SEFARI Fellowship – Scotland Food and Drink – Exploring a Systems Based Approach Towards Net Zero

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Executive Summary

The following report was undertaken between January and March 2023 as part of a SEFARI Research Fellowship funded via Food and Drink Federation Scotland on behalf of the Scotland Food & Drink Net Zero Task Force to support their understanding of the opportunities and barriers for the Scottish Food and Drink sector moving towards net zero.

The report has explored the background literature and current drivers for change to deliver net zero for Scotland's food and drink industry. It explores the need for a root and stem redesign of our food system, while recognising that the food and drink sector is by its nature a complex system. The report explores how change is realised in complex systems and some of the barriers faced by stakeholders in understanding what actions best deliver sustainable sector economic growth, while also achieving the UK's challenging net zero objectives.

While the pathways to delivering systemic change are widely understood, the process lacks the ability to bring together the complex networks of primary growers, producers, supply chains, retailers and consumers into a common framework that recognises and validates efforts and progress against a common set of benchmarks, which is the challenge this work aims to combat.

There were two key outcomes from this work: Firstly, a System Resilience Framework that has outlined how a complete food and drink system might be modelled within a Scottish context. The Framework facilitates the ability to explore both horizontal and vertical relationships between stakeholders, and opportunities for partnership. The second was to develop a methodology and process for defining and measuring the maturity of the systems that manage carbon outcomes within the food and drink sector. The Food and Drink Framework and Systems Mapping template set out a methodology for exploring the systems that are creating the outcomes (carbon emissions), rather than just the outcomes themselves.

By exploring and understanding the process used to manage behaviour we get better transparency into where the numbers originate and how to deliver real systems change. The report concludes with recommendations for actions going forward, which include undertaking sector specific consultation exercises to further develop carbon management system templates for each Tier/Sector and to roll out a Pilot Study for a region in Scotland to test the validity and practicality of the Resilience Framework and Carbon Systems Benchmarking Template.

SEFARI Fellowship – Scotland Food and Drink – Exploring a Systems Based Approach Towards Net Zero

1 Outline Scope of Work

1.1 Background

The following scope of work is an outline summary for a SEFARI based Research Fellowship funded via Food and Drink Federation Scotland on behalf of the Scotland Food & Drink Net Zero Task Force to develop an understanding of the opportunities and barriers for the Scottish Food and Drink sector moving towards net zero.

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1.2 Research Aim

The initial phase of work will develop a framework that supports the F&D sector to better understand current progress towards net zero targets, via assessing current reports across the sector, and also to better identify information gaps and explore opportunities for follow-on studies and initiatives.

2 Introduction - Drivers for Change

The Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 committed Scotland to a climate change target of net zero by 2045. The recent Climate Change Plan Update (CCPu) contains a target of 5.3 Mt CO2e y-1 agricultural greenhouse gas (GHG) emissions by 2032, based on an adjusted 2019 agriculture GHG emission baseline 1 of 7.7 Mt CO2e y-1 (Scottish Government 2021).

While these targets are to be welcomed, there remains significant gaps in our understanding of how various mitigation measures will be implemented at sufficient spatial and temporal scales (Ricardo 2021). The Scottish Government Updated Climate Action Plan (2021) discusses food and drink within the context of an agricultural perspective, yet in order to achieve ambitious national scale targets, cross sectoral initiatives must move beyond traditional sectoral based thinking and metrics.
There are numerous reasons beyond the urgent need for rapid global decarbonisation that are driving organisations in the food and drink sector towards more accurate full supply chain disclosure. Food is a global industry, heavily reliant on complex food logistics and susceptible to disruption. This might be described as a system that currently has low levels of resilience (Davis, *et al*, 2021).

The global challenge of addressing climate change driven impacts is likely to increase over time and will have significant impacts on our ability to operate global food business-as-usual. It is widely acknowledged that change is required, yet transformative work to date has largely been sector based and lacking coordinated systems wide thinking.

Fundamental change to our food systems is possible when driven by collaboration among actors across food systems including food producers, agriculture and horticulture, community groups, businesses, researchers, investors, civil society organizations, and regulatory agencies. It is only when governments, working in partnership with these actors, focus on multiple social, cultural, and ecological determinants of health and wellbeing that the most significant systemic change can occur (Godfray *et al*, 2010).

The need for a root and stem redesign of our food system is recognised, however tensions can arise between aspirational and pragmatic adaptive measures to reach our ambitious carbon targets (Parsons *et al*, 2018). While the pathways to delivering systemic change are also widely understood what is missing from the process is our ability to bring together the complex networks of primary growers, producers, supply chains, retailers and consumers into a common framework that recognises and validates efforts and progress against a common set of benchmarks.

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This short report has explored the development of an integrated, systems-based approach to delivering net zero targets to the Scottish Food and Drink sector and presents methodology for measuring what a 'good' food system might look like in Scotland (Good Food Nation 2014).

3 Challenges facing the Food and Drink Industry on their Pathway to Net Zero

According to the Food and Drink Federation Scotland has 1,285 food and drink manufacturing businesses with an annual turnover of £10.3 billion which accounts for 33% of total Scottish manufacturing, of which 95% are SMEs. These organisations are already facing significant challenges to economic viability, brought about by energy prices and our exit from the European markets.

The F&D sector in Scotland is a broad family, ranging from multinational global brands to crofters on remote islands, united in a common challenge to deliver high quality, sustainable products and services and to achieve and maintain net zero operations. Though there are specific targets for achieving sector-wide net zero, there remain clear challenges in articulating those targets at different levels within the sector to ensure collective movement and eliminate counter-productive impacts elsewhere in the supply chain.

The key challenge in creating a single overarching framework of strategies is the need to realistically and accurately reflect the complexities of the sector in a way that is relevant and accessible to this broad audience. Additionally, there remain challenges in measuring and supporting the decision-making taking place at the most appropriate level, i.e., implementing the principals of subsidiarity, whilst also having clear channels of communication from policy makers to crofters.

The Scotland Good Food Nation Report (2014) highlighted the need for improvements in monitoring and evaluation across the sector. The report highlighted the lack of a cohesive plan to adapt current habitats to a changing climate, and with only small steps taken so far in addressing 2030 emissions reduction goals. As with any high-level goals and strategies for addressing global issues, there are additional risks of focusing on carbon reductions at scale without support for specific, primary producer actions that address carbon alongside other environmental concerns.

The developments in recent decades in technologies that address climate change have been notable. Farm-based carbon reduction practices are constantly evolving and include actions such as restoring and measuring peatlands, agroforestry, and maintaining and enhancing SOC on mineral soils and livestock. However there are challenges in the implementation of these technologies at scale and ensuring that results are collected and fed back across all stakeholders to ensure learning is adopted or adapted to suit other applications

Given the diverse nature of the sector and the risk that an attempt to explore all sectors would result in over generalisation, two specific sectors have been explored as example case studies. Consumers are enormously influential stakeholders in the food and drink sector and their behaviour affects how all stakeholders act and produce. SF&D has the opportunity to engage

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with consumers most directly through engagement with stakeholders at the primary production level who may be the closest to the consumer. What follows is an overview of challenges facing stakeholders at the primary production and consumer-facing levels on their pathway to net zero.

3.1 Challenges for Farmers

Farmers are feeling pressure from many directions and are often seen as part of the problem rather than the solution. This may be a reflection, in part, of the general disconnect between traditional farmers and the wider public. Many studies have shown that farmers feel undervalued, identifying a lack of understanding from the general public about what is involved in farming and its unique pressures (Wheeler, et.el, 2022)

This may be reflected in the challenges associated with attracting labour to the sector post pandemic. The UK Government House of Commons Environment, Food and Rural Affairs Committees report (2022) stated that:

> **"labour shortages, caused by Brexit and accentuated by the pandemic, have badly affected businesses across the food and farming sector. If not resolved swiftly, they threaten to shrink the sector permanently with a chain reaction of wage rises and price increases reducing competitiveness, leading to food production being exported abroad and increased imports. We are also extremely concerned about the impact this is having on the well- being and mental health of people working in the sector."**

These systemic challenges threaten to slow the progress of low-carbon innovation as farmers look to adapt to a changing economic environment. Further, there is a growing feeling that the farming sector should be exempt from net zero targets and concentrate resources on the production of food (Independent 2022). However the National Farmers Union has emerged as a vocal proponent of change, setting a net zero goal by 2040.

The exit from the EU market has radically changed the funding landscape, resulting in the end of a number of key payment schemes, leaving farmers to navigate new application processes. In Scotland, many of these new payment schemes are tied to the implementation of carbon-reduction practices, such as woodland creation or peatland restoration. Although the support may be available, for many farmers this will require knowledge of not only the new application process, but also these methods of sustainable land use.

While the access to digital knowledge has expended to almost unlimited levels, best practice is often more likely to come from trusted sources than researchers and academics. Recent research suggests that farmers regularly used online sources to access soil information, and some were prompted to change their soil management by farmer social media influencers and peers. However, online information and interactions were not usually the main factor influencing farmers to change their practices: Farmers placed most trust in other farmers to learn about new soil practices and were less trusting of traditional experts, particularly agricultural researchers from academic and government institutions, who they believed were not empathetic towards farmers needs (Rust, 2022). Work is needed to improve trustworthy knowledge exchange between agricultural stakeholders to increase uptake of sustainable soil and low carbon

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management practices, while acknowledging the value of peer influence and online interactions for innovation and trust building.

Scenario modelling studies show that it is unlikely that we will be able to meet the target to limit climate warming to "well below 2 degrees C" outlined in the Paris Agreement without removing a significant quantity of greenhouse gases from the atmosphere (Michael, 2021). The use of Greenhouse Gas Removals and Abatement Technologies (GGRs) within the agricultural sector has the potential to significantly impact a wide range of emissions sources, including land competition, greenhouse gas emissions, physical climate feedbacks (e.g. albedo), water requirements, nutrient use, energy and cost,

Preliminary analysis suggests that widespread implementation of GGRs could have significant impacts on land competition, greenhouse gas emissions, physical climate feedbacks (e.g. albedo), water requirements, nutrient use, energy and cost, but that soil carbon sequestration and biochar used as GGR practices have significant potential for GGR (4-6 thousand million tonnes of carbon dioxide per year, together), and can do so with much less competition for land, water and nutrients than, for example, bioenergy with carbon capture and storage and afforestation, and at much lower cost than enhanced mineral weathering and direct air capture of carbon dioxide (Michael, 2021).

Having said that, woodland creation is an increasingly important tool for sequestration of atmospheric carbon, and markets have been formed to support corporations and other large emitters in planting trees and offsetting emissions they cannot otherwise reduce. Although touted as a solution, farmers in Scotland are increasingly wary that land will be prioritised for woodland creation and that this may create scarcity for farmable land in a region that already is characterised as being suitable primarily for rough-grazing (Food Atlas). This wariness is functioning to classify farming and woodland creation separately, entrenching actors in each category. It is important here to acknowledge the significance and sustained memory of the Highland Clearances in the 18th century, during which farmers and land-users were forced off their land in order to make space for “innovative solutions.” This is to say, there is some precedence for wariness around such “solutions”.

While there are some spaces for farmers to get information on how to incorporate woodland effectively onto their farmland, planting the right tree in the right place and in ways that may diversify their income and benefit their land and livestock, this requires knowledge of how to access these spaces and the time, energy, and capital to do so.

The cost-of-living crisis in the UK is affecting food prices and changing the way that consumers shop, which directly impacts farmers’ livelihoods. The costs of farming inputs, like fertilisers and feed, are rising, stemming in part from the war in Ukraine.These factors, especially combined, may work over time to encourage alternative, lower emission methods of farming that require fewer fertilisation inputs and local alternatives for feed, but they may initially act as stressors on an already stressed community, building barriers along the pathway to net zero.

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As a driver for change, Farmer Led Groups were established to develop advice and proposals to the Scottish Government on how to cut emissions and tackle climate change as reaffirmed in the recently published Climate Change Plan update. A series of workshops and reports have covered a wide range of farming sectors including Suckler Beef, Arable, Dairy and Hill, Upland and Crofting. The reports outline a range of carbon reduction measures and system improvement opportunities, highlighting the challenges facing the industry to achieve to meet Scotland's legally binding 2045 Net Zero target, and the target of a 75% reduction from 1990 levels by 2030.

For example, Less Favoured Area (LFA) based farms accounted for 3.2 million hectares, over half of all of Scottish agricultural land and roughly 30% of all Scottish holdings. Emissions from LFA farms account for around 3.4 MtCO2e, or 45% of total agricultural emissions, nearly all of which are from cattle and sheep. This sector has on average very low marginal returns and is highly dependant on subsidies. The RESAS Hill, Upland & Crofting Farming and Food Analysis Report (2021) outlines a series of potential carbon mitigation measures which, if delivered, suggests reductions of around 0.38 MtCO2e, which equates to approximately 11% reduction in terms of 2018 emissions from the LFA sector or 16% of the 2.4 MtCO2e reductions required by agriculture by 2032 with the remaining 84% needed to come from elsewhere in the sector (RESAS 2021).

This presents a significant challenge for a critically important agricultural sector that is at the heart of the Scottish rural landscape. It also highlights the need to be taking a more wholistic approach to climate mitigation that includes both carbon reduction as well as rural economic sustainability and well-being.

Health and wellbeing are inextricably linked to farm work, which is characterised as physically demanding with a high incident of accidents. According to the Royal Agricultural Benevolent Institutions (RABI) "Big Farming Survey" report, which examines factors affecting farmers in the UK in the 2020s, over 20% of farming businesses lost money during the 2019/2020 business year. The overall hectarage of available farming land is declining, as well as livestock numbers. Over 30% of respondents to the survey have low mental wellbeing scores, with over 20% being "probably depressed" and around 50% experiencing anxiety. When asked about the sources of their stress, 43% indicated bad or unpredictable weather (a direct symptom of climate change), 31% indicated public and/or policy pressure re the environment, and 30% indicated not feeling valued by the public.

Without proper support, farmers may not be able to incorporate low-carbon, low-GHG methods into their operations, while maintaining liveable conditions. And this is affecting how and what these producers communicate to their customers.

4 Scoping the Food and Drink Network in Scotland

As outlined earlier much of Scotlands land is characterised as LFA (Less Favoured Area), with an estimated 59% suitable only for "rough grazing" (Food Atlas). Livestock farming predominates the agricultural sector, with beef production valued at over 675 million GBP (NFUS). 74% of the arable land is used to grow cereals, with around half of the crop used as

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livestock feed and around one third for beer and whisky production (Food Atlas). Vegetables are grown on an estimated 3.3% of arable land, and so most consumed vegetables are coming from outside of the country (Food Atlas).

Scotland is known for its unique pattern of land ownership, with the highest concentration of land ownership in Europe, with the most land owned by the fewest people. It is hard to get accurate data on who owns the land, as there has historically been little or no oversight over land transactions. Since powers were devolved from Westminster to Scottish Parliament in 2019, there has been more awareness of this pattern of land ownership and of the possible implications of this situation. This has coincided with rising awareness of Scotland's natural capital potential and an exponential increase in the price of land. There has subsequently been much movement around land justice and towards community ownership of land, guided in part by the Land Reform (Scotland) Act 2003.

The food and drink network in Scotland is wide-ranging, with Scotland Food and Drink serving enterprises as large as the National Farmers Union, with 9,000 members, to the Scottish Organic Milk Producers, Ltd, with 20 members. Producers are united, though, through shared goals of ensuring quality products for consumption throughout Scotland, the UK, and internationally, while maintaining quality living and working conditions.

A summary review of the key Tier 1-5 food and drink stakeholders showed that the food and drink sector has a number of evidence gaps in its public reporting on carbon management (See Appendice 2). In undertaking a review of the current carbon reporting environment an evidence score was used to qualify levels of published activity on carbon management.

Evidence Score

1 Little or no evidence

2 Some evidence but difficult to qualify

3 Some evidence but incompletely reported

4 Good evidence with a degree of reporting transparency

5 Excellent evidence and reporting transparency

We looked at seven evidence criteria:

- Evidence of internal commitment to carbon reduction (Carbon Management Plan)
- Evidence of cross sector initiatives on carbon reduction
- Evidence of collection or dissemination of guidance on carbon reduction
- Evidence of promoting learning/capacity building in carbon management/ skills/ technology

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- Evidence of internal carbon management strategy/plan
- Evidence of supporting or promoting systems or initiatives for carbon reduction

Our desktop based review into 53 particular stakeholders in F&D sector in Scotland found that approximately 80% had no outwardly facing carbon strategy. While there some very good examples of level 5 evidence, (e.g. farming and agriculture, dairy, seafood, whisky) very few organisations were able to demonstrate excellence across the board.

Table 1. Summary percentage of surveyed organisations ranked by score (1-5)

Score	Evidence of internal comittment to carbon reduction (Carbon Management Plan)	Evidence of cross sector initiatives on carbon reduction	Evidence of collection or disemination of guidance on carbon reduction	Evidence of promoting learning/capacity building in carbon management/ skills/ technology	Evidence of internal carbon management strategy/plan	Evidence of supporting or promoting systems or initiatives for carbon reduction
1	86.5%	76.9%	78.8%	80.8%	88.5%	80.8%
2	7.7%	7.7%	5.8%	1.9%	3.8%	1.9%
3	1.9%	5.8%	9.6%	7.7%	5.8%	5.8%
4	3.8%	7.7%	3.8%	7.7%	1.9%	7.7%
5	0.0%	1.9%	1.9%	1.9%	0.0%	1.9%

This desk based study should not be seen as a definitive assessment of the carbon management activity within the sector. There will be cases of excellent work but not publicly available or that our survey did not include. It might be seen as an indicator however that the sector, particularly small to medium sized organisations, as a whole is still in the early stages of the net zero pathway.

4.1 Challenges for SMEs

Small to medium sized enterprises (SMEs), characterised by employing 250 or fewer staff and making up an estimated 95% of Scotland's food and drink businesses (FDF Scotland), will not themselves be major emitters, and so their plan for net zero requires understanding of their Scope 3 emissions. This is a challenge in that it can be difficult to get this type of information even when there is a willingness on behalf of the SME to do so.

Case Study – Jessica Elliott Dennison is the owner of Elliott's, a busy restaurant in Edinburgh which highlights seasonal, homegrown and foraged dishes. According to Dennison: "*My customers care about where their food comes from; our menu is small, it changes seasonally, and I'm sourcing from what I know to be 'the best'. But still much of the information is assumed and not clear – for instance, if you're buying from local suppliers, it is assumed that their footprint is lower than less-than-local suppliers, but still the numbers are not readily presented".*

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The challenges outlined in section 3.1 have the potential to trickle down into challenges for SMEs, in that even when those in charge of the enterprise are cognisant of the benefits of sustainable sourcing, they may not have the information or evidence readily available to make better decisions. SMEs have limited resources, and many businesses are just now regaining footing lost during the Covid crisis. They are trying to maintain functional day-to-day operations, to now be faced with "more work to do" to achieve net zero.

5 Greenhouse gas emissions accounting

5.1 Greenhouse Gas Protocol

The Greenhouse Gas Protocol, published by the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI), outlines reporting principles. Scope 1 covers direct emissions from company owned vehicles and facilities. Scope 2 includes net emissions from energy imports and exports. Scope 3 includes other indirect emissions resulting from company activities, as detailed by the established boundaries. Upstream Scope 3 emissions relate to material acquisition and pre-processing, while downstream Scope 3 emissions relate to distribution and storage, use, and end-of-life of a product. The GHG Protocol outlines five accounting and reporting principles, intended to ensure true and fair reporting of company emissions: relevance, completeness, consistency, transparency, and (as far as practicable) accuracy (Corporate-Value-Chain-Accounting-Reporing-Standard_041613_2.pdf (ghgprotocol.org)).

5.2 Challenges and considerations

Given the complexity of supply chains, there is usually considerable uncertainty in all carbon footprint figures. A major challenge for GHG emissions accounting is the establishment of assessment boundaries. Some of the issues and ways of approaching them have been outlined in the methodology of a published report for the food and drink sector (The greenhouse gas footprint of Booths):

The term 'footprint' can be used to mean the sum of the direct and indirect emissions that arise throughout supply chains of activities and products. As an example, the footprint of yogurt includes contributions for carbon dioxide, methane and nitrous oxide emitted on the farm and the footprint of transport, processing, packaging and storage of the product prior to sale. To give another example, the footprint of vehicle travel includes not only the direct vehicle emissions as covered by emissions factors issued by DEFRA, but also components for the extraction, shipping, refining and distribution of fuel, and components for the manufacture and maintenance of vehicles, and so on".

Clear identification of boundaries (within and between sectors, or tiers) is crucial to avoid either excluding or double-counting emissions sources. Establishing boundaries involves specifying the components included and excluded. Despite the complexities and uncertainties involved, the inclusive treatment of supply chain emissions gives a complete and realistic view of impacts. Footprints of this kind are essential metrics for responsible management (The greenhouse gas footprint of Booths).

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5.3 Cross-sector Carbon Accounting

A coordinated approach to greenhouse gas emissions accounting is needed between, and within, every tier. It is important that consistent methodologies are applied. Various sector-specific carbon calculators and tools exist and should be fully transparent with their methods and emissions factors.

Coordination of GHG accounting within and between sectors may be facilitated by their representative organisations. For example, actions to measure emissions by farmers (primary producers) may be supported by the Scottish Beef Association (Tier 5), and managed across tiers at wide scale (regional landscapes) by National Farmers Union Scotland (Tier 2) or at institutional level (Scotland Food and Drink) and governmental level (Scottish jurisdictions) (Tier 1). Providing a relevant case study, the Scottish Government introduced the Beef Efficiency Scheme (BES) in 2014, requiring all participants to complete carbon audits for their businesses. A specialised online farm carbon calculator, "Agrecalc", was selected to support more than a thousand beef farmers and the Scottish Government with this coordinated process (Beef Efficiency Scheme Agrecalc).

However many farmers have expressed some wariness with carbon calculators, with many overlapping programmes and initiatives. Early work should be undertaken to map and scope various systems with a view to consolidating rather than reinventing, duplicating and potentially duplicating existing efforts.

Progress going forward should include a deeper review of current data collection efforts across the sector, what information is already being monitored and where the gaps might be. This work should be seen as part of a wider consultation exercise where a clear understanding of not just what carbon metrics are required for national reporting, but also what is needed to monitor to better understand how the system is responding to wider policy initiatives and sector specific drivers.

6 Exploring Potential Solutions

The Climate Action Plan commits to ensuring that the transition to net zero is done in a just and fair way. In this respect the most important tool available to SF&D is the ability to build resilient trust-based relationships.

Trust and trust are built through honest dialogue, with applicable, accessible data relevant to the perspective of different stakeholders in the system. Reframing challenges as opportunities for solutions, whilst recognising and acknowledging efforts taken to date is important. Stakeholders must also be able to 'view' themselves and their efforts as a part of a whole solution and be recognised for both small steps and major improvements, as even relatively small changes may be considered as significant at differing scales of operation.

Working with a shared purpose towards a shared goal is an important first step in bringing people together and creating a culture of solutions-based action. Developing transparency in the supply chain will necessitate engaging with stakeholders, and while surveys are a good tool in

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co-development, they require effort from already busy people, who especially recently (as co-development has taken off as best practice) may have already been asked to participate and fill out many surveys.

A staged approach where a smaller group of climate informed stakeholders that have the early opportunity to frame the language used and ensure any new system is relevant to potential users is important. Wider engagement needs the luxury of time to develop momentum, and needs to be explored at a grass-roots level.

7 Addressing Food and Drink Complexity Using a Systems-Based Approach

In exploring alternative approaches to achieving net zero we have attempted to incorporate a number of systems thinking principals and practical applications. These include both initiatives specific to food and drink as well as the public sector and more traditional systems thinking literature. It is a consistent theme in design thinking literature that in order to achieve different outcomes we need to do things differently. In his book, Systems Thinking for Social Change, Stroh (2015) explores the difference between conventional and systems based thinking (See Table 1.1). We briefly outline some of that as a precursor to the SFD template as it does form some of the philosophy behind the template.

One of the key messages from Stroh's work is the best way to optimise a system is optimise the relationship between its parts, not to optimise each part separately. Similarly the recent community mapping work undertaken by Free Ice Cream and the Onion Collective also suggests that connectivity within the system is the best indication of its resilience and capacity for adaptive change.

Table 2. Conventional vs Systems Thinking (Innovation Associates Organisational Learning, Imperial College Business School, London)

Conventional Thinking	Systems Thinking
The connection between problems and their causes is obvious to trace	The relationship between problems and their causes in indirect and not obvious
Others, either within or outside our organisation, are to blame for our problems and must be the ones to change	We unwittingly create our own problems and have significant influence or control in solving them through changing behaviour
A policy designed to achieve short-term success will also ensure long-term success	Most quick fixes have unintended consequences
In order to optimise the whole we need to optimise the parts	In order to optimise the whole we need to improve the relationship between the parts
Aggressively tackle many independent initiatives simultaneously	Only a few key coordinated changes sustained over time with produce a large systems change

The interconnectivity of the Food and Drink sector creates challenges for moving that sector towards net zero operations. There are numerous initiatives currently at various stages of implementation. While any efforts are to be welcomed overdiversification can lead to a fragmentation and dissolution of effort. Therefore, any system that attempts to create a

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standardised process and language requires an evidence-based approach to gain traction and wider buy-in.

Some innovative work being done around Human Learning Systems at Newcastle University by Dr Toby Lowe emphasises the need to build trust-based relationships; that learning and capacity building should be the primary success indicator and that good systems create good outcomes.

The Human Learning Systems (HLS) was originally designed to assist organisations whose goals are complex, such as the public service and healthcare sectors. A defining feature of HLS is the non-linear relationship between causes and effects, which is recognized as being more complex than "a" results in "b", and also the importance of cultural/paradigm shifts, understood to be the deep leverage points that may be better motivators towards lasting change and embed best practices.

HLS emphasises the role that trust plays in functional systems – stakeholders must be able to trust the system that is being developed. This is more likely in an environment where stakeholders contribute in the early design and development stages, emphasizing the importance of seeing oneself as valuable and as a part of a larger system.

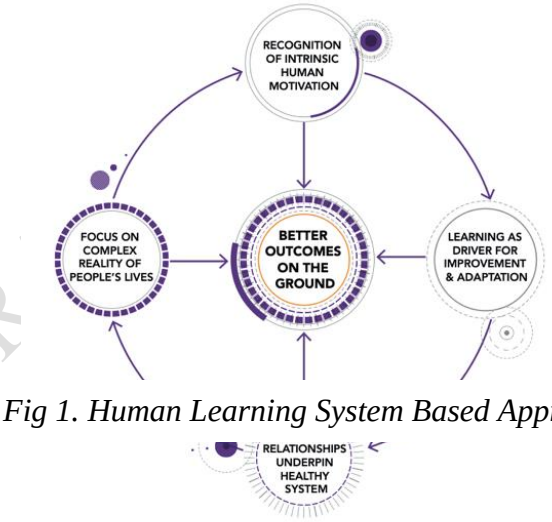

Fig 1. Human Learning System Based Approach

A key function of HLS is the construction of "Learning Cycles", a methodology for encouraging co-development and design with stakeholders at various levels throughout the supply chain, and also for continued experimentation and exploration of co-designed solutions, to encourage feedback and re-design.

This approach rejects a top-down approach, in which a government body e.g. conducts research, diagnoses the problem, thinks up a solution, and enforces that solution with limited feedback, Alternatively, spaces are made for the acknowledgement of issues and the co-development of potential solutions from the ground-up, with feedback loops designed to flow between and among stakeholders, from those "being served" to those "serving" This framework attempts to develop a HLS based approach to understanding how a 'healthy' system might be articulated and how we might start to benchmark best practice against a common set of best practice indicators.

It also recognises that people and the building of trust-based relationships are at the heart of an effective functional system. This approach recognises that there are common goals that are best achieved by aligning strategic thinking, welcoming innovation and creating space for iterative change.

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8 Food and Drink Carbon Systems Mapping Framework

There were two key elements explored within this report. Firstly to develop a framework that mapped the complete food and drink system within a Scottish context, that facilitated the ability to explore both horizontal and vertical relationships between stakeholders and opportunities for partnership working. The second was to develop a methodology for defining and measuring the maturity of the systems that manage carbon outcomes within the food and drink sector.

One of the key aims of the report was to take a more wholistic view of how the food and drink sector 'works' as a system with a view to developing pathways to net zero. While a complete systems map is beyond the context of this report, it was considered important to firstly create a contextual map of the complete system that facilitates an understanding of the relationships between different stakeholders.

This recognises that the sector has both spatial and temporal dimensions and to attempt to demarcate sub-sectors by geographical location or sector leads inevitably to issues over boundaries and co-produced impacts, particularly when applied to measuring scope 3 carbon emissions. The Stakeholder Mapping Framework (Fig 3) was an attempt to structure the food and drink sector into five "tiers' that represent a hierarchy of commonality between stakeholders.

8.1 Framework Design Philosophy

A tiered approach was used to develop a narrative around how to create a core design philosophy. Traditional systems thinking would suggest that we want to be think of the system as a whole, but there is also a need to qualify activity, objectives and motivations at different levels of the food and drink sector.

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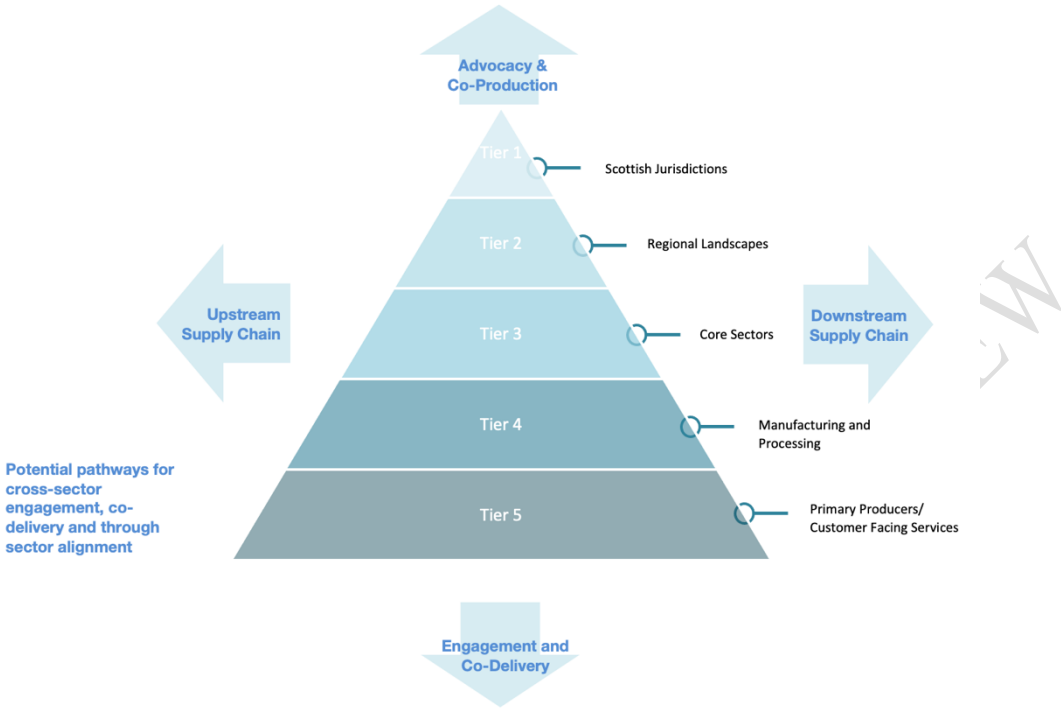

Fig 2. Pyramid diagram of a Tiered approach to stakeholder mapping the F&D sector

A five-tiered approach was developed that categorised stakeholders in a hierarchy of representational jurisdictions and regional landscapes. While it has the highest representations at the top of the tier it could have been equally shown the other way around, indicating that the primary producers are of primary interest. However, representing by numbers alone would naturally see the Tier five as representing by far the largest group by size. The diagram also recognises that SF&D is itself part of a wider network, both upstream in terms of supply chain, downstream consumers, as well as representing a significant proportion of the wider Scottish economy.

The 2019 Accountability Framework Initiative report (2019) Achieving Commitments Through Collaboration sets out the case for identifying jurisdictional, regional landscapes and sectors to promote supply-chain collaboration. While they primarily apply this in an international development context the principals are a useful one for modelling the Scottish F&D environment.

The Scotland Food and Drink Stakeholder Mapping Framework, (see Fig 3.) sets out how a multi-sector cascading model that might bring together the various stakeholders in the SF&D ecosystem.

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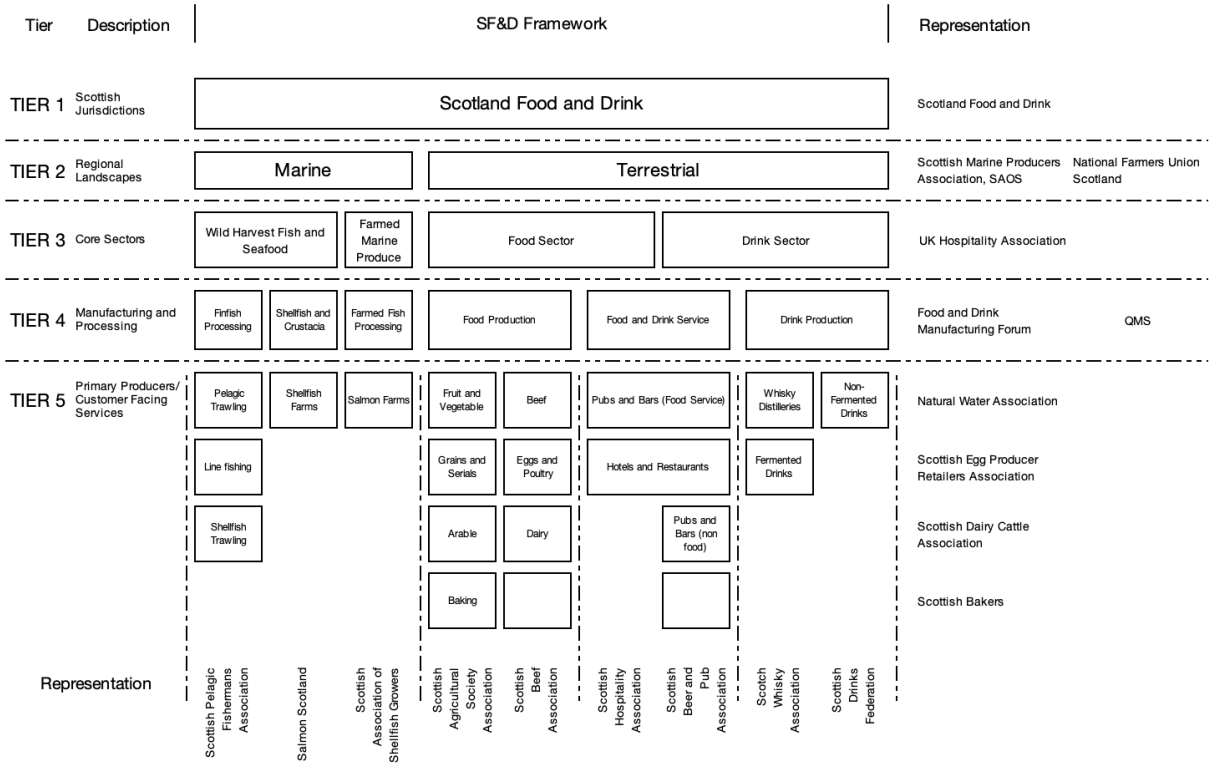

Fig 3. Scotland Food and Drink Stakeholder Mapping Framework

The overall purpose of the Framework is to explore the relationships between different 'levels' of the sector. To reiterate this does not suggest a hierarchy of importance or influence, rather a way of creating a Systems Map that illustrates how each sector might 'fit' within a governance framework and where opportunities exist for cross-sector partnership and collaboration.
The Framework might best be described as an attempt to explore both vertical and horizontal opportunities for information exchange. This exchange includes sharing of best practice, policy advice and clarification, signposting opportunities and funding support (top down), or data collation and reporting, feedback on priorities and needs and case studies (bottom-up). Opportunities also exist for horizontal information exchange which might include adaptable innovative practices, opportunities for co-development and supply-chain efficiencies. These might be summarised as:

Table 2. Opportunities for Information Exchange

		Horizontal Information Exchange		
Vertical Information Exchange		**Policy Alignment**	**Best Practice**	**Net Zero**
		Policy alignment from jurisdiction to sector specific stakeholders	Sector relevant best practice case studies	Information and feedback pathways on net zero experiences

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Feedback on policy reception and effectiveness	Opportunities for cross-sector learning	Carbon metrics alignment
Alignment between regional representation and primary producers	Small producers are engaged with best practice learning	Common use and understanding of language and reporting

While the Framework is a representational model of the Scottish Food and Drink sector it should be recognisable from a 'real world' perspective in that its aim is to be an operational tool, rather than an academic exercise. It should also be populated and recognised by the businesses and people it represents. An important early step is to engage with a broad audience to explore how it might 'work' at the various tiers. This engagement in the early design stage will be an important element in any new initiative to get local level buy-in.

When we look at the data from the desktop review from the perspective of how organisations in each Tier are evidencing their carbon management, the graph below shows that the better performing organisations are operating in Tier Level 3 (29) and 4 (25.3). This score is the average across the seven categories outlined in Table 1.

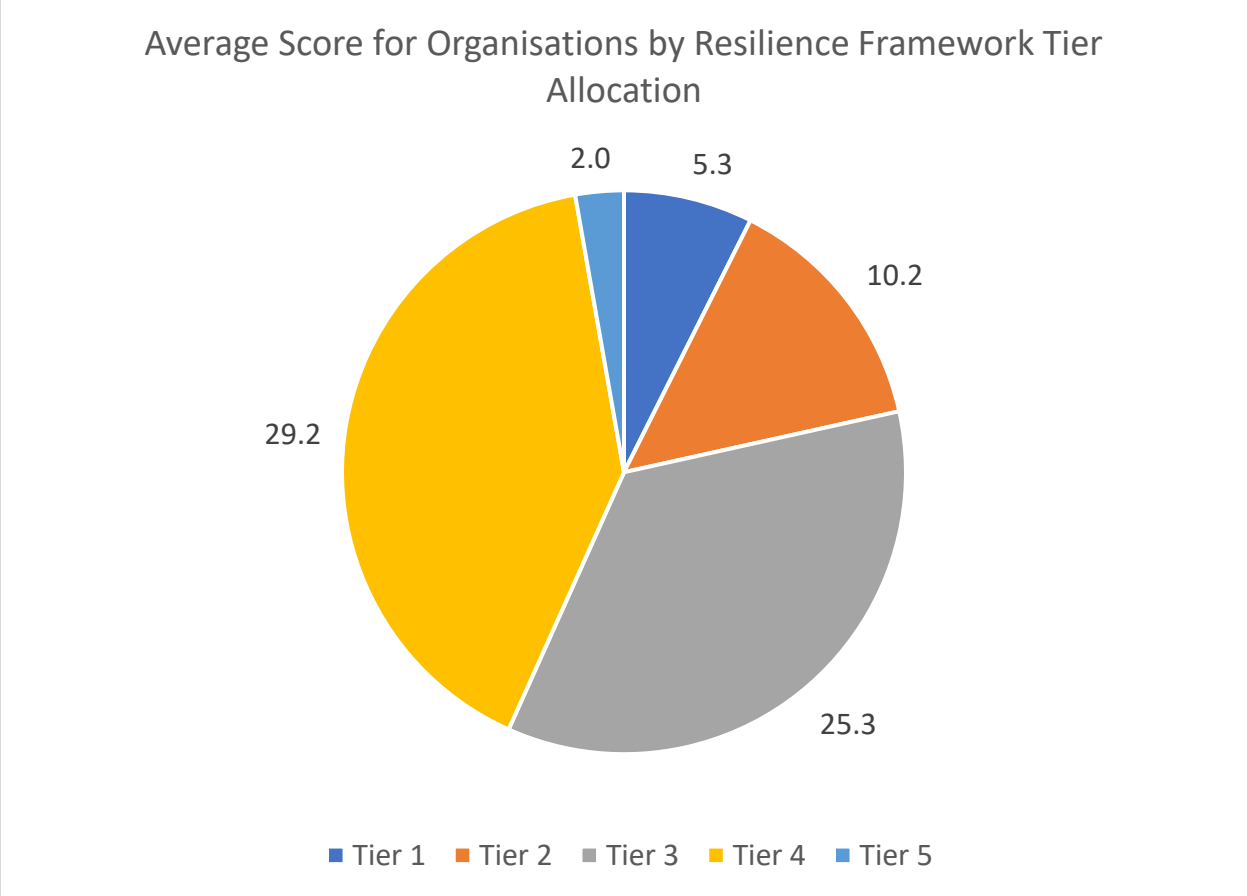

Fig 4. Average score for organisations by Resilience Tier allocation across all seven categories.

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This might suggest that those organisations that are better at evidencing carbon management are those that are operating at a sector representational level, (i.e. Dairy Association, The Malt Whisky Association) which might be a result of better marketing, better resources to gather and report or competitive pressure (See Appendice 2 for full data set).

9 Carbon Systems Benchmarking Template

It was also considered important to explore not just how to measure emissions, but more importantly, how to define and measure the processes and procedures that manage carbon emissions. The result of which was the development of an interactive Net Zero Benchmarking Template (NZBT) was developed that identified progress against targets for agreed sectors that align with Scottish Government net zero pathway objectives.

The template maps the systems that produce good carbon outcomes and facilitates specific sectors to map an organisations progress against each indicator. The NZBT would (where appropriate) align with current F&D NZ initiatives (i.e. Courtauld 2030, NFU Farm Status Indicator, Sustainable Food Trust) and aspire to support and signpost how these initiatives could be allied.

The template had a number of key desired design principals:

1. Be representative of the current food and drink sector in Scotland
2. Facilitate aligning mutually reinforcing policies across all sectors that span traditional operational and regional-based food and drink sectors;
3. Facilitate the ability to set robust targets for good human, ecological and well-being outcomes aligned with Scottish Government net zero objectives;
4. To facilitate the ability to develop multi-regional, cross-sector, and cross-silo impact evaluations to ensure system-wide positive outcomes;
5. Increase awareness of how each player contributes to both the problem and the solution;
6. To support and mobilise diverse stakeholders to take actions that increase the effectiveness of the whole system over time rather than meeting their immediate self-interests.
7. Identify high leverage interventions that support decision-making focus on investing limited resources for lasting, system-wide improvement;
8. Motivate and support continuous learning.

While the template outlined below does not cover all those bases, it may, once fully developed provide a mechanism for achieving those outcomes. Another important outcome would be to support and enable diverse stakeholders to see the bigger picture and their role in a bigger purpose. It would also ideally catalyse conversations around accountability and where roles and information flows are shared or mis-aligned.

As discussed in Chapter 2 we have adapted a number of methodologies in design of the framework. Key to this is the Human Learning Systems approach developed by Toby Lowe and the team at Newcastle University. This revolves around three core principals:

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1. **Engagement and Co Design** - Foster and develop trust-based relationships (human)
2. **Learning and Capacity Building** - Focus on capacity building and experience as primary outcomes (learning)
3. **Systems and Co Delivery** - Foster and support partnership working to address complex systems by taking an integrated approach (systems)

From these core principals a subset of nine Activity Headings (three per core principle) evidences how each of the core principals is described and delivered (See Table 3). These nine activity headings can be seen as describing an area of work that builds on the capacity of the system to deliver outcomes. From this basic template we can start to build a map of what an effective carbon management framework would look like for a wide cross-section of organisations in the Food and Drink sector.

It is important that any framework is sufficiently generic to be used by a wide range of stakeholders and at the same time ensure there are common elements that run through every level of the framework. This is particularly important when thinking about data collection and consistency between food sectors from a strategic perspective (e.g. UK governments *Government Food Strategy*). It also needs to be sufficiently specific to the needs and interests at each Tier in order to reflect the diversity of business and interests across the system.

The risk is that the framework becomes too complex to navigate which means possibly being not used or poorly understood or so generic that that language used to describe activities is difficult to apply at each level. To manage this the definition of what each Activity Heading is specific to the Tier, i.e. that Tier 1 Engagement and Co-Design has the same three Activity Headings. How to theses are subsequently mapped is specific to each tier.

For example Stakeholder Engagement will be different for a national representational body (i.e. Scotland Food and Drink, Tier 1) to a primary producer (i.e. Mackies Crisps Tier 5) or a sector specific representation body (ie.. Scottish Dairy Cattle Association, Tier 4).
While this might be impractical to implement in a static word document, when filtering is used (either web-based or within the appending excel spreadsheet), it becomes easier to navigate the sector of interest.

Table 3. Cores Principles and Activity Headings

Core Principle	Activity Heading
Engagement and Co Design	Stakeholder Engagement
	Internal Engagement and Cultures
	Partnership and Co-Design
Learning and Capacity Building	Shared Values
	Learning Based Outcomes
	Shared Learning

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Systems and Co Delivery	Information and Technology
	Carbon Awareness
	Carbon Systems

9.1 Tier Level Description and Filtering

The description of the Activity Heading at each Tier is relevant to that Tier level. To avoid swamping users with tables of text, the tool asks the user to define the Tier they are working at, which filters out the rest of the system.
Table 4. Example of the description of Activity Heading at each tier level for Engagement and Co-Design.

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Table 4. Example descriptions of Tier categories for Engagement and Co Design

Engagement and Co-Design			
Tier	Stakeholder Engagement	Internal Engagement and Cultures	Partnership and Co-Design
1	Working with key policy stakeholders to advocate on behalf of the SF&D industry	Internal strategic vision and mission cultures align with SG net Z\zero objectives	Develop and support cross-sector initiatives in achieving strategic net zero objectives
2	Signpost and promote relevant carbon reduction policies and disseminate best practice strategies. Endorse value of stakeholders within net zero pathway	Internal organisation vision and mission cultures align with F&D sector net zero policy objectives	Signpost and promote best practice for carbon management through membership (stakeholder) engagement
3	Signpost and promote relevant carbon reduction policies and disseminate best practice strategies. Endorse value of 4stakeholders within net zero pathway	Internal organisation vision and mission cultures align with F&D sector net zero policy objectives	Share supply chain mapping and traceability information, best practice strategies and partnership opportunities
4	Co-develop carbon reduction commitments with upstream and downstream stakeholders	Organisation vision and mission align with F&D sector net zero policy objectives	Improve supply-chain efficiencies through co-development and delivery opportunities. Prioritise carbon-neutral/carbon-negative procurement standards
5	Engage with supply chain and customers on carbon reduction commitments	Organisation and supply chain actors commit to carbon reduction objectives	Improve supply-chain efficiencies through co-development with others in the industry. Prioritise carbon neutral/carbon-negative procurement standards

While this may at first seem like itself is a complicated system, however the tool needs to be able to reflect the needs of organisations at each level or be so generically described that it becomes vague and unclear.
Appendice 1 is a screen shot of the Evidence Template, showing how each action is scored by one of the five levels and how the system creates a radar chart of progress. The Benchmarking Tool an attempt at qualifying the System Maturity for carbon management within an organisation. This is best viewed in the Excel tool where the functionality of the template illustrates how the tool creates a visual score of system maturity from which decisions around what actions to prioritise can be made.

The tool is therefore a method for taking a 'snapshot' of an organisations process which can be used as a benchmark for subsequent reviews. It also sets out the next steps in the implementation of a fully functional system. Organisations can then choose which actions they will commit to over the next 12 months, hence building a pathway to improving year on year. When used in conjunction with a carbon calculator (not designed) it becomes a very powerful tool for SMEs to develop net zero strategies and demonstrate progress and ambition.

10 Conclusion

The aim of this initial phase of work was to develop a framework that supports the F&D sector to better understand current progress towards net zero targets, understand data and information gaps and explore opportunities for follow-on studies and initiatives. It became evident that the F&D sector is hugely complex and presented a number of particular challenges associated with allocation of responsibilities, managing potential overlaps in carbon reporting, particularly with Scope 3 emissions. This project was an attempt to create a template that could be used to explore this complexity and begin to create an overarching structure which described and qualified the systems and processes that create the carbon outcomes.

The template arises from the premise that there is value in addressing the systems that are creating the outcomes (carbon emissions), rather than just the outcomes themselves. By exploring and understanding the process used to manage behaviour we get better transparency into where the numbers originate and how to deliver real systems change.

A key next phase of work will be to explore the existing food and drink carbon accounting methodologies, and the level at which the processes are appropriate to the scale and location of the producer. A recent report by Scottish Farmer suggests that Scottish farmers have been poorly represented by carbon assessment tools to date, which fail to account for differences in farming systems, such as land types or management practices. Scotland's new Agricultural Reform Programme (ARP), Scottish Government recently published a detailed road map, will focus more attention on improving business resilience and profitability through a natural capital perspective and extend beyond carbon. Scottish primary producers therefore need appropriate software and guidance that allows them to easily manage all aspects of natural capital, including biodiversity and water quality.

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11 Possible Next steps

An outline of potential next steps has been summarised below:

Timeline	Action	Outcome
Within the next month	• Convene a post report meeting to review findings and explore opportunities/appetite for second phase project	• Short term action plan • Commission scope of work for second phase
Within 3 months	• Convene SF&D working group to explore second stage • Undertake select group initial consultation to 'pitch' Framework as a workable concept • Explore funding opportunities	• Explore potential partnership opportunities • 3 year action plan
Within 6 months	• Develop and deliver sector specific consultation exercise to develop carbon management system template for each Tier/Sector • Rollout Pilot Study for one region in Scotland	• Complete Carbon Mapping Template for each Tier and sector specific mapping
Within the year	• Mapping system digitisation • Rollout Scotland wide programme	• Collective agreement on pathways to Net Zero Scotland food and drink sector

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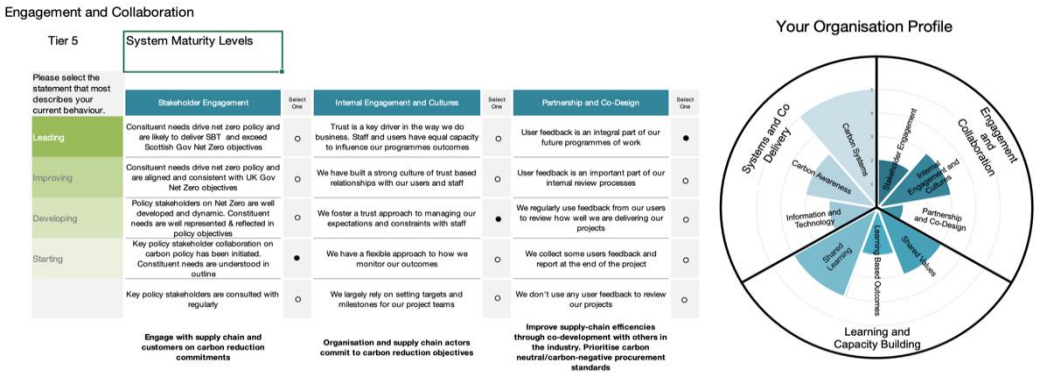
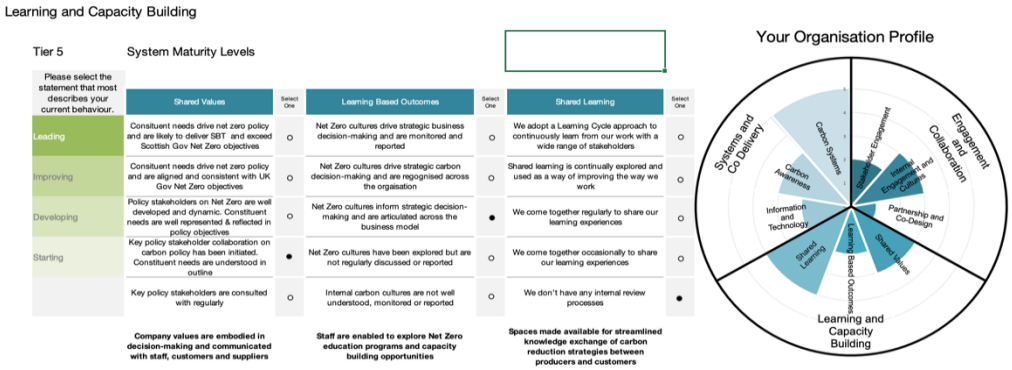
12 Appendices

Appendix 1 – Carbon System Maturity Evidence Template

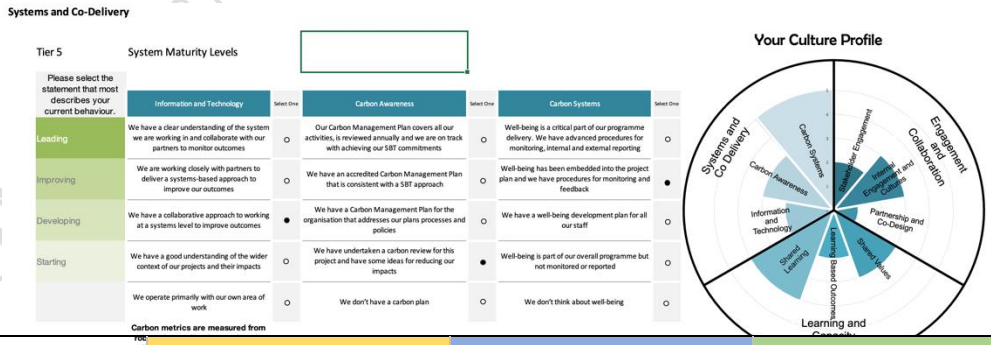
Engagement and Collaboration



Learning and Capacity Building



Systems and Co-Delivery



Appendix 2 - Summary High Level Assessment of Carbon Systems in Scotland's Food and Drink Sector (Tiers 1 – 5)

	Engagement and Collaboration		Learning and Capacity Building		Systems and Delivery		
Sector/Actor	Evidence of internal commitment to carbon reduction (i.e. Carbon Management Plan)	Evidence of cross sector collaboration on carbon reduction	Evidence of collection or communication of carbon data on carbon reduction	Evidence of promoting learning/capacity building on carbon management/skills/technology	Evidence of internal carbon management strategy/plan	Evidence of supporting or promoting systems or innovation for carbon reduction	Tier
National Farmers' Union	1	2	3	3	1		2
Food and Drink Federation Scotland	1	3	3	4	1	1	1
Fisheries Management Scotland	1	1	1	1	1	1	2
Scottish Whisky Association	2	3	3	3	1	3	3
Scottish Distillers Association	1	1	1	1	1	1	3
Dairy UK	4	5	5	5	4	4	2
Quality Meat Scotland	1	1	1	1	1	1	3
Seafood Scotland	1	1	1	1	1	1	2
Scottish Agricultural Organisation Society (SAOS)	2	4	2	4	3	5	2
Scottish Bakers	1	1	1	1	1	1	3
Salmon Scotland	1	2	1	1	1	1	3

13 References

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