Scottish Enterprise

# Climate Tech
## Mapping the Landscape in Scotland


**A report for Scottish Enterprise by the University of Edinburgh**
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THE UNIVERSITY *of* EDINBURGH
Edinburgh Earth Initiative

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# Executive Summary

Securing a globally competitive position and responding to the global threat of climate change presents a major opportunity for the future of our planet's protection and our people's prosperity.

Growing evidence of the impact of climate change is making climate technologies an increased priority for policymakers, investors, businesses and consumers. Prioritising growth in the climate technology markets is an identified priority in Scottish[1] and UK Government[2] economic and industrial strategies, with the development of climate tech potentially worth $1.5tn and $2tn of capital investment globally[3].

This report was commissioned by Scottish Enterprise to develop greater insights on the size, scale and composition of the climate technologies (herein *climate tech*) sector in Scotland.

## Analysing the Sector

Our research has highlighted key challenges in gathering data on this complex, emerging and fragmented sector. A keystone obstacle is that activity is defined by the problem it is trying to address rather than the products, services or technologies it uses.

We have put forward a:

- **Definition of climate tech.**
- **Taxonomy for sector analysis** which builds from previous industrial classifications, and,
- **Set of principles for inclusion**, or otherwise, of companies in the final dataset.

It is also important to note that:

- In seeking to fully reflect the value of the sector to Scotland, we have **adopted a broader definition for inclusion in the taxonomy**.
- The **absence of reliable data sources** on climate tech has meant that sector analysis has relied heavily on 'soft' research.
- There is a dearth of representation in the start-up, pre-revenue and the earliest stage companies. This is because, by their nature, they are less visible or searchable via traditional research methodologies with a limited employment or income footprint.

## Sector Insights

Sector analysis gives us a high-level statistical insight into the climate tech sector, which would merit further and more detailed investigation to inform decision making:

- The largest number of companies within Scotland's climate tech community are in Renewable Energy, reflecting Scotland's natural assets and previous policy innovation, investment and support for the sector.
- The greatest ratio of turnover to employees is also in Renewable Energy (£1.242m per employee) which suggests this is an efficient, productive and profitable sector.
- The greatest number of employees are in Climate Business Services, highlighting an emerging market with significant employment opportunities in bringing climate technologies, data and skills into both public and private sectors.
- The largest turnover is in grid infrastructure, reflecting the dominance of large utility providers and our current reliance on large-scale national infrastructure.

Our company analysis indicates that the largest sectors are dominated by established companies and service providers. Much of the rest of the sector is still evolving and optimising technologies, scales and applications, developing markets and business models, and working to secure investment.

Enabling technologies in other co-beneficiary sectors, such as digital, will deliver substantial benefits in terms of economic growth and tackling climate change. Further analysis of how exportability and foreign direct investment is, or may in future lead to, enabling multi-sector market growth would significantly enhance our understanding of the climate tech ecosystem's future.

## Climate Tech Investment

Our analysis also gives some key insights into the nature of climate tech investment in Scotland:

- Top investors in the Scottish climate tech ecosystem are predominantly Scottish-based and government backed (Scottish National Investment Bank, Scottish Venture Fund and Scottish Enterprise), alongside some private investors from the rest of UK (BGF Growth Capital and EG Group). The relatively small presence of non-UK private equity and venture capital funders means there is a substantial opportunity to tap into this investor pool in the future.
- Top funding rounds were secured by in food and agriculture (£229m), energy efficiency and storage (£112m) and digital technologies (£67m). This shows the focus of venture capital and private equity funders into new technologies and varies from renewable energy generation which is historically funded through project finance due to its capital intensiveness.
- Grants are weighted towards renewable energy generation and energy efficiency and storage, which constitute approximately 38% of the overall funding achieved in both categories. The largest grant funder is Innovate UK with £214 million.

## Sector Support

Tackling climate change effectively is a systemic problem, and the climate tech community can have greatest impact, optimise opportunities, and maximise benefits through collaborations and partnerships to use technology and innovation for disruption and transformation at system level.

As the Logan Review[4] highlights, we should deploy the international best practice for climate tech by supporting the ecosystem as a national and international market square. In doing so, we would build communities to bring cohesion and connectivity to an extremely diverse group of companies and investors with the common purpose of delivering economic benefit and tackling climate change. Co-creation and co-design of interventions with this multi-sectoral community would lead to:

- Outcome-focussed support and interventions which are designed to connect companies, organisations and other key stakeholders within, and across, sectors.
- Innovative and intersectoral collaborations and partnerships aligning climate tech to the social, economic and environmental opportunities and challenges of climate change.
- Clarity of routes to engagement and, ultimately, impact; accelerating innovation, market access and technology deployment, leading to greater investment and faster sector growth.

Clearer industry landscapes and market signals alongside research and development commitments will give confidence to companies and investors. As climate tech is a rapidly emerging sector and market segment, policymakers and development agencies will play a key role in creating signals and incentives by firmly establishing and embedding climate impact and climate tech as a priority in policy, investment and decision-making.

Successful activation of this approach will clarify and streamline the pathways for emergence and growth of climate tech innovation in Scotland. In turn, this will create education opportunities, environmental transformation and sustainable, long-term economic growth across Scotland whilst building local resilience and meeting Scotland's commitments on our contribution to the global challenge of tackling climate change.

## Conclusions

The insights from this analysis lead to a number of conclusions about the climate tech sector and how best to support its evolution and potential for high-growth. The dominance of larger companies highlights a need to better connect SMEs to established companies and opportunities in order to streamline climate tech development and deployment whilst facilitating market access. Recognising the interconnectivity of these ecosystem components and designing support to facilitate and streamline that engagement will help accelerate both innovation and impact.

Actively and intentionally resourcing the development of a climate tech market square will encourage enhanced confidence, clarity and activity in the sector and its investors. A properly resourced and integrated market square will increase the size, reputation and global connectivity of climate tech investors and companies alike with Scotland as a hub, whilst stimulating the innovation and entrepreneurship needed to maximise economic return and radical innovations.

[1] **Scotland's National Strategy for Economic Transformation** *(Scottish Government, October 2022)*
[2] **The Spring Budget** *(UK Government, March 2023)*
[3] **Innovating to Net Zero: An Executive's Guide to Climate Technologies** *(McKinsey & Co., 2021)*
[4] **Scottish Technology Ecosystem: Review** *(Scottish Government, August 2020)*

# Introduction

This report has been commissioned by Scottish Enterprise to better understand the emerging climate tech sector in Scotland and the current investment landscape supporting it. It maps complementary sector components to help inform how support can be most effectively directed to enable Scotland to realise the opportunities from climate tech growth.

## Global Context

The Intergovernmental Panel on Climate Change's special report (2018) on the impacts of global warming at 1.5°C above pre-industrial levels rapidly accelerated the policy response to climate change. This transformational scientific report has led to the adoption of net-zero targets and commitments from policymakers and industry across the world, creating an increasingly favourable environment for investment in innovation and adoption of climate technology.

With increasingly visible catastrophic impacts and an expanding, compelling evidence base expounding the urgency of action the climate crisis demands, a challenge previously viewed as an optional and costly imposition across sectors is now a major market opportunity for investors, employers and entrepreneurs alike.

Increasing awareness around the world of the impacts of climate change has seen a growing demand for technologies that help us adapt, manage, and mitigate the effects of human activities on the environment. Demand is being driven by increasing consumer awareness and expectation of climate-conscious products and services, as well as international political and business policies on reducing greenhouse gas emissions and making better use of energy and resources.

## Climate Tech in Scotland

Scotland starts from a position of significant and unique strength to benefit from, and capitalise on, the growth of the global climate tech sector. Our springboard is an unparalleled combination of technological expertise, world-leading research institutions, and strong governmental commitments to reducing Scotland's carbon footprint alongside a wealth of natural assets. Developing our understanding of this emerging sector is crucial to fully realising the opportunities it presents in terms of economic growth, employment, entrepreneurship, investment, and climate impact.

Scotland has already led the world in setting national legislative climate targets, and its commitment to addressing climate change is reflected in support for the growth of the climate tech sector. Scottish Enterprise, as the national economic development agency, has a key role in enabling, shaping and designing support and interventions to deliver further sector growth.

## Scotland's Opportunity

As the global demand for climate tech solutions continues to increase, it is essential for Scotland to capitalise on its ability to lead this technology revolution. Putting Scotland on the front foot will enable the greatest possible chance to maximise, and maintain in the long-term, the economic opportunities and global contribution to combating climate change.

In this report for Scottish Enterprise, we will define and analyse Scotland's climate tech sector, use the insights into the current landscape to explore opportunities and challenges in supporting it, and provide recommendations for the Scottish Government to promote and facilitate growth.

## Report Aims

This report seeks to provide Scottish Enterprise with a comprehensive assessment of the climate tech economy in Scotland as it stands today. We have done so by clearly defining sectors, delineated through a taxonomy and broken down by technologies and businesses.

The report also assesses the size and composition of the climate tech industry in Scotland, identifying emerging clusters and outlining the investor landscape actively targeting and supporting climate tech investment in the country.

If we can measure it, we can improve it.

By providing a clear understanding of the climate tech industry in Scotland, this report can help inform Scottish Enterprise's support for the sector. Ultimately, this begins to define Scotland's route to being a global leader in tackling climate change by understanding and capitalising on the global market opportunities this creates.

For the first time in either a Scottish or UK context, this report sets out to:

Define 'climate tech', alongside an appropriate taxonomy to analyse and break down the technologies and businesses within the sector.

Assess the size and composition of the climate tech industry in Scotland, identifying and highlighting any emerging clusters.

Understand the investor landscape that is actively targeting and supporting climate tech investment in Scotland.

Inform Scottish Enterprise, and their key stakeholders, in shaping and designing their support, interventions and influence to further enable sector growth.

# Methodology

This section sets out our approach to deliver a clear, comprehensive and reliable mapping of the climate tech sector in Scotland, and the investment landscape which supports it. It also outlines the challenges in defining and mapping climate tech as a sector, to provide opportunities for improvement in the future which would create greater clarity in monitoring and evaluating activity.

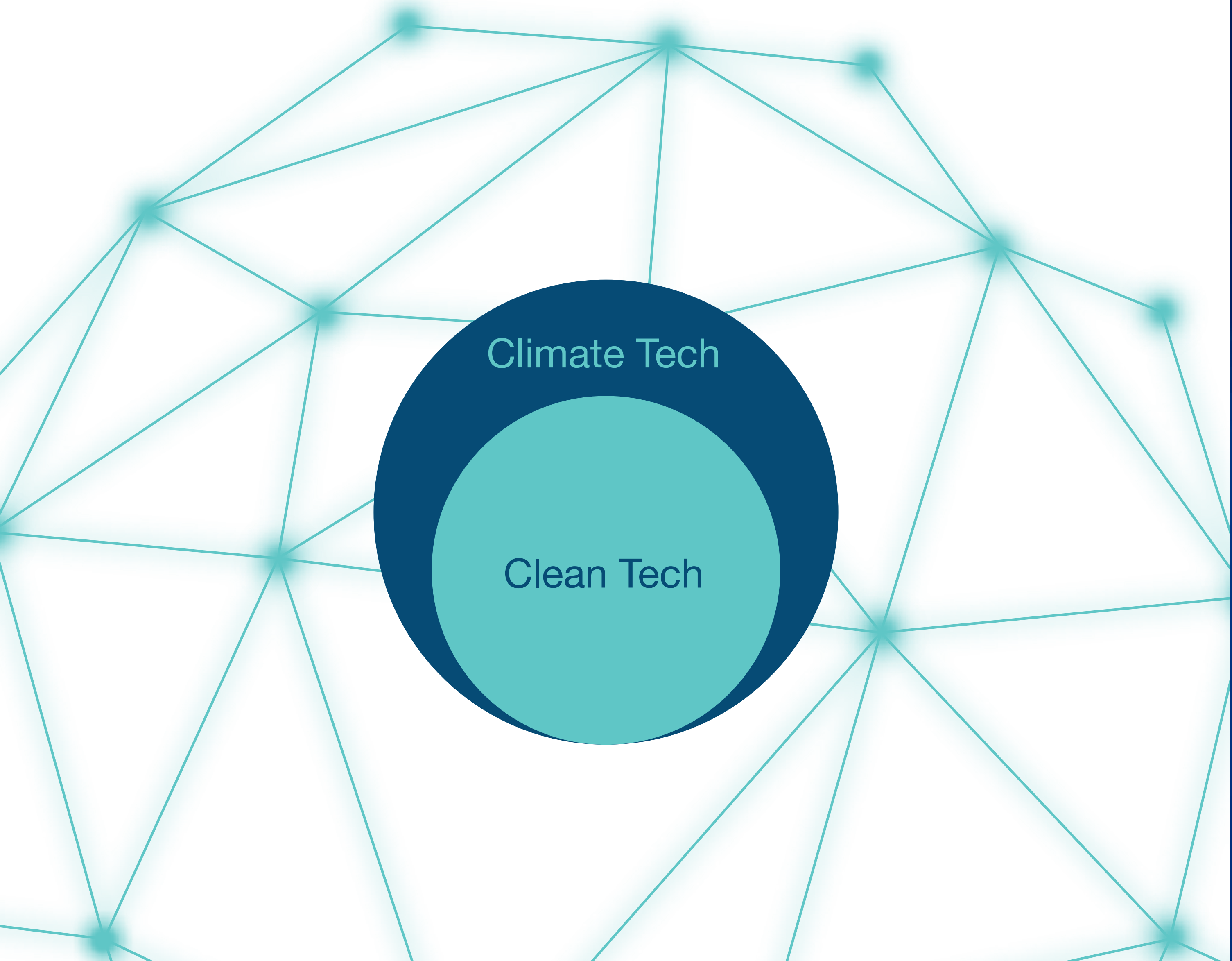
In order to map climate tech companies across Scotland, we must first identify and adopt a clear definition of climate tech; and then build an appropriate taxonomy for sector analysis.

## Definitions

To fully assess Scotland's capabilities in the application of technologies to tackling climate change, it is important to differentiate 'Climate Tech' from the more commonly used and understood definition of 'Clean Tech'. This distinction is set out below:

- **Climate Tech** refers to the application of data, devices and systems to manage, mitigate and/or adapt to climate change.
- **Clean Tech** refers to systems, technologies and devices aimed at harnessing renewable materials and energy sources to dramatically reduce the use of natural resources with a focus on eliminating greenhouse gas emissions and/or waste.

We consider that Climate Tech is a more expansive definition. In practice, this means that all clean tech is likely to be climate tech, but not all climate tech is clean tech.



## Taxonomy

To develop a comprehensive and applicable taxonomy for analysis of existing data sources, we built from established industrial classifications and enhanced this with addition of emerging climate technologies and solutions. Crucially, our taxonomy and the allocation of companies using it focusses first on the application of the technology rather than the technology itself.

The high-level taxonomy is set out in Table 1

**Table 1: Taxonomy of climate tech sectors**

| Level 1 Taxonomy | Technologies including, but not exclusively: |
|---|---|
| **Biofuels and Biochemicals** | Non-fossil fuels, and chemicals derived from natural or waste products and sources. |
| **Digital and Information Technologies** | Hardware, software, applications and data intelligence. |
| **Low Carbon Transport and Infrastructure** | Freight, personal or public transport, on air, land and sea, and low carbon buildings and infrastructure. |
| **Energy Efficiency and Storage** | Low carbon living, electrical components, energy production, batteries, machinery, fuel cells. |
| **Food and Agriculture** | Low carbon food alternatives, biomass, agricultural improvements and efficiencies. |
| **Greenhouse Gas Removals** | Carbon capture and storage, direct air capture, industrial conversion and reuse of GHG emissions. |
| **Grid Electrical Infrastructure and Power Conversion** | Electricity storage and transportation. Grid improvements, smart grids, and off-grid technologies. |
| **Low Carbon Materials** | Less resource intensive production or materials innovation for metals, chemicals, plastics, packaging and printing. |
| **Nature-Based Solutions** | Natural solutions for adaptation and mitigation, including land, coastal and marine sequestration and alleviation. |
| **Other** | Cross sectoral and other technologies and services specific to the climate tech sector. |
| **Climate Business Services** | Consulting, finance, carbon markets and accounting, emissions monitoring. |
| **Renewable Energy Generation** | Hydroelectric, wind, wave, tidal, solar and geothermal, including the operation of wind farms and other renewable energy assets. Also includes hydrogen. |
| **Waste and Recycling** | Waste minimisation and circular resource use, including water filtration, waste recycling, and energy from waste. |

This high-level taxonomy is the primary structure for analysing and presenting data on companies in the climate tech sector in this report.

## Data Collection
Our data collection methodology combined extracted company data from the following established and authoritative databases:

**Fame** (from Bureau van Dijk): private company information for active and inactive companies in the UK and Ireland (as of February 2023).

**i3 Market Intelligence**: a database of companies focussed specifically on sustainable innovation.

**Beauhurst**: a database of UK companies and investment funds giving particular detail on investment and early-stage companies.

This data was enhanced through desk-based research using online directories such as Scottish Renewables, and cross-checked with data and information from further websites, particularly for early-stage companies. This included lists of participants from Scottish-based climate and clean tech accelerators, news articles and awards lists for sustainable businesses. We also integrated two baseline lists provided by Scottish Enterprise to build the most comprehensive data set from these available sources.

## Data Validation and Aggregation
The resulting dataset of potential climate tech companies was then validated for inclusion through online research of, for example, company websites or any other online presence. Where relevant, we have further applied our own knowledge and insights of companies and their activities to enhance the dataset and classify the companies. We have allocated companies to sectors based primarily on the application of their technology rather than the technology used to deliver it.

## Selecting Companies for Inclusion
The lack of an established method for classifying companies within the climate tech sector required us to define a broad set of principles for which companies to consider as part of the climate tech ecosystem, and therefore to include into the climate tech dataset.
In what has proven to be a complex, evolving and hard to define sector, with a distinct lack of reliable, comprehensive and structured data, this has required us to set our own principles for deciding inclusion or non-inclusion of companies, and to apply them on a case-by-case basis. Some of these principles, and examples of their application in practice, were:

- **Inclusion**: We adopted a relatively broad definition for inclusion in the climate tech sector, to reflect the impact and benefits of the sector in stimulating company growth and economic benefit. This meant that we included, for example, added-value resellers, specialist installers, business or consulting services enabled by climate tech or specific to the climate tech sector, and a broader selection of companies involved in sorting waste materials and recycling. We have included companies who have a significant footprint for activity in Scotland, either through operations or company registration.
- **Non-Inclusion**: We applied a principle of the extent to which climate tech was a core component of company operations. This meant that, for example, general environmental consultancies, non-added value resellers, building and property developers, and companies who were involved purely in waste collection and transportation would not be included as climate tech.

In applying these principles to the dataset, often on a case-by-case basis, we were reliant on interpreting available company information such as their websites or other online presence for early-stage companies. In some cases, particularly companies established as legal entities for the deployment of renewables, there may be no dedicated online presence.

Where companies specifically highlighted climate-focussed applications of their products they were included, but we did not include companies focussed on broader optimisation or efficiency gains in, for example, animal health or engineering maintenance, even though these may potentially deliver climate benefits.

Through this process, we have established, categorised and analysed a final dataset of climate tech companies.

## Future Data Collection

This methodology has evolved to reflect the challenges of capturing data from structured sources on companies in an emerging and as yet undefined sector. There were particular challenges in categorising companies which apply more ubiquitous technologies to understanding climate problems, and in capturing early-stage companies. There are also limitations to the granularity of data below the level of public company records.

Some specific challenges to be overcome if Scottish Enterprise were to repeat this analysis, as part of monitoring and supporting the ongoing growth of the sector, include:

- Searching based on Trade Descriptions may lead to omission of companies without accurate descriptive content in the database at the time of searching. This is why we have had to complement the search with additional databases and soft research.
- Results from soft research have had to be matched against databases to aggregate turnover and number of employees, which might be another cause of omissions. Some companies were trading as different names from those appearing on the database, and the matching algorithms might not work accurately in all cases.
- Participation in Scottish accelerators was one of our data sources, but these accelerators have been made open to companies outside Scotland, so further validation was required.
- Although we have carried out soft research on data sources known to us, there may be others as yet unidentified, particularly on early-stage companies. This could be mitigated through wider engagement within the sector to validate findings and gather intelligence.
- The nature of the data is that it focuses on companies registered and headquartered in Scotland. In any economy the company base will always include offices or subsidiaries of companies registered or headquartered elsewhere. There will also be instances where we have included a Scottish registered subsidiary of a larger group.
- Some duplicated subsidiary and group level companies in Scotland have been included to retain employee and turnover figures for all actively trading companies.
- Where climate tech is only part of a company's business, the limitations on company data prevent the attribution of specific turnover and employment figures for the climate tech component.
- A number of companies are formed as a stand-alone entity for development, investment and operation of wind farms or other deployment of renewables, by either a larger group or a local developer. These are part of the ecosystem but may not have employees or turnover attributed to them.

These are issues for Scottish Enterprise and its partners to consider in maintaining a future dataset and monitoring growth in the climate tech sector.

# Sector Analysis

Our analysis has focussed on companies registered and headquartered in Scotland. Using the taxonomy outlined, companies identified and classified as climate tech were broken down into a number of sectors using our chosen taxonomy, and available company information was aggregated to give the overall size of each sector, indicated by the number of companies, the total turnover and the employee numbers in 2021.

**Table 2: Summary statistics for climate tech companies in Scotland**

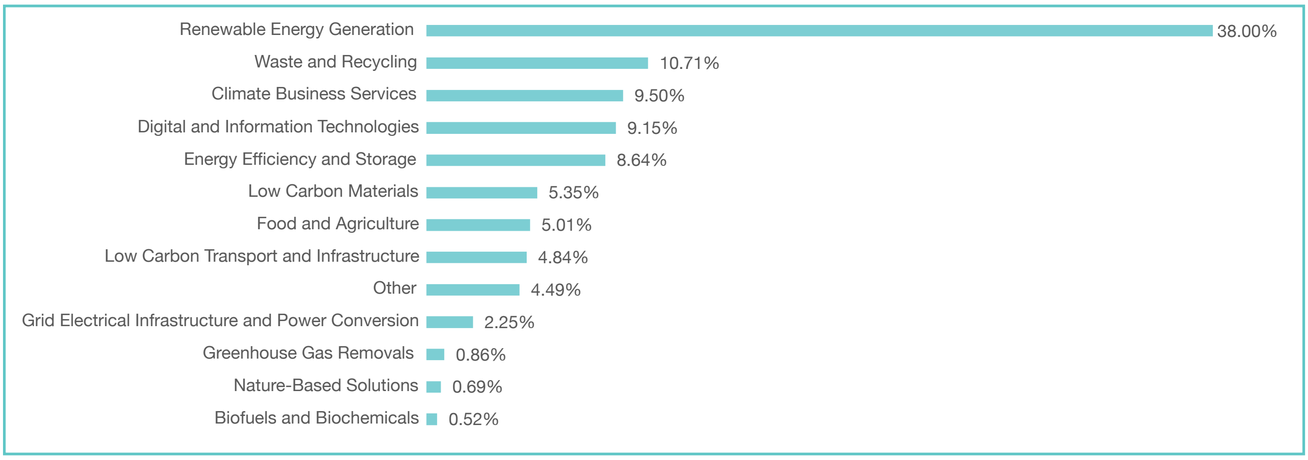
| Sector | Companies | Employees (2021) | Turnover (£M, 2021) |
|---|---|---|---|
| **Biofuels and Biochemicals** | 3 | 81 | £52.05M |
| **Climate Business Services** | 55 | 8831 | £1,431.00M |
| **Digital and Information Technologies** | 53 | 779 | £39.14M |
| **Energy Efficiency and Storage** | 50 | 4085 | £921.09M |
| **Food and Agriculture** | 29 | 439 | £61.29M |
| **Greenhouse Gas Removals** | 5 | 8 | £0 |
| **Grid Electrical Infrastructure and Power Conversion** | 13 | 7058 | £6,266.09M |
| **Low Carbon Materials** | 31 | 717 | £290.12M |
| **Low Carbon Transport and Infrastructure** | 28 | 879 | £120.10M |
| **Nature-Based Solutions** | 4 | 34 | £3.03M |
| **Other** | 26 | 394 | £38.23M |
| **Renewable Energy Generation** | 220 | 4177 | £5,189.22M |
| **Waste and Recycling** | 62 | 4132 | £834.50M |
| **TOTAL** | **579** | **31614** | **£15,245.86M** |

# Sector Profile

## Companies

In terms of the number of companies, renewable energy generation is the largest area within the climate tech sector, reflecting Scotland's significant natural resources for renewable energy, including wind, wave, and tidal power. The sector includes 220 companies, accounting for 38% of all companies currently identified within the climate tech sector. This reflects Scotland's strong commitment to renewable energy and the growing number of companies operating in this area. It also reflects a large number of companies being set up for operating particular renewable assets, such as wind and solar farms.

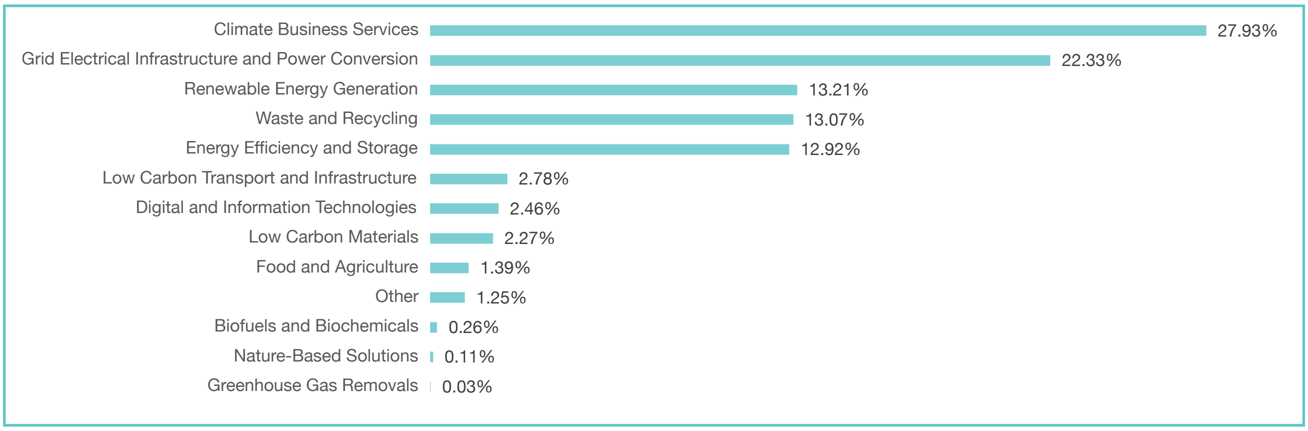
**Figure 1: % of overall climate tech companies by sector**




## Employment

When looking at employment, climate business services is a key area which employs a large proportion of the people in climate tech. The sector currently employs 8831 staff, accounting for 27.93% of the climate tech workforce. This suggests that there may be a substantial emerging sector using climate tech, and in particular climate data, in response the evolving business priorities and emerging market opportunities presented by the drive towards a zero carbon economy.

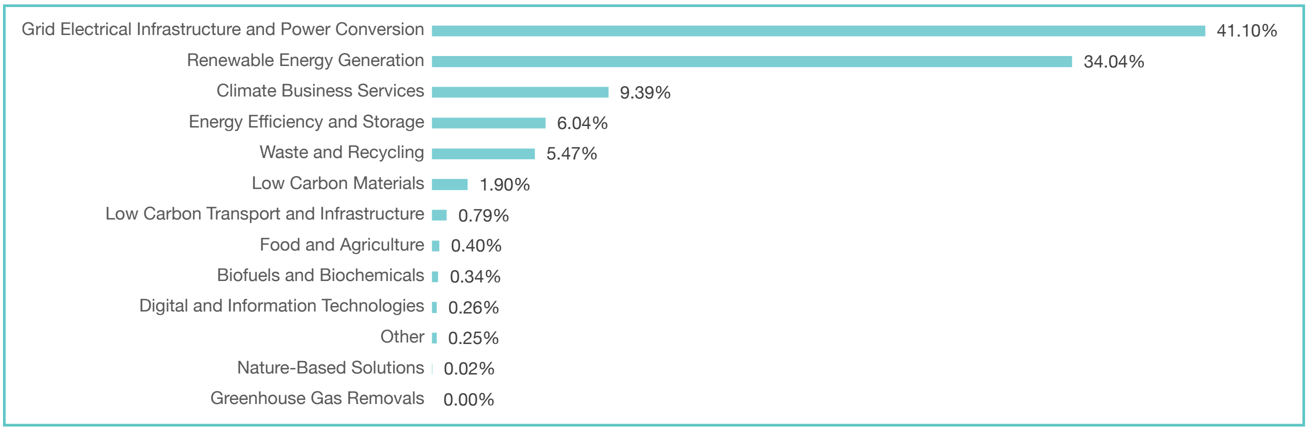
**Figure 2: % of overall climate tech employees by sector**



## Turnover

The electricity infrastructure sector is significant in Scotland, as the country has been investing heavily in grid infrastructure to support the growth of renewable energy. The sector includes 13 companies in Scotland, with a combined turnover of nearly £6.3 billion, and accounting for 41.1% of total turnover of companies in the climate tech sector. This highlights the importance of the electricity infrastructure sector in supporting the growth of renewable energy in Scotland.

**Figure 3: % of overall climate tech turnover by sector**




## Interpreting the Data

It is worth noting that the sectors with the highest turnover or number of employees may not necessarily be the fastest-growing sectors in the climate tech sector in Scotland. Other sectors, such as digital and information technologies, energy efficiency and storage, and nature-based solutions, may grow rapidly and have significant potential for future growth and development. Enabling technologies such as digital also underpin many other sectors, with the growing data sector deepening our understanding of climate challenges at multiple levels and helping to optimise the development and deployment of climate tech solutions across all sectors.

It should also be noted that while the available data provides evidence that there are many companies who could be described as climate tech, there are likely to be many more who are applying existing technologies to climate challenges. Across all climate tech sectors further analysis is needed to better understand which companies and clusters are emerging as genuine climate tech, which are value added services designing and deploying climate tech systems, and which may be more ubiquitous services which are offering or reselling more climate friendly solutions as part of a market response. We should also note that information on enabling technologies such as digital may be captured within the sectors where their technology is applied rather than as a stand-alone sector.

Finally, it is important to acknowledge that the nature of the sector and the distribution of climate tech into other industries means that it may require more granular and longitudinal analysis to firmly define which companies or divisions are predominantly climate tech, and within the sector which are jobs specifically attributable to climate tech.

# Sector Insights

This section sets out to provide insights into the sectors within climate tech, combining findings from our data analysis with knowledge of past, current and likely future trends which present opportunities or may affect sector growth. These are set out by sector in the table below.

## Sector Trends

| | | |
|---|---|---|
| **Biofuels and Biochemicals** | **Companies:** **3**<br>**Employees:** **81**<br>**Turnover:** **£52 Million** | Our analysis shows limited market penetration in this sector in Scotland, perhaps because of some of the challenges associated with supply chains and land use for biofuels and biochemicals. Depending on the source of materials and practices associated with obtaining them, this may be regarded as a bridging solution to more long-term sustainable solutions such as renewable energy, supporting our transition away from fossil fuel dependency while other technologies scale and mature.<br><br>The sector is likely to see more focus with the recent announcement of a Green Freeport in the Firth of Forth, with the inclusion of Grangemouth. Part of the successful bid was to support a 'just' transition for areas which have been economically dependent on fossil fuel industries and are most likely to be impacted by the transition to a zero carbon economy. The potential to transfer skills and assets into lower carbon industries may present opportunities in this sector. |
| **Climate Business Services** | **Companies:** **56**<br>**Employees:** **8,831**<br>**Turnover:** **£1.4 Billion** | Distinguishing climate tech companies from those delivering services which may utilise some climate tech makes this a harder sector to categorise and analyse. What is clear is an emerging and growing market of professional services, in response to both customer demand and market opportunities, as businesses, consumers and policymakers look for skills, knowledge and insight to support climate commitments.<br><br>Our analysis shows this to be the largest sector in climate tech by employee numbers, suggesting that alongside its important role in providing the tools, knowledge and insights to support decarbonisation across other sectors it also presents significant economic opportunities from its own growth. Both of these can perhaps be best enabled by facilitating better connectivity between these services and the wider climate tech community, and by using them as a bridge between climate tech and the wider business community to support decarbonisation in other sectors. |

## Digital and Information Technologies

**Companies:** 52

**Employees:** 779

**Turnover:** £39 Million

The application of digital and data capability to managing and monitoring climate variables, and to embed climate impact into decision making, clearly aligns to Scotland's strengths but has proven one of the more difficult areas to capture. With relatively low barriers to entry there is an emerging and often fragmented market around data and climate which needs to consolidate, and in which both public and private sectors are trying to identify the most accurate and comprehensive solutions with viable revenue-based business models. This is reflected in a relatively low turnover figure for the number of companies and employees represented, of only c.£50K per employee.

We also know that digital, and in particular data, technologies are enablers which underpin the development, deployment and performance of other technologies and contribute to the growth of other sectors. Digital and information technologies are as embedded in climate tech as they are in other sections of the economy, and will continue to support those through enhanced data intelligence and design.

We can expect this to be an area in which services will evolve as the market develops and consolidates. For example, we know that carbon calculations have a lot of underlying assumptions and a large degree of variance, and that the standards, availability and application of data need to improve. This presents both opportunities and challenges for this sector as it develops, with the market likely to ask for more sophisticated data driven intelligence, on a wider range of outcomes and indicators, drawing from more sophisticated and innovative data sources.

This growth seems more likely to come from companies applying established data and digital capabilities to climate problems than from the development of new climate tech, so may be best supported by building capability, capacity and knowledge in Scotland's digital sector to develop climate solutions.

## Energy Efficiency and Storage

**Companies:** 50

**Employees:** 4,085

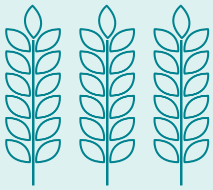
**Turnover:** £61 Million

This is a highly varied sector covering technologies ranging from low carbon buildings to the development of energy storage capability on different scales.

Reducing energy demand by designing and building for energy efficiency in new or refurbished buildings is the first principle in reducing energy use in the built environment. A fabric first approach will reduce energy demand and therefore overall energy use and resource requirements. Growth in this area can be expected as consumer demand and expectations continue to rise. This may not all lead directly to growth in the climate tech sector where installation of climate tech to the built environment may be service provision or reselling, rather than the development of new climate tech or value-added solutions.

Energy efficient machinery and batteries are also a critical component of the low carbon transition, and are needed at scales which will suit multiple industrial and consumer applications. The opportunities are for Scotland to develop its own manufacturing capability, delivering economic benefits and developing solutions which will work effectively in Scotland to support our transition to a decarbonised economy.

## Food and Agriculture



**Companies:** 29

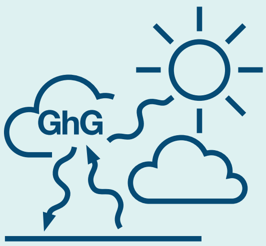
**Employees:** 439

**Turnover:** £61 Million

The climate impact of agriculture and food production is widely publicised and is already leading to significant shifts in consumer expectations and demand. The sectors themselves can and are responding in terms of means and methods of production, but some of these changes are proving difficult to implement in parts of the sector where capacity and margins for innovation and investment are limited, and which require changes to long-established practices driven by both traditions and market pressures. There remain significant both global and local opportunities for scalable and innovative technologies and approaches to improving the efficiency of agriculture and food production, and to reducing its climate impact.

Our analysis shows a growing sector in Scotland, with a particular focus on agricultural efficiency by improving yields and feedstocks, and on using natural by-products for biomass. Where there is more need and opportunity for innovation is in bringing innovation into farming and land use practices, so that these support wider sustainability indicators and outcomes such as biodiversity, as well as promoting long term carbon sequestration in soil and land use. These are areas in which we can anticipate growth to be enabled by both policy and market factors, and which would benefit from more clarity on policy and support mechanisms for the agricultural sector in particular.

## Greenhouse Gas Removals




**Companies:** 6

**Employees:** 8

**Turnover:** £

Our analysis has identified no records for revenue generating companies in this sector, reflecting that this is still an area largely at the research stage which is still proving technology viability and understanding the optimal application and scale of deployment.

Carbon Capture and Storage (CCS), in particular, is essential to net zero targets and industry decarbonisation; and presents clear economic opportunities in both transition and innovation, capitalising on natural assets, physical infrastructure and established sector expertise. However, there is currently no operating $CO_2$ transport and storage infrastructure in Scotland. The Scottish Cluster is awaiting a UK Government announcement on Track 2 of its CCUS Cluster Sequencing, which it is anticipated will provide support and give certainty to project developers and investors, leading to operational activity by around 2030.

Bioenergy with CCS (BECCS) is another area where Scotland has significant potential across renewable electricity production, from facilities processing biogenic waste or feedstocks, working alongside established industries such as waste and water treatment or distilling. This is a sector where there are significant opportunities to support the growing market for decarbonisation and resource efficiency across other sectors.

## Grid Electricity Infrastructure and Power Transmission

**Companies:** 13

**Employees:** 7,058

**Turnover:** £6.3 Billion

Better management of energy is a critical component of energy decarbonisation and efficiency, particularly in helping to spread and balance capacity requirements and allowing smarter and more flexible use of existing generating capacity. The ability to respond to changes in both supply and demand are critical to the wider adoption of renewable energy sources, which by their nature are variable and not continuous.

Better and more flexible infrastructure allows easier switching between energy sources and balancing of demand, and reduces our residual dependency on fossil fuels for energy security and capacity. Effective and efficient technologies for energy storage on multiple scales are also critical to a full transition to renewable energy sources. The ability to store energy at varied scales and for deployment to different applications, using a range of different energy assets and principles, is an area where a number of innovative approaches are being developed.

Our analysis shows a relatively small number of companies in Scotland, in a category that can be expected to grow for both global and local application. It should be supported alongside and integrated with other innovative technologies and models for energy management.

Our analysis also suggests that this is a huge area of climate tech, but one in which Scotland is yet to foster and develop opportunities for innovation from the SME sector. In particular this may be around the development of grid infrastructure at different scales, for local deployment which may not be dependent on national infrastructure.

## Low Carbon Materials

**Companies:** 31

**Employees:** 717

**Turnover:** £290 Million

Our analysis shows this to be one of the more established sectors, which has benefited from an increasing recognition of both the environmental and business opportunities arising from less resource intensive production and processing of materials. Compliance, regulatory and cost drivers have been further supplemented by consumer and supply chain demand, particularly in areas like plastics and packaging, and these trends seem set to continue. Innovation in materials needs to be complemented by innovation in business models, which supports the return, recycling, repair or reuse of products and materials across the full range of goods and services in our economy.

These trends can be expected to present further opportunities as we continue the transition to a low carbon and circular economy. Support for this sector is better understood and designed alongside other enabling industries, for example waste management or other industries which can provide a source of materials and resources from their own by-products or processes.

## Low Carbon Transport and Infrastructure

**Companies:** 28

**Employees:** 879

**Turnover:** £120 Million

This small group of companies includes some substantial infrastructure companies alongside companies at the early stage of planning provision for future transport requirements, anticipating a widespread transition to electrical vehicles alongside the potential deployment of hydrogen into passenger and goods transportation. It also includes some vehicle manufacturing.

The companies are diverse in scale and maturity, reflecting some current uncertainties around the speed of transition to low carbon transportation, the current costs and concerns over energy supply and infrastructure, future levels of vehicle ownership and dependency, and the application and use of different technologies for different transport requirements. There is also a natural cycle for vehicle replacements in both business and consumer markets, which may be currently extended because of cost pressures, and also because of awareness of the resource implications and embodied carbon created in producing any new vehicle.

This is an area which would benefit from clearer policy commitments and timelines, and their implementation, which would accelerate the widespread transition to low carbon transportation and build confidence to stimulate innovation and investment.

## Nature-Based Solutions

**Companies:** 4

**Employees:** 34

**Turnover:** £3 Million

This is an emerging growth area, with innovation being demonstrated in both solutions and technologies, and in business models and investment propositions, as demonstrated by companies like Highland Rewilding. With nature-based solutions being based on tried and tested 'technologies' in that it deploys natural resources and processes, it seems likely that business model innovation will be the most important component in supporting and enabling the growth of this market.

This is an area which can be expected to grow as carbon offsets become an essential component of many net zero commitments and the market for offsets matures. This will push up land values and drive the need for more quality and validation of offset quality, with an increasing focus on biodiversity as well as sequestration. Another growth factor will be the increasing recognition of the impacts we are already seeing from climate change and the development and deployment of climate adaptation measures in response.

With the potential for this sector to deliver wider sustainability benefits beyond just climate mitigation, this is a critical sector in tackling other components of the global climate crisis and protecting Scotland's natural environment. Both the sustainability and local economy benefits and impacts of this growing sector can be shaped by the policies, regulations and governance which it operates and applies, so it will be important to design these appropriately to deliver those benefits and outcomes.

## Other Sector Services

**Companies:**
**26**

**Employees:**
**394**

**Turnover:**
**£38**
**Million**

This covers a broad range of services supporting other parts of the climate tech sector, in particular around servicing and maintenance, combined with some collection, distribution, wholesale and retailing of climate tech products and materials. These services can be expected to grow and become more specialised as the wider climate tech sector develops.

## Renewable Energy Generation

**Companies:**
**220**

**Employees:**
**4,177**

**Turnover:**
**£5.2**
**Billion**

Our analysis tells us that the most significant proportion of identifiable Climate Tech companies in Scotland are involved in renewables, as we would expect given Scotland's natural resources. The sector has already benefited from significant policy and market led investment and has been largely responsible for the >40% reduction in Scotland's emissions we have seen since 2000. It makes up over a third of Climate Tech companies in Scotland.

The prevalent technology by far is wind generation, particularly offshore, reflecting a more mature market with established planning and deployment pathways and proven business models which give confidence to developers and investors.

There are still significant opportunities and emerging growth in other forms of renewable generation, using alternative sources such as wave and tidal power, or deploying to different scales and locations. Renewables can deploy a mixture of technologies to add to generation capacity, capability and flexibility both on and off-grid, by utilising locally available renewable assets. What will need further analysis is to understand how many of these companies have the potential to scale as global leaders, and how many are more aligned to building a decarbonised and resilient economy through deployment of renewable energy assets for local, national and export supply in different parts of Scotland.

This sector also includes hydrogen, an area of climate tech which is still in the early stage of deployment with uncertainties around the optimum applications and scale, but it is seen as a critical growth sector by the Scottish Government in terms of both decarbonisation of local energy supply and export potential.

Scotland performs relatively well in terms of renewables, reflected in the current size of the sector. What we are perhaps not seeing is the diverse range of technologies providing innovation in scale and source, utilising local assets to support wealth building and energy resilience, and creating more opportunities for global market development.

## Waste and Recycling

**Companies:**
**62**

**Employees:**
**4,132**

**Turnover:**
**£835**
**Million**

This sector has the largest number of employees by analysis, reflecting its importance in terms of waste minimisation and resource use, and also the reliance on manual processes for sorting, treatment and collection which present opportunities for future efficiencies and innovation.

Better and more efficient use of resources and materials are crucial in driving down the climate impact of goods production and disposal of waste materials. This will reduce the energy used in handling and processing goods and materials throughout their lifecycle, and support Scotland's aims to be a more circular economy.

Our analysis shows this to be a more mature sector, which over several decades has developed in a more regulated policy and compliance landscape, supporting an established and growing market for recycled materials. These have continually evolved in response to additional legislative and policy directives.

Companies in this category include a number of larger public contractors alongside some of the arms-length companies established by local authorities for waste management services. This suggests there is still scope for integration and innovation by better connecting SMEs in this sector. Growth opportunities and support may be best understood and designed alongside that for low carbon materials, which has circularity at its core and often seeks to reuse or repurpose natural or waste materials for which it needs a reliable source of supply.

# Climate Tech Clusters

Our research showed some limited development of hubs and clusters for climate tech activity. Physical or virtual hubs for start-up activity have focussed around the dedicated Clean Tech and Net Zero Accelerators, notably the Net Zero Technology Centre in Aberdeen, the Michelin Scotland Innovation Parc in Dundee, and previously the Climate-KIC Accelerator programme in what is now the Edinburgh Climate Change Institute.

It is worth noting that during the global pandemic, these programmes opened themselves up to global participation, perhaps inflating the impression of early-stage climate tech activities and companies based in Scotland. Further virtual hubs have been supported by industry bodies such as Scottish Renewables, and by innovation centres such as the Arrol-Gibb Innovation Campus and the Built Environment – Smarter Transformation, who have developed a strategic focus on sustainable manufacturing and construction respectively.

Clusters are emerging, or likely to emerge, to capitalise on existing capability, skills and assets in key areas around Scotland. These include areas which are heavily dependent on fossil fuel industries such as Aberdeen and Grangemouth, but also areas where natural assets and industry concentrations lend themselves to climate tech, for example the development of wave and tidal energy around the islands and the eastern coastline, and the use of depleted oil fields for carbon capture and storage, or the proximity to concentrations of distilleries for new or existing industries using by-products from the whisky industry.

Stimulating targeted cluster development can support and focus the development of the climate tech industry, and of sectors within it. In policy terms, this may seamlessly reside within a specialised version of the Scottish Government's TechScaler programme. Identifying opportunities to collaborate and collocate for the implementation and adoption of emerging climate tech can shorten the time for market development and fast track the deployment of new technologies while facilitating growth in the climate tech sector. In particular, collaborations with large infrastructure, service or utility providers can support product development and give confidence to investors.

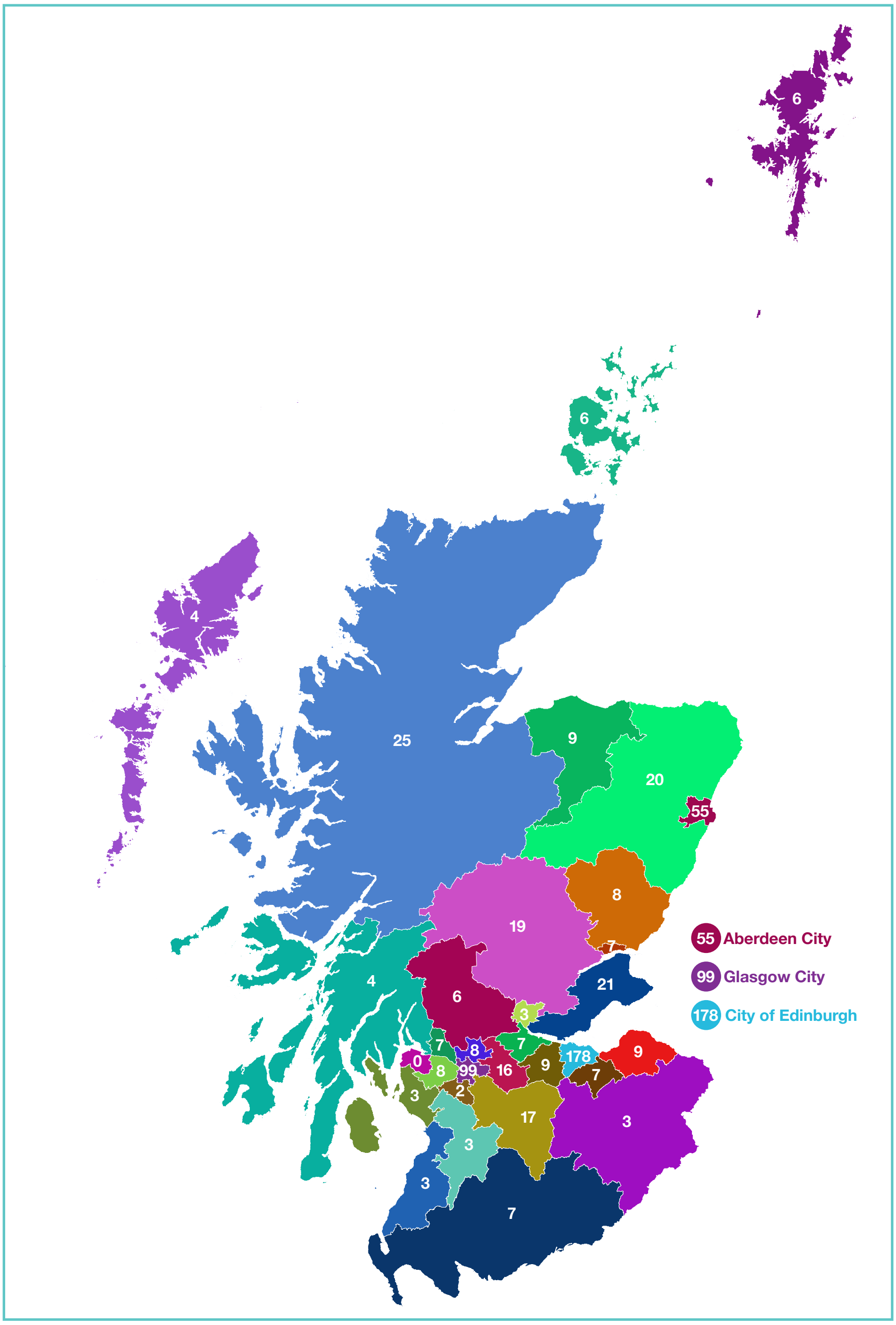
## Distribution of Climate Tech Companies

### Regional Distribution

The map on the following page shows the distribution of climate tech companies across Scotland, grouped into local authority areas. This reflects both the concentration of clusters as above and also the proximity to natural assets for renewable energy generation. This can be expected to be distributed across Scotland as more localised solutions are developed and adopted for energy resilience and community benefit.

What this distribution shows us is that Scotland is making progress towards its goal of becoming a climate tech centre of excellence, with a significant number of climate tech companies located across the country. However, there are significant regional disparities in the distribution across the country, with Edinburgh and Glasgow having the highest percentages of 30.74% and 17.10%, respectively, and Inverclyde having 0% of climate tech companies. Aberdeen is home to 9.5% of the companies making it an emerging hub, this is largely driven by energy transition growth. The proximity to natural resources and niche areas of expertise can influence the distribution in different council areas. This suggests that support may need to be designed to bring companies closer to natural assets in order to realise the benefits of climate tech more evenly across Scotland.

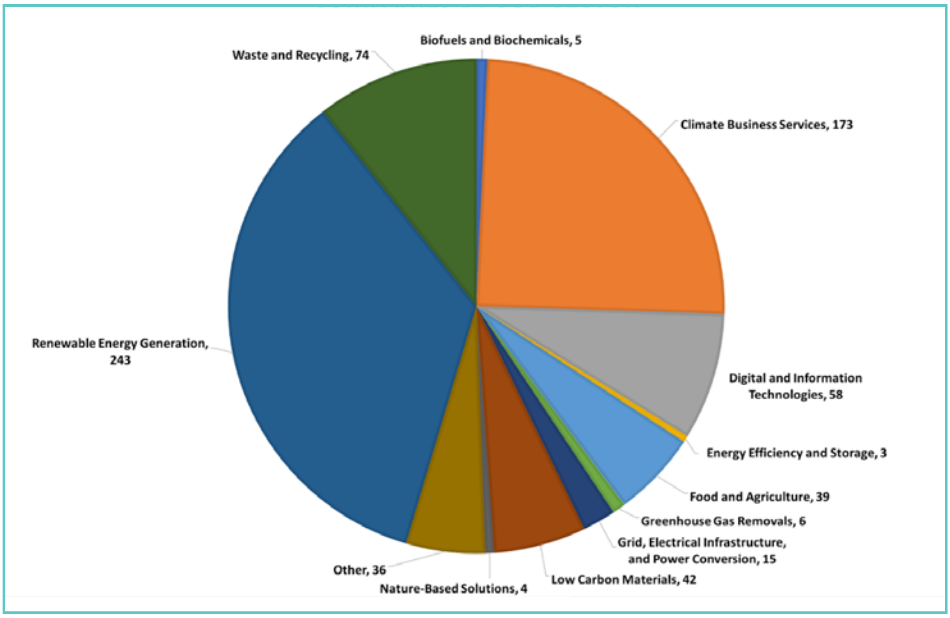
Figure 4: Climate tech company distribution across Scotland by local authority area



## Sectoral Distribution

The graphs below show the breakdown of companies within climate tech into the sectors we have outlined. These highlight the dominance of renewables in terms of companies, and the relatively small growth of some sectors to date. This further highlights the need for balanced and targeted support to deliver growth in different climate tech sectors, to both realise the economic potential and because they are all a critical component of decarbonising our economy, achieving energy resilience, and delivering our national commitments on climate change.

**Figure 5: Breakdown of climate tech companies by sector**



# Climate Tech Investment

The data available allows us to break down and analyse investment in climate tech into grants and fundraising, and also to track activities such as whether companies have previously participated in an Accelerator programme to help them prepare for investment and growth. The following summary statistics explore the share of each sector in terms of amount of fundraising and grants, and the number of investors as well as the growth of climate tech investment from 2005 to March 2023.

This data is derived from a database which presents information on sources and value of investment going into companies. It should be noted that where the company operates across multiple sectors including climate tech, or with a potentially relevant climate tech application, it is not always possible to analyse which grants or investments are specific to climate tech within those companies.

It is possible that state-backed investment activity may have spiked as a response the COVID-19 Pandemic and may skew some current figures. Further analysis would disaggregate this with more granular data to understand what lay behind funding decisions and activity.

## Investors

Analysis of available datasets indicates a mixture of public and private investment, reflecting the nature of the start-up landscape in Scotland. 130 companies included in the dataset successfully secured fundraising, and 170 companies received at least one grant. The majority of these funds are angels and private investors, but the landscape also includes publicly supported seed funds from, for example, Scottish National Investment Bank (SNIB), Scottish Enterprise and Highlands and Island Enterprise, alongside investments from universities and colleges in their own spin outs.

## Fundraising

Data in the following tables provides analysis of the volume and breakdown of investment deals into climate tech companies from 2005 to March 2023.

Table 3 on the following page shows that the Food and Agriculture sector received the most funds, accounting for nearly 30% of total fundraising secured by all the companies. It should be noted that this figure reflects overall investment into these companies rather than being specific to the development climate tech.

It also shows, for example, only 3 deals and 4 investors investing in the 7 companies in the Greenhouse Gas Removals sector. With the UK Government recently announcing a £20bn commitment to the sector over the next two decades, this gives a strong indicator that current levels of investment are not commensurate with the scale of the climate change mitigation benefits of GHG removal technology, and the decarbonisation and economic growth opportunities from different scales and types of deployment. This imbalance suggests a need for interventions that facilitate and enable investment into companies innovating in this space, as well as investment in development activity to aid acceleration of the immature market sector.

**Table 3: Fundraising deals, amount raised, and number of investors by sector**

| Sector | Number of deals | Amount raised (GBP) | Number of investors |
|---|---|---|---|
| **Biofuels and Biochemicals** | 13 | 32,192,587 | 12 |
| **Climate Business Services** | 64 | 55,312,710 | 79 |
| **Digital and Information Technologies** | 104 | 67,668,351 | 99 |
| **Energy Efficiency and Storage** | 69 | 112,386,679 | 120 |
| **Food and Agriculture** | 73 | 229,452,016 | 120 |
| **Greenhouse Gas Removals** | 3 | 335,000 | 4 |
| **Grid Electrical Infrastructure and Power Conversion** | 28 | 24,653,765 | 49 |
| **Low Carbon Materials** | 41 | 24,631,399 | 64 |
| **Low Carbon Transport and Infrastructure** | 30 | 54,700,787 | 32 |
| **Nature-Based Solutions** | 1 | 7,500,000 | 1 |
| **Other** | 15 | 58,419,675 | 11 |
| **Renewable Energy Generation** | 51 | 56,197,148 | 40 |
| **Waste and Recycling** | 19 | 13,771,724 | 12 |
| **Grand Total** | **511** | **737,221,839** | **643** |

Table 4 shows the amount of fundraising by stages of a company at the time of the deal. Stages of evolution are explained in **Appendix 5**. While there are more grants awarded in the seed stage than in the venture stage receiving funds (218 vs. 191), the amount of fundraising secured by venture companies is approximately three times that secured by seed companies. This is understandable in that venture stage companies are expected to earn revenues from their products or services; hence, they require more investments to achieve that milestone.

**Table 4: Deals and number of investors by stage of evolution at deal date**

| Stage of evolution at deal date | Number of deals | Amount raised (GBP) | Number of investors |
|---|---|---|---|
| **Seed** | 218 | 133,073,008 | 209 |
| **Venture** | 191 | 361,307,602 | 312 |
| **Growth** | 81 | 177,207,628 | 105 |
| **Established** | 21 | 65,633,602 | 17 |
| **Grand Total** | **511** | **737,221,839** | **643** |

Figure 6: Funds raised (in £M) by climate tech companies from 2005 to March 2023

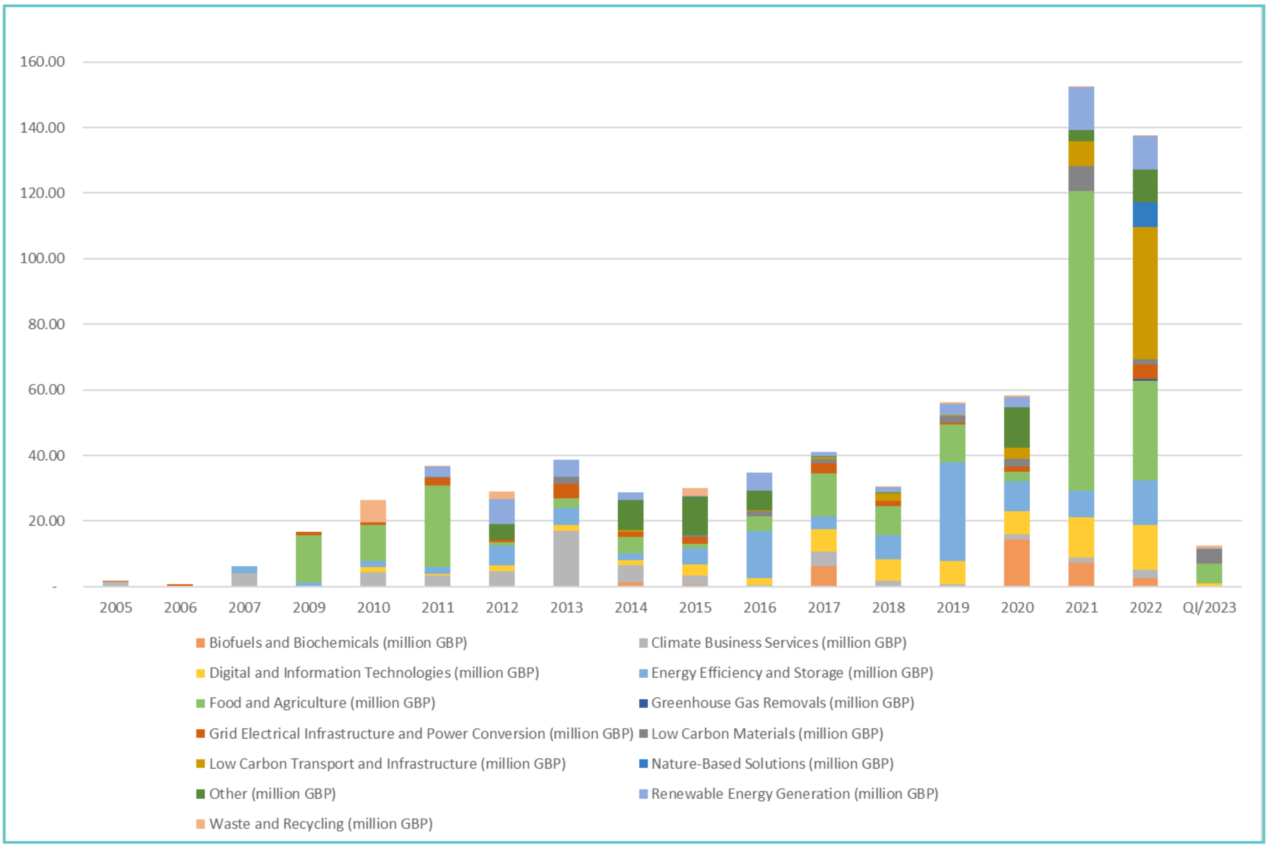



Figure 7 highlights material upward momentum for investments into climate tech companies from 2018 onward, reflecting the emerging market and investment appetite for climate tech in response to global trends. Fundraising by companies in our list reached £152 million in 2021, which is an increase on the pre-pandemic level of investment of over 150%.

Table 5: Funders by geographic regions (2005- March 2023)

| Country/ Region | Amount invested (GBP) |
|---|---|
| **Scotland** | 139,794,782 |
| **Rest of UK** | 121,917,749 |
| **Europe** | 15,551,993 |
| **United States** | 1,819,971 |
| **Rest of World** | 3,449,993 |
| **Undisclosed/ Business Angels** | 16,022,320 |

Table 5 demonstrates the geographic distribution of funders based on their head office countries. Scottish funders lead the table as the highest investor in Scottish climate tech companies, followed by investors from the remaining regions of the United Kingdom. What this shows is relatively limited penetration of non-UK investors into the Scottish climate tech ecosystem, and therefore both an opportunity to increase that connectivity and also the importance of ensuring that Scottish and UK investors are aware of, focussed on, and well connected into the climate tech sector in Scotland.

**Table 6: Top 20 funders by value of deals (2005-March 2023)**

| Fund name | Country/ Region | Fund type | Amount invested (GBP) |
|---|---|---|---|
| **Scottish National Investment Bank (SNIB)** | Scotland | Devolved Government | 45,900,000 |
| **BGF Growth Capital** | Rest of UK | Private Equity and Venture Capital | 33,700,000 |
| **EG Group** | Rest of UK | Corporate | 25,000,000 |
| **Scottish Venture Fund** | Scotland | Devolved Government | 16,557,271 |
| **Scottish Enterprise** | Scotland | Devolved Government | 13,904,136 |
| **Albion Capital** | Rest of UK | Private Equity and Venture Capital | 12,400,000 |
| **ABB Technology Ventures (ATV)** | Europe | Corporate | 11,000,000 |
| **Archangels** | Scotland | Angel Network | 10,793,342 |
| **British Innovation Fund** | Rest of UK | Commercialisation Company | 10,000,000 |
| **Circularity Capital** | Scotland | Private Equity and Venture Capital | 10,000,000 |
| **Crowdcube** | Rest of UK | Crowd funding | 8,856,803 |
| **Par Equity** | Scotland | Private Equity and Venture Capital | 7,916,953 |
| **Scottish Co-Investment Fund** | Scotland | Devolved Government | 6,959,335 |
| **Abundance** | Rest of UK | Crowd funding | 6,319,746 |
| **Growth Loans** | Rest of UK | Specialist Lender | 5,500,000 |
| **Equity Gap** | Scotland | Angel Network | 5,127,393 |
| **Beehive Equity** | Rest of UK | Private Equity and Venture Capital | 5,000,000 |
| **Early Stage Growth Challenge Fund** | Scotland | Devolved Government | 4,844,661 |
| **Foresight Williams Technology EIS Fund** | Rest of UK | Private Equity and Venture Capital | 3,700,000 |
| **Aurus Capital** | Rest of World | Private Equity and Venture Capital | 3,200,000 |

Table 6 indicates that, of the top five investors, three are supported by government-backed agencies and funds which reflects strong financial support in Scotland for early-stage companies which has carried into the growth of climate tech. Altogether, these three funders (SNIB, Scottish Venture Fund, and Scottish Enterprise) invested £76 million over the years into companies we have classified as climate tech.

## Grant Awards

This section provides analysis on the awards of grants to climate tech companies in Scotland between 2005 and March 2023.

**Table 7: Grants and number of investors by sector (2005 – March 2023)**

| Sector | Number of grants | Amount received (GBP) |
|---|---|---|
| **Biofuels and Biochemicals** | 1 | 10,925,000 |
| **Climate Business Services** | 101 | 18,824,687 |
| **Digital and Information Technologies** | 127 | 14,511,093 |
| **Energy Efficiency and Storage** | 111 | 49,961,142 |
| **Food and Agriculture** | 75 | 21,548,384 |
| **Greenhouse Gas Removals** | 6 | 215,107 |
| **Grid Electrical Infrastructure and Power Conversion** | 44 | 5,714,315 |
| **Low Carbon Materials** | 83 | 14,674,007 |
| **Low Carbon Transport and Infrastructure** | 31 | 28,162,722 |
| **Nature-Based Solutions** | 3 | 191,011 |
| **Other** | 98 | 25,893,448 |
| **Renewable Energy Generation** | 97 | 38,285,036 |
| **Waste and Recycling** | 21 | 1,547,835 |
| **Grand Total** | **798** | **230,453,787** |

We can see from Table 7 that the grant volume and awards totals are weighted towards renewable energy generation and energy efficiency and storage, which constitutes approximately 38% of the overall funding achieved in both categories. The recurring lagging category is Greenhouse Gas Removals and Nature Based Solutions which account for less than 0.01% of the amount raised. It is also worth noting that there is a singular skewing investment in biofuels and biochemicals, which would otherwise be null. This raises questions about the competitiveness of the market, the future opportunities for growth and the systems which have led to this anomalous investment category.

Table 8: Grants received and number of investors by stage of evolution at grant date

| Stage of evolution at grant date | Number of grants | Amount received (GBP) |
|---|---|---|
| **Seed** | 252 | 43,322,512 |
| **Venture** | 178 | 76,959,893 |
| **Growth** | 145 | 30,474,990 |
| **Established** | 103 | 46,283,243 |
| **Exited** | 11 | 5,961,478 |
| **Zombie** | 1 | 273,288 |
| **Dead** | 1 | 74,962 |
| **Undisclosed** | 107 | 27,103,421 |
| **Grand Total** | **798** | **230,453,787** |

Apart from companies where the database could not track its stage of evolution, the majority of grants have been awarded to seed, venture, and growth stage companies (a total of 575 grants awarded). This means that early-stage companies, in addition to funds from angel investors and crowdfunding, usually receive initial funding from grant-awarding bodies.

The graph below also confirms a steady rise in grant awards made to companies involved in climate tech up to 2022, indicative of the growing support for climate tech as an emerging priority sector.

Figure 7: Grant received (£M) by climate tech companies from 2005 to March 2023

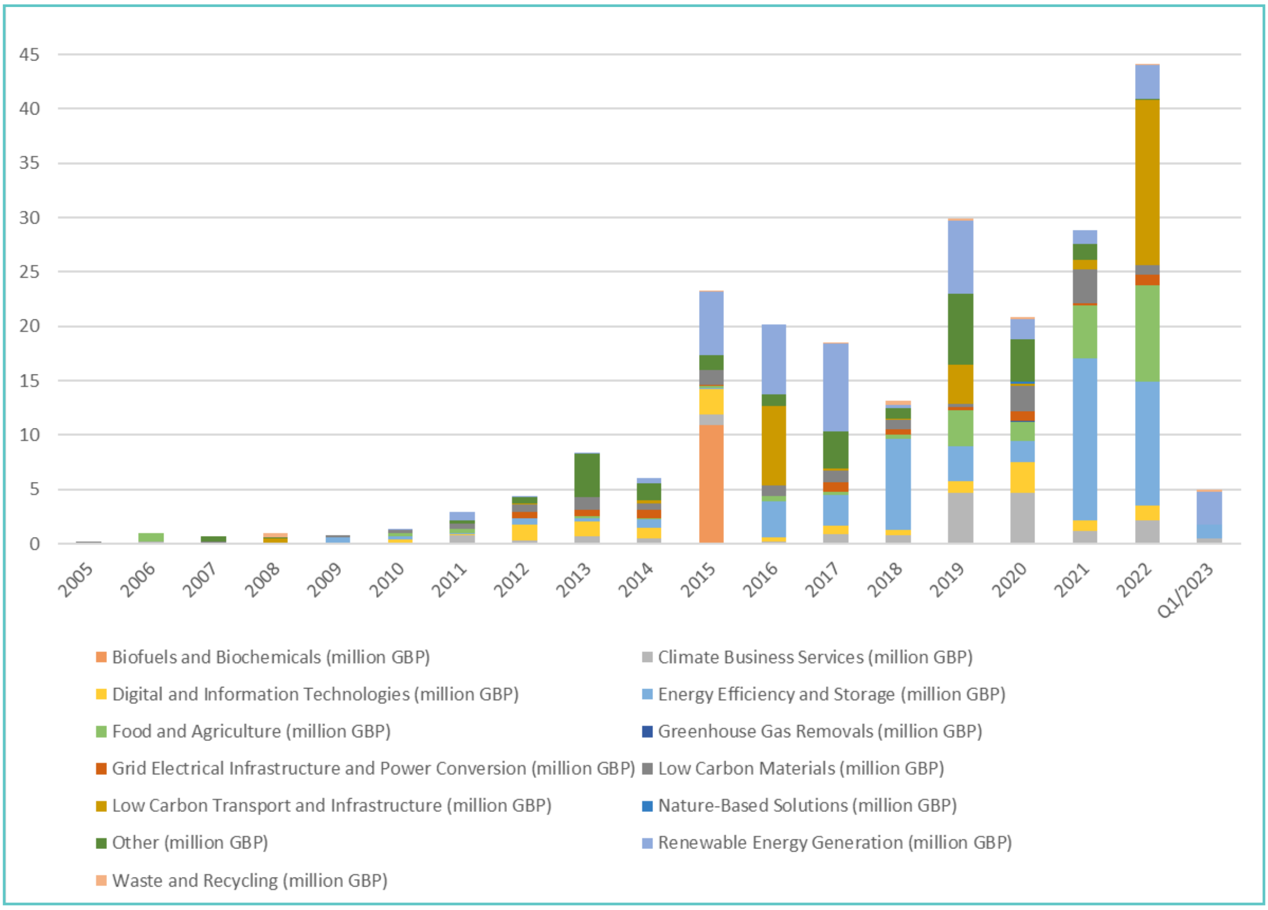


**Table 9: Top 20 grant-awarding bodies by value of grants (2005-March 2023)**

| Grant funder name | Grant funder country/ region | Grant amount (GBP) |
|---|---|---|
| **Innovate UK** | Rest of UK | 214,537,817 |
| **Longer Duration Energy Storage (LODES)** | Rest of UK | 64,298,833 |
| **Energy** | Rest of UK | 59,705,202 |
| **Advanced Propulsion Centre (APC)** | Rest of UK | 15,000,000 |
| **Energy Entrepreneurs Fund** | Rest of UK | 13,414,488 |
| **Research and Development Grant** | Rest of UK | 12,136,173 |
| **Development** | Rest of UK | 11,560,753 |
| **Advanced Biofuels Demonstration Competition** | Rest of UK | 11,000,000 |
| **Ultra LCV Tech & Supply Network** | Rest of UK | 9,166,645 |
| **Advanced Propulsion Centre: Creating UK capability in low-carbon automotive technologies** | Rest of UK | 7,651,633 |
| **Connected and autonomous vehicles** | Rest of UK | 5,629,412 |
| **Agri-Tech Catalyst - Industrial Research** | Rest of UK | 5,507,882 |
| **Office for Zero Emission Vehicles** | Rest of UK | 3,500,000 |
| **Wave Energy Scotland (WES)** | Scotland | 3,325,000 |
| **Crop and Livestock Disease Challenges** | Rest of UK | 2,636,422 |
| **Prosperity Partnership** | Rest of UK | 2,600,000 |
| **Transport** | Rest of UK | 2,586,041 |
| **European Maritime and Fisheries Fund** | EU | 1,791,956 |
| **Scottish Enterprise** | Scotland | 1,600,000 |
| **Technology Inspired Innovation** | Rest of UK | 1,512,941 |

Table 9 displays the top 20 grant-awarding bodies by value of grants from 2005 to March 2023. The largest amount is from Innovate UK, a part of UK Research and Innovation, who have awarded an overall £214 million. This is four times the amount from the second largest funder, the Longer Duration Energy Storage project. Only one grant funder is from the EU, and this source of funds will be largely closed as a result of Brexit.

Only two of the grant funders are from Scotland, Scottish Enterprise and Wave Energy Scotland, while the rest are UK agencies based in England. This shows the importance of connecting the Scottish climate tech ecosystem not just within Scotland but across the UK.

## Accelerators

Our analysis of climate tech investment also includes data on companies who have received funding alongside participating in an accelerator programme, giving us some insights into the form and function of the accelerator ecosystem in Scotland. Companies have been supported by a number of programmes, which may be either dedicated climate tech, climate-specific cohorts within wider programmes, or more generic business accelerators.

**Figure 8: Breakdown of accelerator support by company attendance**

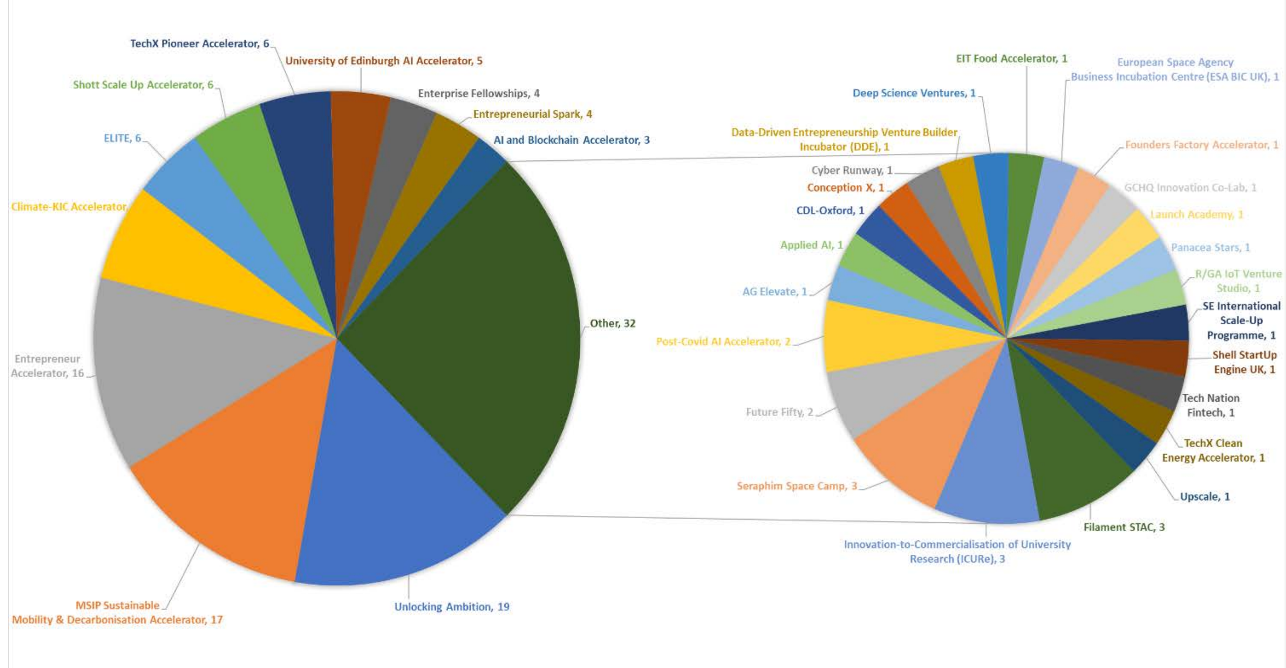



Figure 8 shows the breakdown of this support. From the underlying data we can see that a number of companies have been supported by multiple programmes, which is clearly beneficial to companies in terms of leveraging and continuing investment, especially in the early stages.

It does also suggest a fragmented funding landscape with some duplication, especially in the training and advisory components of the support. We know from experience that active participation in these programmes can be highly varied among companies who have already had similar training and mentoring support elsewhere, but companies still apply because of the financial support, and duplication arises from companies being successful in multiple programmes based on the strength of their proposition.

It is worth also noting that with Accelerator programmes moving online during the global pandemic, they opened up to global participation irrespective of company location. While this may have supported the development and connectivity of Scottish climate tech, it may also have skewed the picture of early-stage climate tech activity with global application taking place here in Scotland.

# Climate Tech Events

Events are a crucial part of any ecosystem, with a vital role in bringing together diverse and distributed stakeholders to share knowledge and build partnerships. Some key events supporting and connecting climate tech in Scotland and beyond are included in **Appendix 4**. These will be supplemented locally, for example by the activities of the accelerator programmes and innovation centres mentioned in the section on **Climate Tech Clusters**.

Current events vary considerably in consistency, relevance and accessibility for small businesses, with high costs of participation, particularly for exhibiting, alongside the time commitment and considerations over the readiness and demonstrability of technologies and solutions. These events will be primarily commercially run or sponsorship dependent, and therefore driven by sponsor or exhibitor needs. Our list may not be comprehensive, but it shows a variety of sector specific events aimed at particular areas of climate tech, alongside large-scale exhibitions which can present some opportunities to connect large and small companies, and awards showcases which can present opportunities for smaller companies to highlight their work.

All of these events will present some opportunities to develop and support the climate tech ecosystem. However, larger events in particular tend to facilitate networking among larger organisations and towards established and proven business models, such as the further deployment of and investment in offshore wind generation. While this, as an example, is a critical component of Scotland's decarbonisation as well as a significant opportunity to export energy, these events may not be the most effective way to develop the ecosystem and support investment in other innovative and disruptive forms of climate tech.

## Disrupting the Ecosystem

To support the climate tech sector we should capitalise on opportunities to integrate climate tech into existing innovation and sectoral event landscapes, in order to support industrial decarbonisation and build routes to market. This would include giving climate tech more focus in other key sectors, in particular those such as data, construction, manufacturing, finance, healthcare, and tourism. Challenging these sectors to accelerate both development and adoption of climate tech would both stimulate innovation and give market confidence, while accelerating impact against climate change.

However, a different design and approach for events is needed to support the ecosystem towards disruptive innovation at scale. This needs climate tech specific events, designed to convene its critical system stakeholders (SMEs, investors, large companies and business support agencies) using events and other supporting interventions to facilitate access to technologies, markets and investment. By making these purpose-led and designing to deliver specific outcomes or address particular decarbonisation challenges at a system level, these can support open collaboration and be designed to enable and share stakeholder actions.

## Looking Internationally

Scottish climate tech companies with growth ambitions, and those organisations who support them, will be looking to connect to a global ecosystem throughout the UK, Europe and beyond, in which some key events are highlighted in **Appendix 4**. The Scottish ecosystem needs to support companies to a level of scale, technology readiness and maturity that allows them to make viable and credible connections into the global marketplace, in order to realise business opportunities and deliver economic benefits in Scotland.

# Conclusions

## Overview

Our research highlights that there is a significant and growing climate tech ecosystem developing organically, and delivering significant economic benefit within current systems, policy interventions and support structures. This growth would benefit from targeted interventions and support designed to create a cohesive community, and to enable and accelerate specific sectors and regions.

Delivering this needs us to vastly improve the quality, timeliness, availability and communication of data, insights and intelligence across all stakeholders in the ecosystem. This would also include creating and maintaining consistent sector definitions and frameworks, in partnership with subject matter experts and policymakers. Doing this will help innovators, investors, and other sector stakeholders, to engage with greater clarity and effectiveness. Supported by clear policy and investment priorities, this will improve the functioning of the ecosystem, lower the barriers to deployment and market entry, and accelerate sector growth.

## Climate Tech as a sector

Climate Tech does not currently present itself as a single and cohesive 'sector' in the more established sense, where sectors are typically defined by products, services or technologies which they have in common. Our analysis shows Climate Tech to be a highly varied set of companies who are deploying a wide range of technologies to tackle climate change. Their strategic drivers will also vary, typically from either, or a combination, of:

1. Their own mission and purpose, and a desire to have an impact on tackling climate change and contribute to global sustainability.
2. A business response to changes in the operating environment, such as:
   - regulatory or compliance requirements
   - cost pressures
   - availability of materials and resources
   - policy or stakeholder expectations
   - new sector or market opportunities

What defines climate tech as a sector is the application of technologies to the complex challenge of climate change. Early-stage businesses in particular may be purpose-led as much as profit-driven.

## Supporting Climate Tech Growth

Climate tech as a whole does not lend itself to a traditional sector support model because of its particularly complex and diverse nature. The diversity of companies and stages of sector maturity in our analysis shows support needs for sectors and companies within climate tech are very different.

This can create opportunities for innovation and cross fertilisation across different sizes of business, solutions and business models. That needs a support model in which enabling and supporting communities of businesses to collaborate and develop, sometimes across traditional boundaries, will be important. This would include both cross-sectoral development and the facilitation by design of large and small companies to support innovation and growth at multiple scales.

Some climate tech sectors can be seen to be dominated by large infrastructure and utilities providers, suggesting that targeted interventions may be needed to ensure that SMEs benefit from sector growth and are able to bring the innovations in scale and approach needed to deliver a net zero and energy resilient economy across Scotland. More focussed and challenge-led design in climate tech events can support this, but is likely to need targeted intervention as the market will not deliver it naturally. Sector support would also include facilitating connections into the parts of the economy climate tech can help to tackle climate change, whether those are other industries or more system-led approaches such as area-wide emissions reduction.

## Building a Climate Tech community

What can unify climate tech companies, and particularly the more early-stage mission-led companies, is a common purpose in responding to climate change. This common purpose lends itself well to community building, and to companies supporting each other through shared opportunities and challenges in terms of business, market and product development; and in finding their way through the policy, funding and investment landscape that supports them. Communities build themselves rather than being built, so Scottish Enterprise must decide how and who is best to facilitate that.

Support for the climate tech sector should acknowledge both the diverse nature of that sector and the complex and interconnected nature of both climate challenges and solutions. It should facilitate connections between what may historically be disparate companies, industries and processes. There are good examples of this already, both within and between sectors, for example in by-products from the whisky sector or the application of data and sensor technology to land use and agriculture. This can be fostered by aligning and sharing outcomes, objectives and resources, and creating the right enabling environment for further collaboration and innovation across climate tech.

## Monitoring sector growth

With the potential for growth across the climate tech sector, we would expect Scottish Enterprise to want to continue to monitor and analyse this growth so that it can better understand and respond to sector needs and opportunities when designing and delivering future support. This work has shown the challenges which the emerging, evolving and diverse nature of climate tech presents to analysing the sector using established datasets.

The definitions and taxonomies proposed here, along with the data sources identified and datasets created, should be validated, refined and enhanced through further engagement with the sector, for future use by Scottish Enterprise and its partners in economic development to build shared intelligence and provide integrated support.

## Enabling Growth: Recommendations for public support

Our analysis and insights highlighted a number of areas by which the Scottish Government and its delivery agencies may better enable the growth of climate tech in Scotland. A fundamental need is for the different system stakeholders to be better enabled to share information, insights and knowledge between one another and streamline the deployment of climate tech towards both market needs and system level challenges.

Recommendations to support this include:

- **Target support and leverage investment**: Any sector can clearly benefit from the injection of investment and resources to facilitate and support growth. If Scottish Enterprise chooses to focus on climate tech, then it should direct support towards this sector and make climate impact one of its own priorities in determining which businesses to support. This needs a better understanding of the workings of the sector and the potential impact and effectiveness of any targeted interventions. Targeting would also be designed for regional coverage and impact.
- **Challenge-Led Events and Accelerators**: There is an opportunity to support innovation and company formation in the climate tech sector through targeted events and accelerator programmes designed to tackle particular climate challenges at a system level. These would move beyond the traditional model of supporting individual companies through their journey to investment and seek to bring together stakeholders to design and facilitate innovation in system design. This design would also reduce some of the duplication in the accelerator ecosystem.

  By breaking down ecosystem barriers and spanning traditional sector and scale boundaries, such an approach would both tackle some of the systemic challenges in reducing climate impact and facilitate pathways to the development and exploitation of climate tech. It would also enable more effective engagement with impact investors who are focussed on particular challenges, by creating opportunities to co-design programmes and support with identified climate tech investment.
- **Embed climate impact into investment, procurement, and decision making**: Market confidence is a critical component in attracting investment to and growing any sector. The Scottish Government and its public sector bodies can support that growth, and deliver their own climate commitments, by more consciously and deliberately embedding climate impact into all of their policy and investment decisions. This would include, for example, public sector procurement, with the climate impact of goods and service delivery being designed and weighted as a critical factor in contract awards. An assessment of the climate impact of operation and implementation should be part of the business case for public sector projects.
- **Create a supportive policy environment**: The Scottish Government should aim to create a supportive policy environment that encourages the growth of the climate tech sector. This may include incentivising investment or co-funding activity through established mechanisms such as Free Ports, City-Region Deals or Innovation Parks. It may also add benefits to create regulations that promote the use of sustainable technologies, and tax incentives for companies that are developing climate-friendly technologies. This would include using both policies and public investment to stimulate local markets and give companies confidence to invest in growth.

  This is particularly important for sectors where policy direction is needed to give investment confidence, such as hydrogen and GHG removals through carbon capture and storage, or where it is critical in shaping and delivering the right impact and outcomes, such as land use and nature-based solutions.
- **Build innovation partnerships**: Government should use its convening power and incentive mechanisms to create strong partnerships between the private sector, academia, and government agencies as well as maximise global opportunities for inward investment and collaboration. This could include partnerships that promote research and development, funding for startups, development of the investor landscape, and greater collaborations between universities and industry to deliver the mix of innovation and skills needed. This will bring forward opportunities from research and innovation and will be critical in securing Scotland's leadership in some key areas of climate tech.
- **Promote talent development**: To support the growth of the climate tech sector, the government should also focus on developing and retaining a highly skilled workforce. This could involve creating programs to attract and retain talent, funding for education and training programs, and initiatives to promote diversity and inclusion in the industry as well as establish a strong entrepreneurial pipeline to maintain global competitiveness. A proactive approach to talent development is needed to ensure the sector is not constrained by availability of skills, and to support a just transition with local opportunities.

# Next Steps

Immediate progress can be made by engaging closely with the multiple stakeholders in this emerging sector, as a collective ecosystem, and co-designing sector support to develop and improve that ecosystem with and for them.

## Co-designing future support

With a better understanding of the scale and composition of the developing climate tech sector, Scottish Enterprise is better placed to engage more strategically with the sector and to begin to shape and co-design future support. This would include events and other activities designed to better connect the climate tech ecosystem and build a cohesive climate tech community. Any interventions would clearly benefit from further insight, intelligence and analysis of the specific needs and levels of maturity of the different climate tech sectors, and a better understanding of the enablers and inhibitors for growth in each.

This understanding could be facilitated, and a co-design process for support started, by conducting interviews with key stakeholders to validate and seek their interpretation of the findings of this report, and to carry out a more substantive qualitative assessment of the climate tech ecosystem with in-depth practitioner input. A primary aim of this would be to gather intelligence on which interventions would most effectively increase investment and lead to business growth.

## Developing a connected ecosystem

The sectors and companies within Climate Tech are highly varied in their profiles, maturity and support needs. Finding effective ways to bring together and align the innovation capacity of SMEs with the needs and investment capabilities of larger companies and organisations will be critical in accelerating climate tech investment and adoption. Designing the system more holistically, particularly around acceleration, product validation and access to markets, would remove some of the current duplication. This would help the landscape deliver more participant value and create better outputs and outcomes for funders and sponsors. It would also make it more visible, cohesive and attractive to investors.

The potential alignment of companies and investors by mission and purpose, and their complementary needs in terms of innovation, development and investment suggest the sector would benefit from support to develop more connectivity and cohesion across the sector. This would foster the development of a community which shares skills, knowledge and resources openly, in which stakeholders support each other with co-design and problem solving, in order to both realise the economic benefits and deliver climate impact. Connecting to global markets and climate challenges should be a shared endeavour in which the community supports each other.

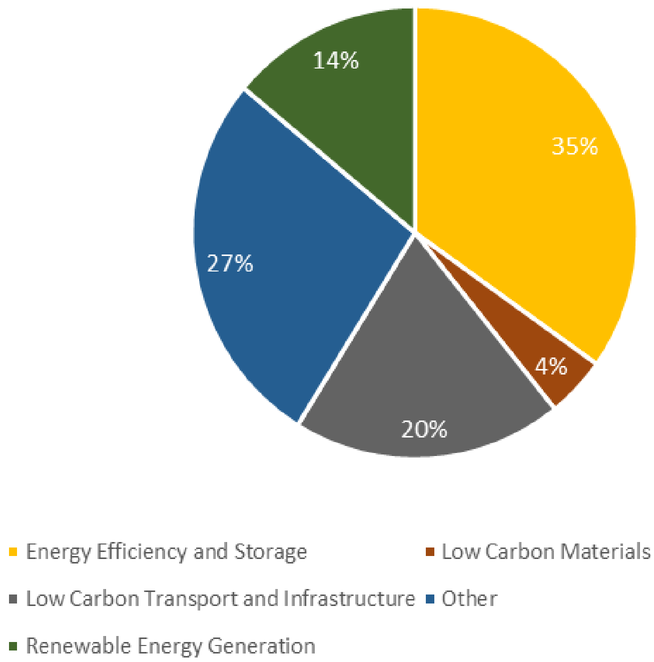
This ecosystem should, by design, seek to engage closely with established initiatives in other sectors, to avoid duplication, build market access, and help companies across Scotland to contribute to national decarbonisation. Practically, this would look like integrating climate technologies in the review points expected in the City-Region Deals, emerging regional economic plans such the Regional Prosperity Framework, and exploring the opportunities to optimise unified activity working alongside and through Tech Scaler. It would involve active and structured engagement with sector stakeholders to identify and address some of the gaps highlighted in the current ecosystem.

# Appendix

## Appendix 1: Top 10 funders and their investments by sector

**Scottish National Investment Bank (SNIB) – Total amount invested: GBP 45,900,000**

1

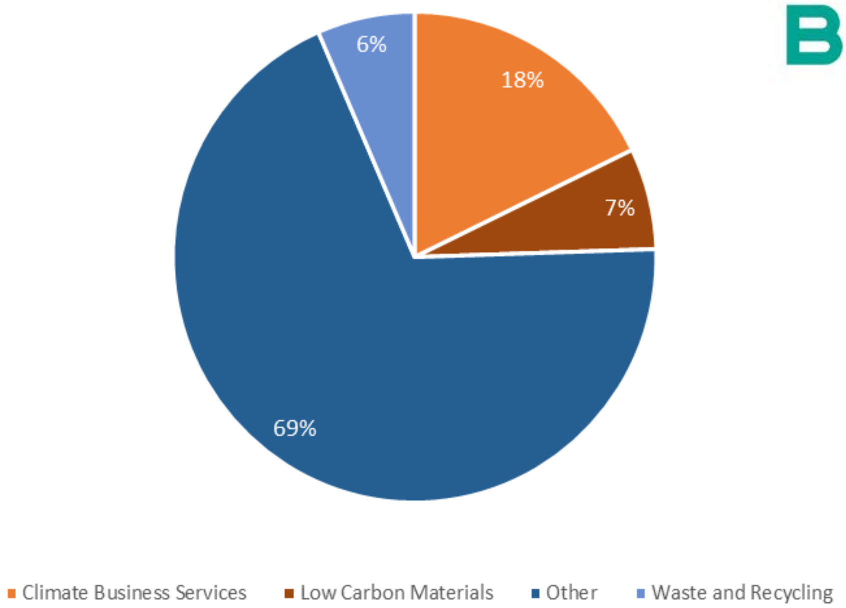



The Scottish National Investment Bank

**BGF Growth Capital – Total amount invested: GBP 33,700,000**

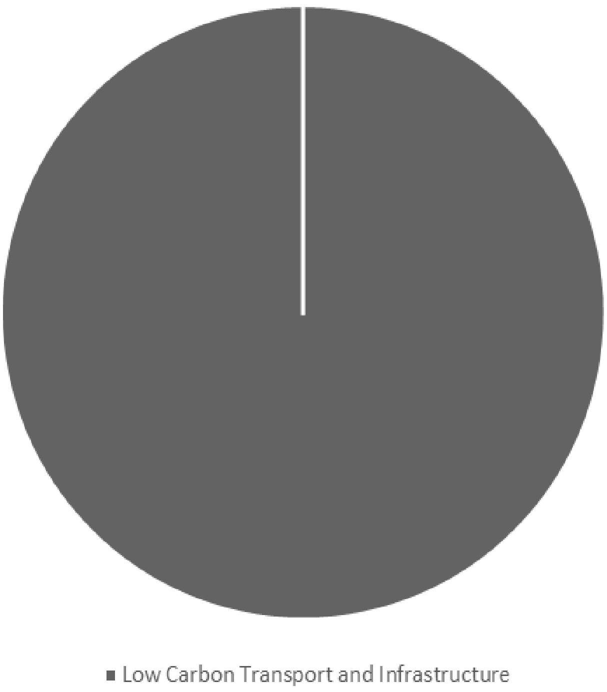
2

BGF



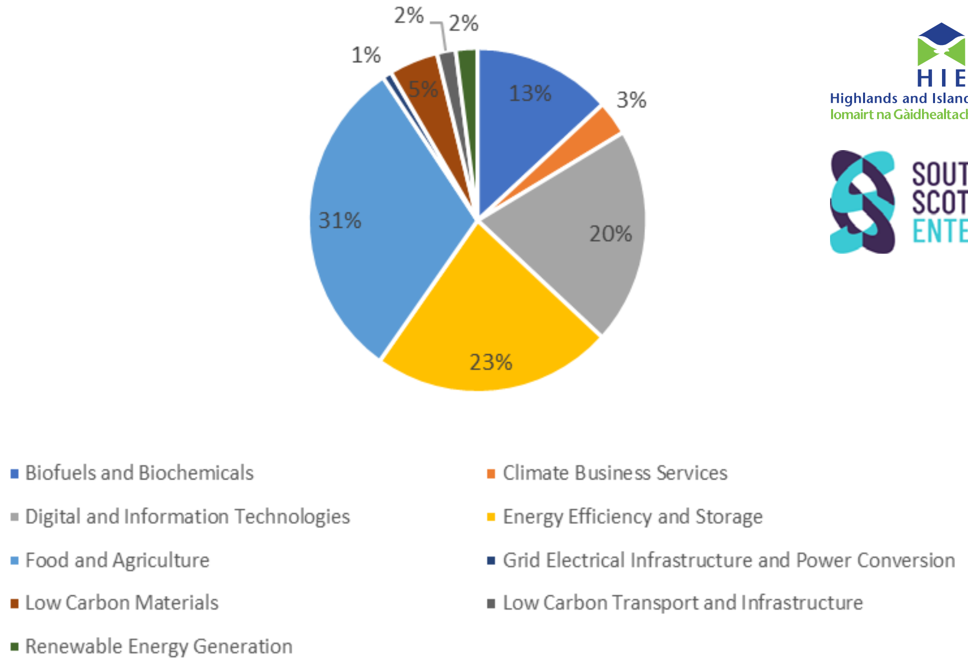
### EG Group – Total amount invested: GBP 25,000,000

3



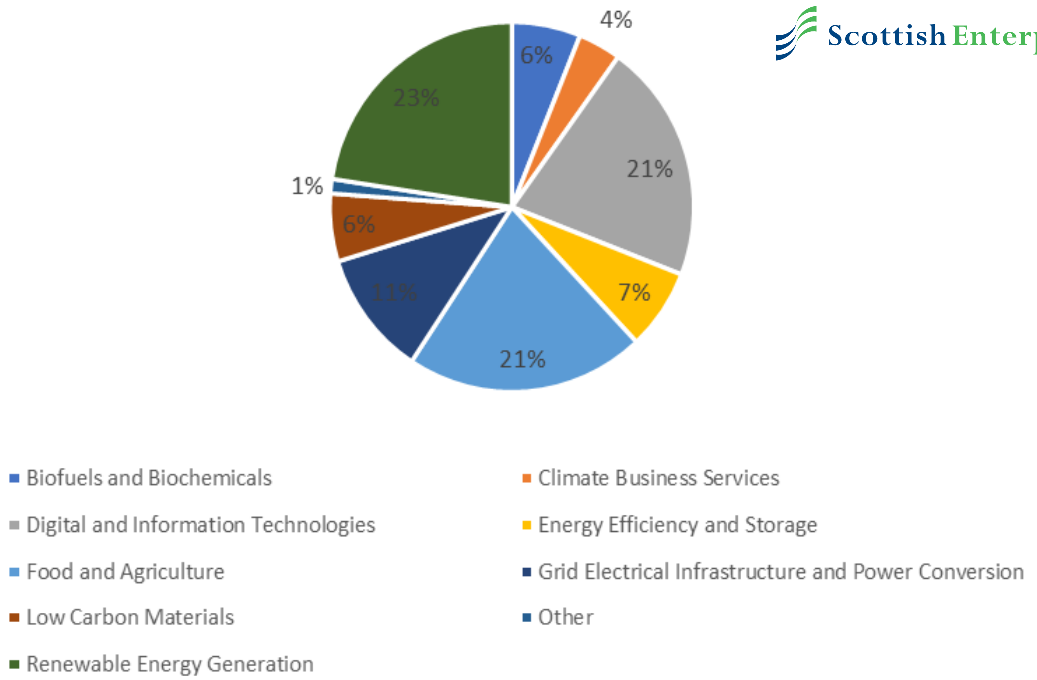

### Scottish Venture Fund – Total amount invested: GBP 16,557,271

4



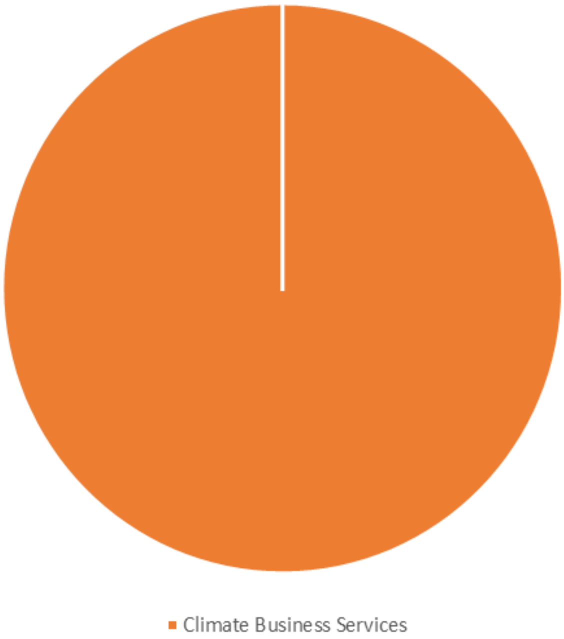
**Scottish Enterprise – Total amount invested: GBP 13,904,136**

5



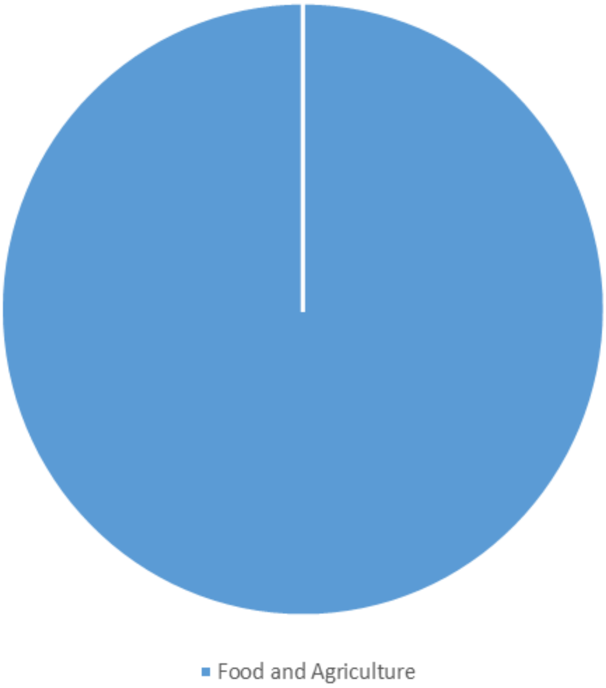

**Albion Capital – Total amount invested: GBP 12,400,000**

6



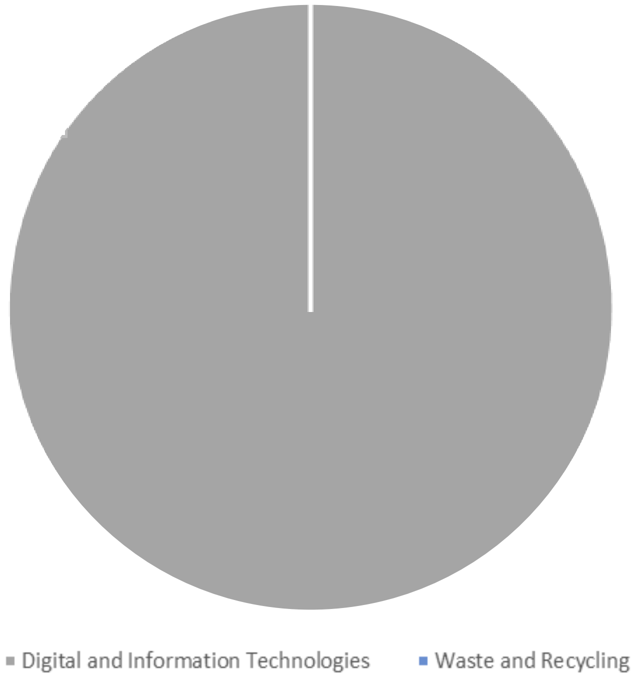
## ABB Technology Ventures (ATV) – Total amount invested: GBP 11,000,000

7



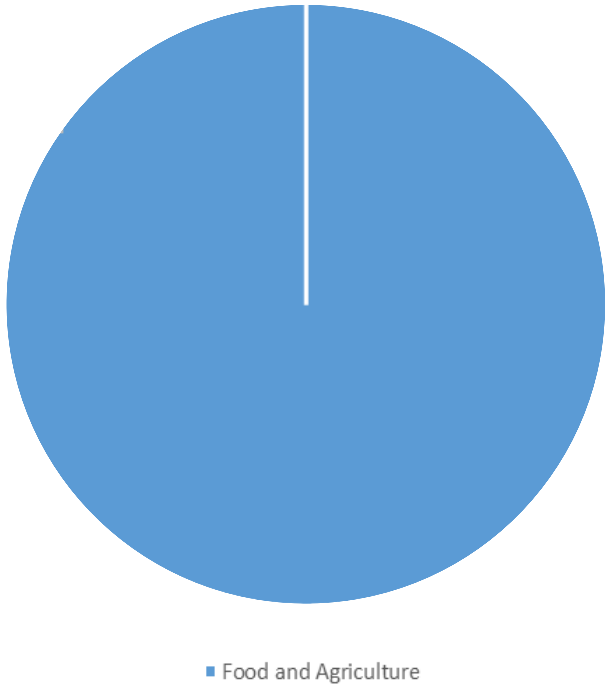

## Archangels – Total amount invested: GBP 10,793,342

8



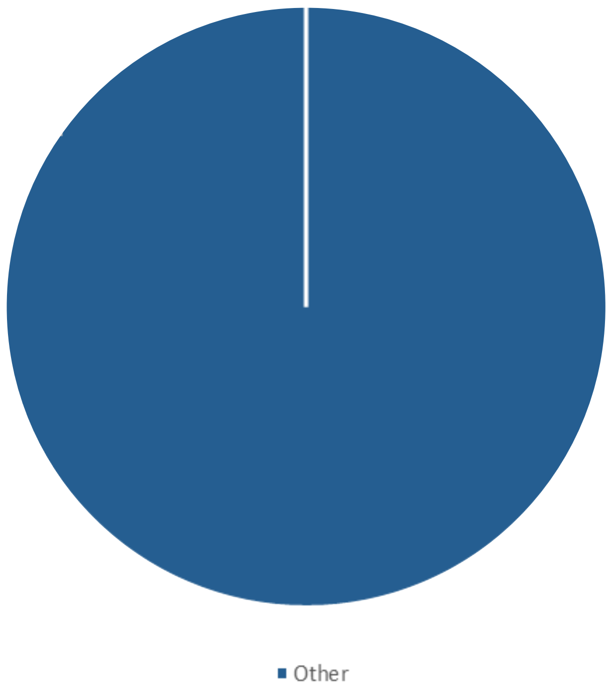
**British Innovation Fund – Total amount invested: GBP 10,000,000**

9




**Circularity Capital – Total amount invested: GBP 10,000,000**

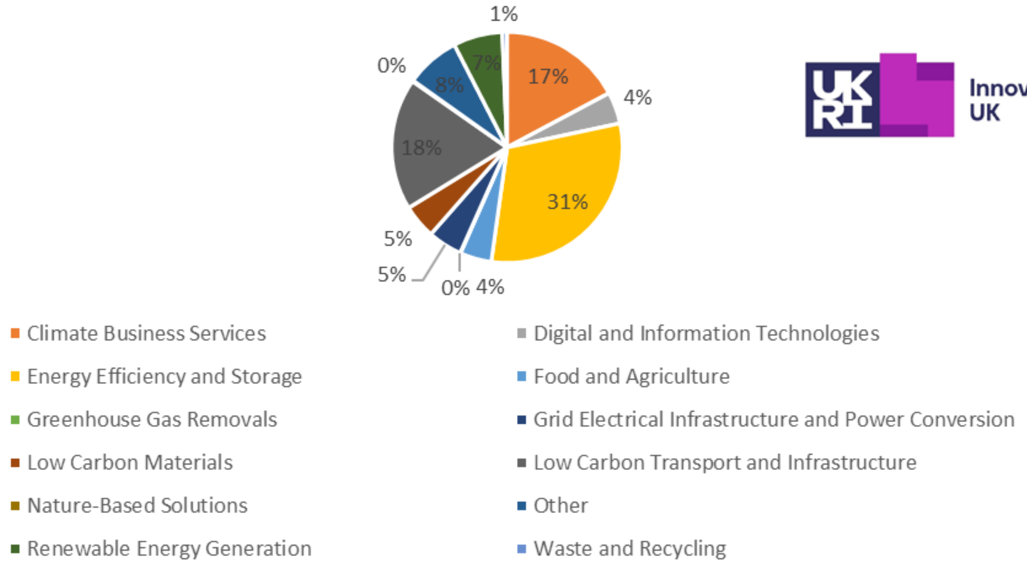
10



## Appendix 2: Top 10 grant-awarding bodies and their grants by sector

**Innovate UK – Total amount awarded:**

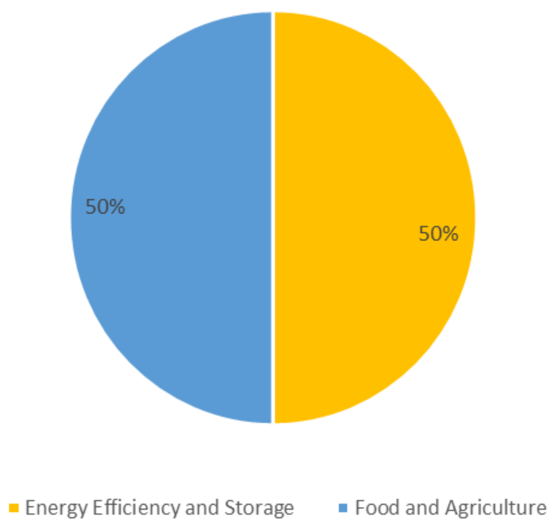
1




**Longer Duration Energy Storage (LODES) – Total amount awarded: GBP 64,298,833**

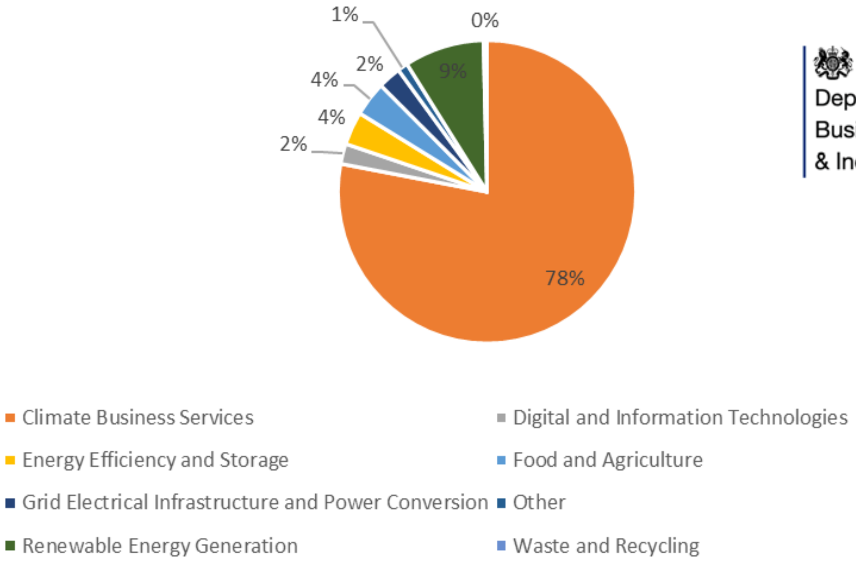
2

Department for Business, Energy & Industrial Strategy



## Energy – Total amount awarded: GBP 59,705,202

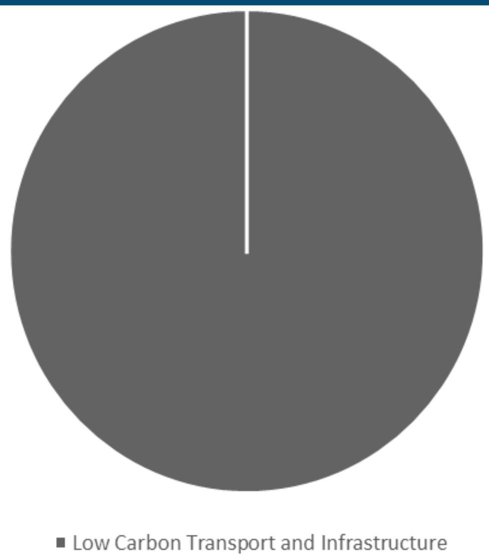
3




Department for Business, Energy & Industrial Strategy

## Advanced Propulsion Centre (APC) – Total amount awarded:

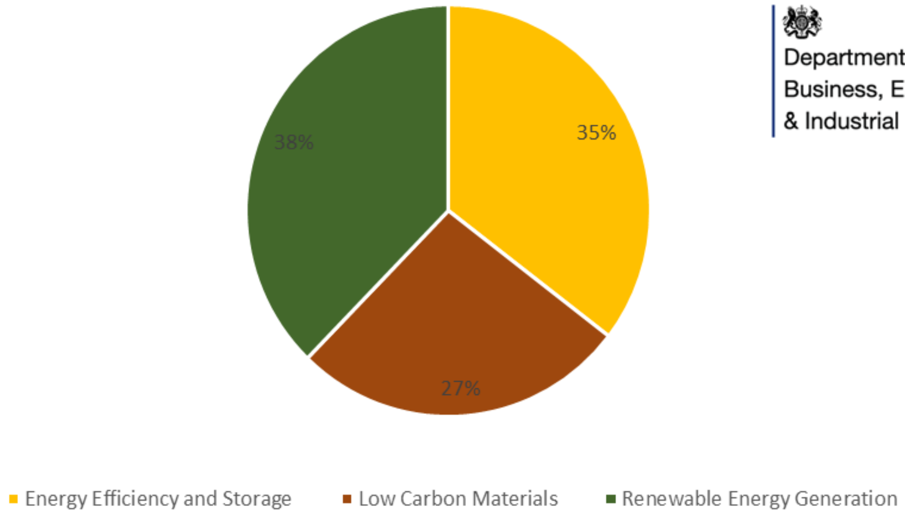
4




ADVANCED PROPULSION CENTRE UK

## Energy Entrepreneurs Fund – Total amount awarded: GBP 13,414,488

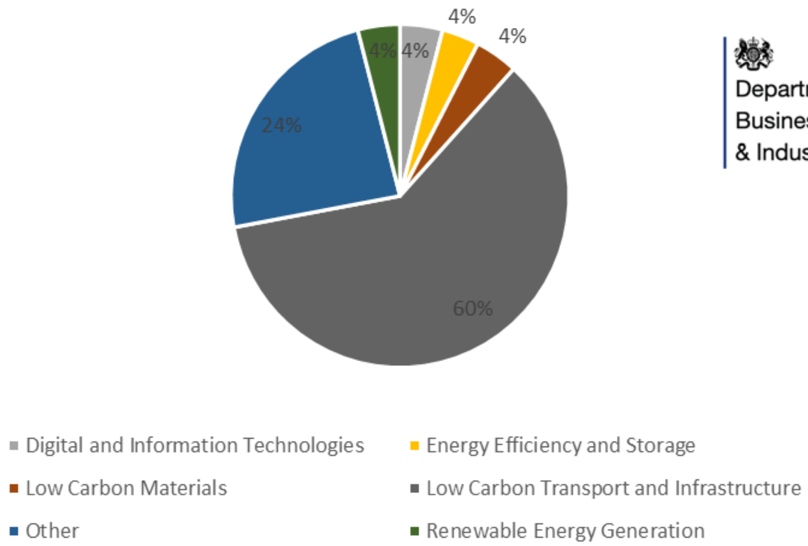
5




Department for Business, Energy & Industrial Strategy

## Research and Development Grant – Total amount awarded: GBP 12,136,173

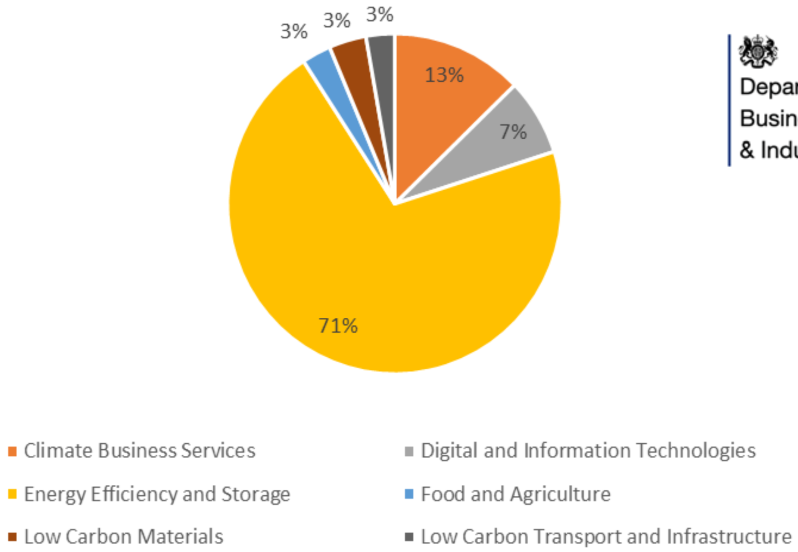
6




Department for Business, Energy & Industrial Strategy

## Development – Total amount awarded: GBP 11,560,753

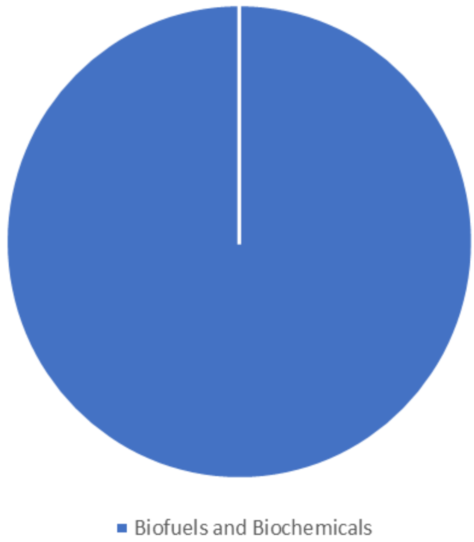
7




Department for Business, Energy & Industrial Strategy

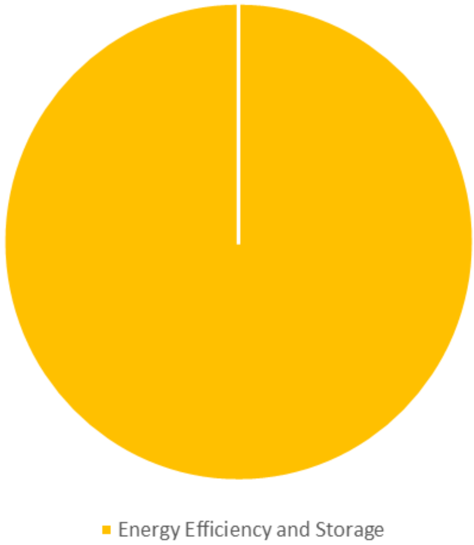
## Advanced Biofuels Demonstration Competition – Total amount awarded: GBP 11,000,000

8



## Ultra LCV Tech & Supply Network – Total amount

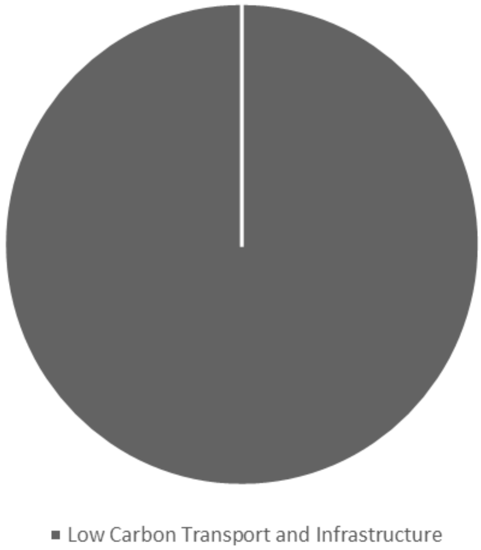
9




Department for Business, Energy & Industrial Strategy

## Advanced Propulsion Centre: Creating UK capability in low-carbon automotive technologies – Total amount

10

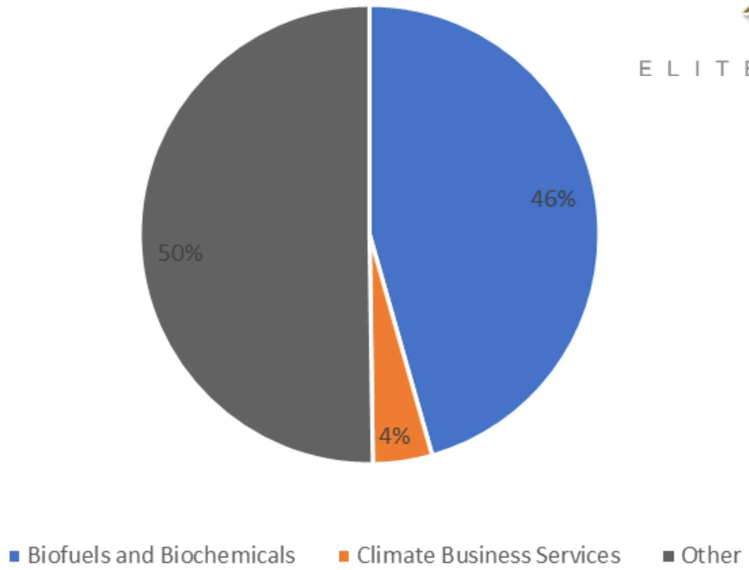



ADVANCED PROPULSION CENTRE UK

## Appendix 3: Top 10 accelerators attended by companies with the most funding

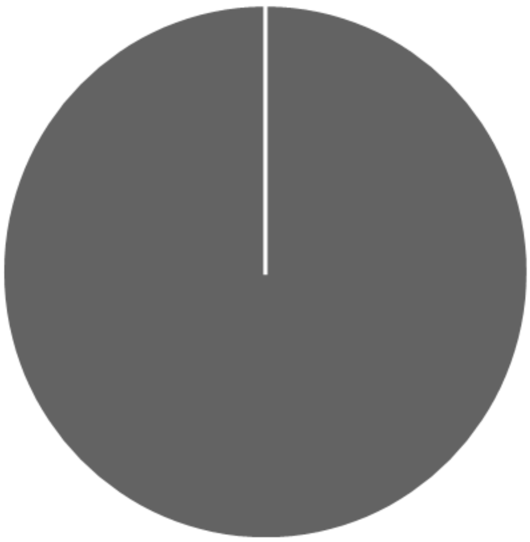
**ELITE – Total amount of funds and grants secured by companies attending the accelerator:**

1



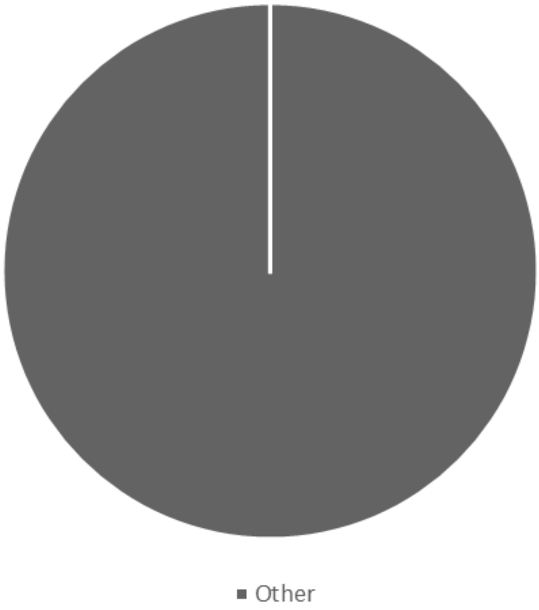

**Future Fifty – Total amount of funds and grants secured by companies attending the accelerator: GBP 90,748,076**

2



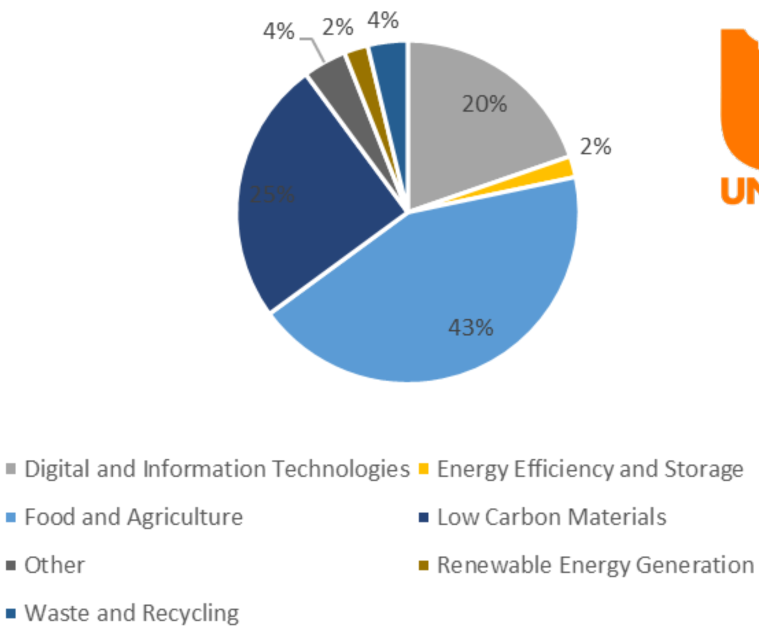
## Upscale – Total amount of funds and grants secured by companies attending the accelerator:

3



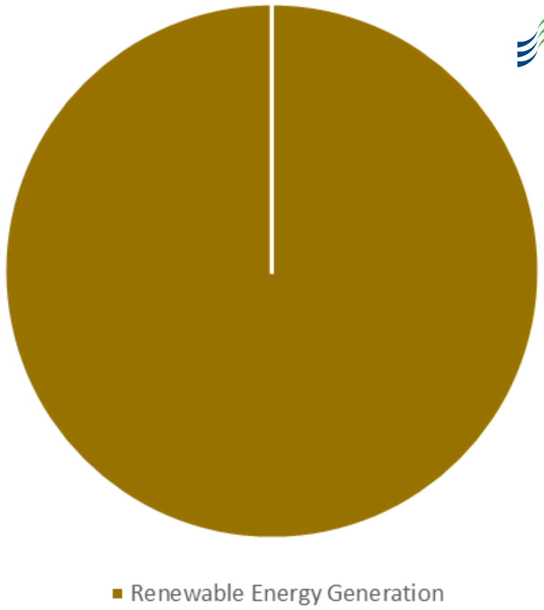

## Unlocking Ambition – Total amount of funds and grants secured by companies attending the accelerator:

4



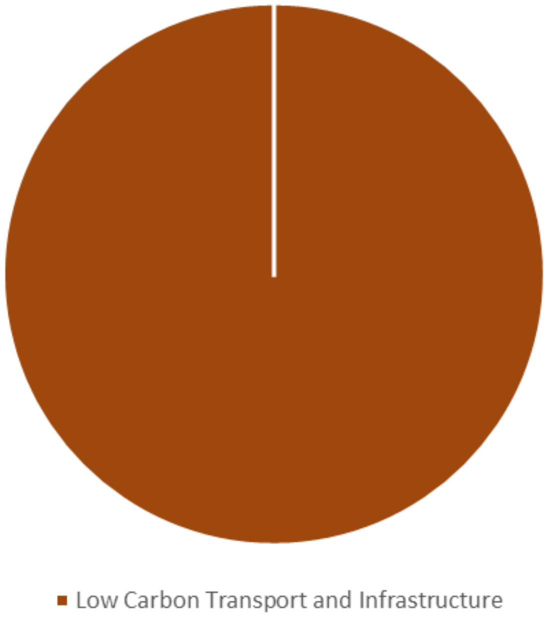
**SE International Scale-Up Programme – Total amount of funds and grants secured by companies attending the accelerator: GBP 23,682,668**

5



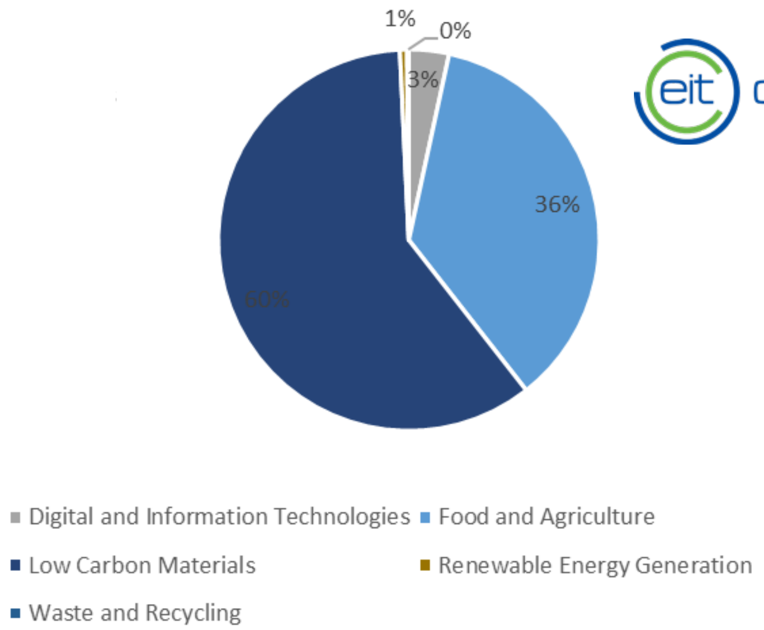

**AG Elevate – Total amount of funds and grants secured by companies attending the accelerator: GBP 20,310,354**

6



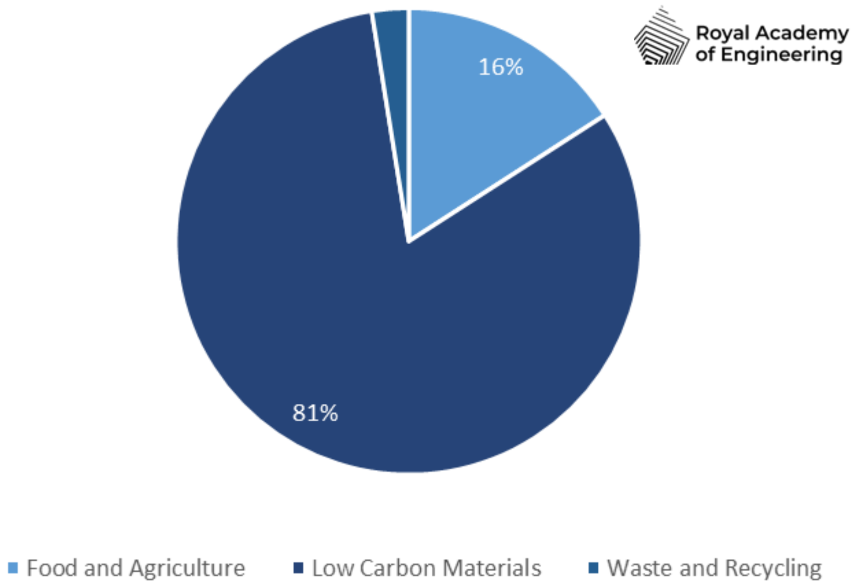
**Climate-KIC Accelerator – Total amount of funds and grants secured by companies attending the accelerator: GBP 16,565,534**

7



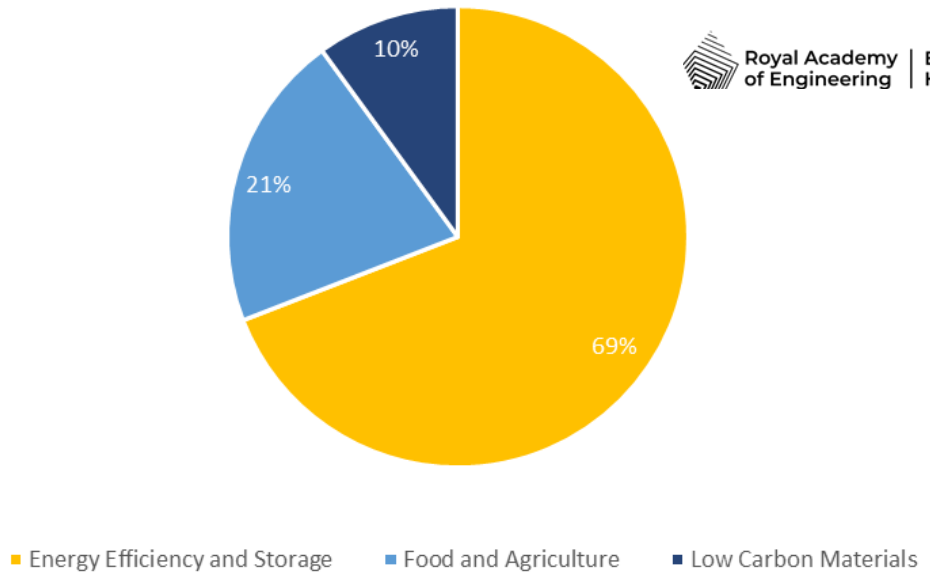

**Shott Scale Up Accelerator – Total amount of funds and grants secured by companies attending the accelerator: GBP 16,085,344**

8



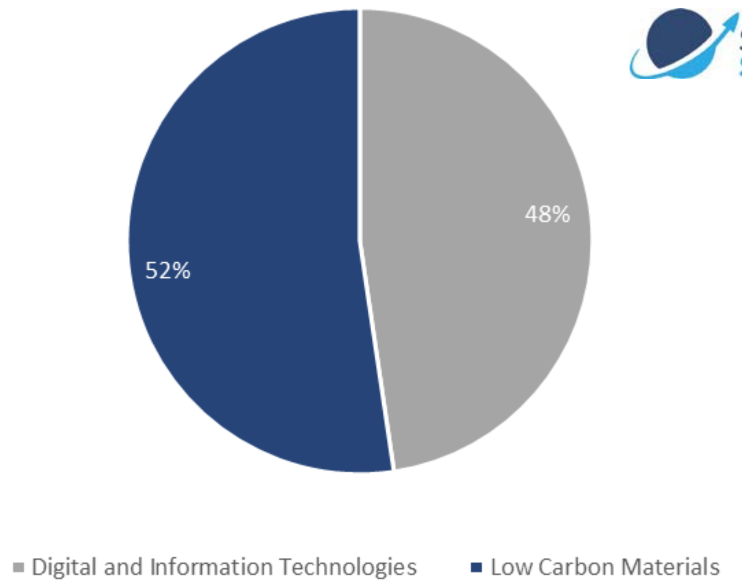
**Enterprise Fellowships – Total amount of funds and grants secured by companies attending the accelerator:**

9




**Seraphim Space Camp – Total amount of funds and grants secured by companies attending the accelerator: GBP 11,353,247**

10



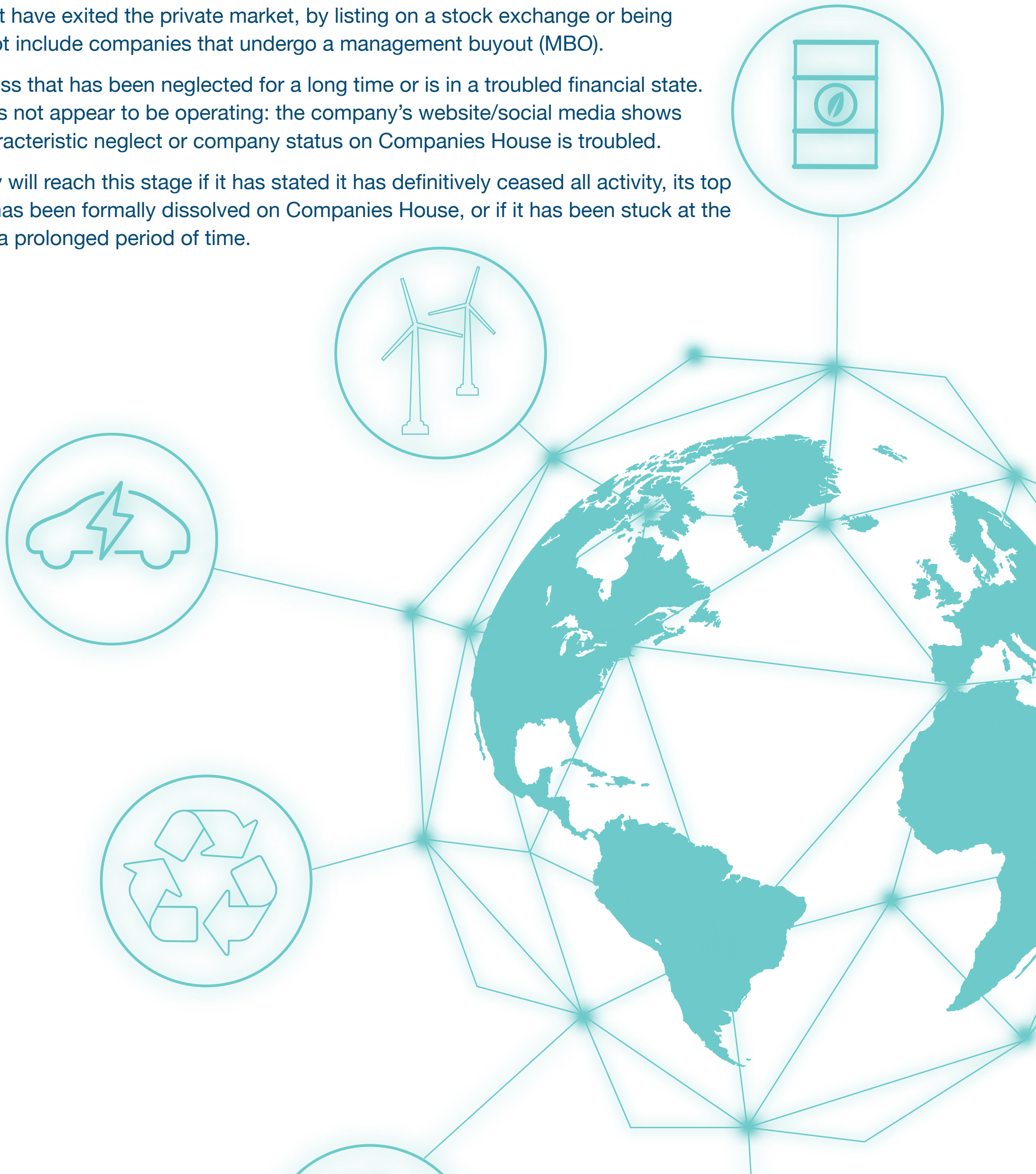
# Appendix 4: Selected Climate Tech Events

| | Event | Website |
|---|---|---|
| SCOTLAND | All-Energy & DCarbonise 2023 | www.all-energy.co.uk |
| | Net Zero Scotland Projects Conference | www.net-zero.scot |
| | Young Professionals Green Energy Awards 2023 | www.scottishrenewables.com/events/193-ypgea23/about |
| | Marine Conference & Dinner 2023 | www.scottishrenewables.com/events/181-marine23savethedate |
| | Net-Zero Energy Transition Awards 2023 | www.scottishrenewables.com/events/182-marine23savethedate |
| | Onshore Wind Conference 2023 | www.scottishrenewables.com/events/183-onshore23savethedate |
| | Floating Offshore Wind 2023 | www.scottishrenewables.com/events/198-floating-offshore-wind-2023 |
| UK | Innovation Zero | www.innovationzero.com |
| | Climate Tech Summit | climatetechconference.co.uk |
| | London Climate Technology Show | www.excel.london/whats-on/london-climate-technology-show-2023 |
| EUROPE | Net Zero Nations Projects Conference | www.net-zeronations.co.uk |
| | Wind Europe | windeurope.org/annual2023 |
| | Ocean Energy Europe Conference & Exhibition 2023 | blue-economy-observatory.ec.europa.eu/events/ocean-energy-europe-conference-exhibition-2023-10-25_en |
| GLOBAL | VERGE 23 | www.greenbiz.com/events/verge/2023 |
| | Other International Events | medium.com/@startupbasecamp/the-ultimate-list-of-climate-tech-conferences-q1-2023-6cdb47b69b82 |

# Appendix 5: Stages of Evolution for Invested Companies

To consistently and impartially capture a company's stages of evolution, we relied on the data and definitions provided by Beauhurst which is a database providing intelligence on funds and accelerators of high-growth companies. This replaces normal UK terminology of 'First Round', 'Second Round', etc by classifying a company's stage as one of the following:

- **Seed**: A young startup, with low employee count, valuation, and total equity investment raised. There may still be uncertainty as to whether its product or service has an adequate market, or it may be working to gain regulatory approval.
- **Venture**: A company having developed its business models and technology over multiple years, typically securing investment and a valuation in the millions. It is likely to have some revenue, and may be expanding their initial product range.
- **Growth**: When a company has been operating for more than five years, and has grown to multiple offices, it is more likely to have reached the growth stage of evolution. A growth-stage company will also have regulatory approval and is likely bringing in significant revenue and investment, with a valuation in the millions. It will be continuing to expand its product range and international activities.
- **Established**: Trading for 15 or more years, or 5-15 years with a three-year consecutive profit of more than £5m or turnover of more than £20m. These usually have several offices and a widely-recognised brand. Funding at this stage is often deployed by corporates, private equity firms, banks and specialist debt funds, or major international investors.
- **Exited**: Those that have exited the private market, by listing on a stock exchange or being acquired. Does not include companies that undergo a management buyout (MBO).
- **Zombie**: A business that has been neglected for a long time or is in a troubled financial state. The business does not appear to be operating: the company's website/social media shows prolonged, uncharacteristic neglect or company status on Companies House is troubled.
- **Dead**: A company will reach this stage if it has stated it has definitively ceased all activity, its top parent company has been formally dissolved on Companies House, or if it has been stuck at the Zombie stage for a prolonged period of time.



This is an independent review commissioned by Scottish Enterprise, led by the University of Edinburgh.


The research team which delivered the report was:

**Jamie Brogan** Edinburgh Climate Change Institute, *University of Edinburgh*

**Lauren Chin** Centre for Business, Climate Change & Sustainability, *University of Edinburgh*

**Theodor Cojoianu** Edinburgh Futures Institute and Centre for Business, Climate Change & Sustainability, *University of Edinburgh*

**Patrick Kilduff** Edinburgh Earth Initiative, *University of Edinburgh*

**John Mutua** Edinburgh Earth Initiative, *University of Edinburgh*

**Anh Vu** Queen's Management School, *Queen's University Belfast*


Scottish Enterprise

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Edinburgh Earth Initiative

ecci EDINBURGH CLIMATE CHANGE INSTITUTE