this risk. Support needs identified in this area include support to develop detailed case studies and quantification of benefits arising from adopting the new solutions.



## Scaling up technology providers to support commercial deployment

Stakeholders identified that a lot of the current support to tackle the gap between pilot demonstrations and commercial deployment focused on improving the commercial skills of the technology providers. It was highlighted that although a number of Accelerator programmes existed (e.g. the NZTC TechX Clean Energy Accelerator) these focused mainly on the start-up phase and there is little available to support the commercial deployment phase. It is this area of support that the Scottish Government's planned Tech-scalers will help to address.



## Incentivising deployment of new solutions by early adopting challenge owners

Another approach identified by some stakeholders focused more on provision of support to the demand side: companies seeking to address the same Net Zero challenge that were not involved in the initial innovation pilot and demonstration project. The form of support suggested here involves subsidising the cost of a new digital solution for a period of time or fixed number of companies that are early-adopters of the solution.