This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 776503
- CIRC4Life-H2020-IND-CE-2016-2017/CIRC-2017/TwoStage

A circular economy approach for lifecycles of products and services

D6.3 On-site demonstration of CEBM with vegetable foods

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D6.3 On-site demonstration of CEBM with vegetable foods

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Summary

The aim of Work Package (WP) 6 is to integrate the three new Circular Economy Business Models (CEBMs) developed in WPs 1-3, including Co-creation of Products/Services model, Collaborative Recycling/Reuse model, and Sustainable Consumption model, into the demonstration cases. WP6 will demonstrate the CEBMs to key actors through the value chain of the electrical and electronic products and farming/ agri-foods (vegetable food and meats). This WP will test, demonstrate and validate the different CEBMs to be developed, in a number of demonstration scenarios, and prepare for up-scaling to other areas.

Deliverable 6.3, On site Demonstration for Vegetable Foods, is the culmination of this, and the main aim of the deliverable is to demonstrate the CEBMs listed above, within the sector of vegetable farming in project partner Scilly Organics (owned by JS). This has involved the following work:

(1) demonstration of co-creation and sustainable consumption of vegetables, such as use of focus groups, creation of new markets and impacts on consumers. Co-creation focus groups across different sectors have enabled the development of new products. The impacts of products from Scilly Organics have been communicated to customers, which also links with the Sustainable Production CEBM. These tasks have overlapped with Tasks 7.2 and 7.3 (Living Labs).

(2) demonstration of sustainable production of vegetables, such as use of environmental impact analysis studies, use of 'before and after' scenarios, implementing sustainable management changes, a Decision Making Tool to make informed decisions on routes to reducing impacts, and reduction in supply chain length. Task 1.2 has complemented this work, along with Tasks 7.2 and 7.3.

(3) demonstration of waste reduction, reuse and recycling in vegetable production, such as an assessment of options for reducing waste, including organic and material items that can be recycled. Through looking at best practice and case studies for waste management on farms, promoting new types of systems, backed up by evidence of environmental impacts to aid decision making. Also, an analysis of options for alternative packaging materials in Scilly Organics and in a trial with fellow organic growers. Complimented by work in Tasks 1.2, 7.2 and 7.3.

These demonstrations were conducted in both physical and virtual events and involved various key stakeholders in order to capture validation for the work that had been carried out. The events showcased the vegetable growing system of Scilly Organics, and work by various consortium partners to demonstrate how the new CEBMs have been implemented through the whole business of Scilly Organics.

Task 6.4 has shown how the CEBMs developed in WPs 1-3 can be implemented in real world scenarios. It has also shown that the methods developed, and the structure for the CEBMs, is also transferable to various industries and sectors both inside and outside of farming, and have the potential to have significant uptake with key stakeholders if they were deployed to the market after the project duration. This work is further explored by Task 8.2.

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Acronyms and abbreviations

Abbreviation	Description
CEBM	Circular Economy Business Model
CO_2	Carbon Dioxide
E-LCA	Environmental Life Cycle Assessment
EU	European Union
LCA	Life Cycle Assessment
LL	Living Lab
OIC	Open Innovation Camp
PDS	Product Design Specification
S-LCA	Social Life Cycle Assessment
WP	Work Package

1 Introduction

The aim of Task 6.4 is to demonstrate the Circular Economy Business Models (CEBMs), created in Work Packages (WPs) 1-3, in the vegetable farming sector.

WP1 developed approaches for the implementation of co-creation of products and services with sustainable features, throughout the production process. This was undertaken by JS by assessing the product scoping with eco-constraints, understanding the environmental and social impacts of production – in specific developed toolsets, and methods of sustainable production.

WP2 was devoted to the development of business models based on the collaborative recycling and/or reuse of goods and products. For vegetables this entailed understanding of reuse and recycling systems for food products, optimising the use of organic wastes to make compost, productive use of outgrade or unsold vegetables or fruits, and the minimisation of packaging waste. Eco-credits offered an opportunity for consumers to be rewarded for certain positive actions.

WP3 aimed to develop methods/approaches to implement the sustainable consumption business model, interacting with the approaches that will be developed within the other two CEBMs. The eco-points method developed in WP1 was considered for application to vegetable products. Increasing awareness for consumers of the environmental and social impacts of vegetables was completed, along with consumer surveys to harness feedback and preferences, to build in to the co-creation process.

The goal of Task 6.4 was to demonstrate exactly, and specifically, how these CEBMs were implemented. Sections 2,3 and 4 of the Deliverable (6.3) will focus on the implementation of CEBMs in vegetable food products by Scilly Organics, which is a small organic fruit and vegetable farm in the UK, owned and managed by project partner JS.

2 Co-creation of vegetable products

2.1 Objectives

CEBM1, the co-creation of vegetable products, has been implemented by JS. There are two distinct types of customers – consumers (individuals) and business customers (e.g. restaurants). The co-creation approach was different for each customer, but the outcomes from both considered to be very important for the success of CEBM1. To achieve this, and implement this CEBM effectively, the following work was completed:

Businesses

- Feedback - asking questions about Scilly Organics, Circular Economy, and the products planned. Use of direct interviews, in conjunction with T7.3
- Use of focus groups to get structured feedback and ask open (not leading) questions
- Co-creation with businesses supplied by Scilly Organics – local pub and café

Consumers

- Feedback - asking questions about Scilly Organics, Circular Economy, and the products planned. Use of surveys, direct interviews and other communications with target groups, in conjunction with T7.3
- Showing the farm to people so the growing system can be explained

Other

- Development of new products and services following co-creation activities
- Co-creation processes embedded in Scilly Organics' business practices
- Life Cycle Assessment (LCA) studies (both environmental and social) were conducted to evaluate the environmental and social impacts throughout the production process, as evaluated in Task 1.2
- Use of Open Innovation Camps to discuss and formulate ideas for new business opportunities and adaptation to Circular Economy
- Testing the Nutritional Density of food at Scilly Organics through a citizen science project

Note that the concept of co-creation to influence Product Design Specifications (PDS) is discussed in the Description of Action (DoA) in much of WP6; however, it is more applicable to industrial processes. For instance, it is well represented in Task 6.2, co-creation of LED lamps (domestic and industrial), where the design of products is actually influenced by the feedback from co-creation participants. PDS is not, however, a concept that works in farming – farming is a 'production process' that lasts at least a year, is dependent on many variables (such as weather and biological systems), and is not the input-output system that many industrial processes are. Therefore, the concept of PDS has to be adapted for farming systems in to a set of principles rather than prescriptive practices or exacting processes per se.

2.1.1 Survey results

A survey of Scilly Organics individual customers was undertaken in summer 2020. An in-person survey was intended to be undertaken, but due to Coronavirus restrictions this was not possible, so an online survey was conducted instead. This was answered by 38 respondents, all of whom were customers at some point, split between local residents (37.5%) and visitors (62.5%).

The survey focussed on some key questions: 1) understanding of eco labels, 2) packaging, and 3) social impacts.

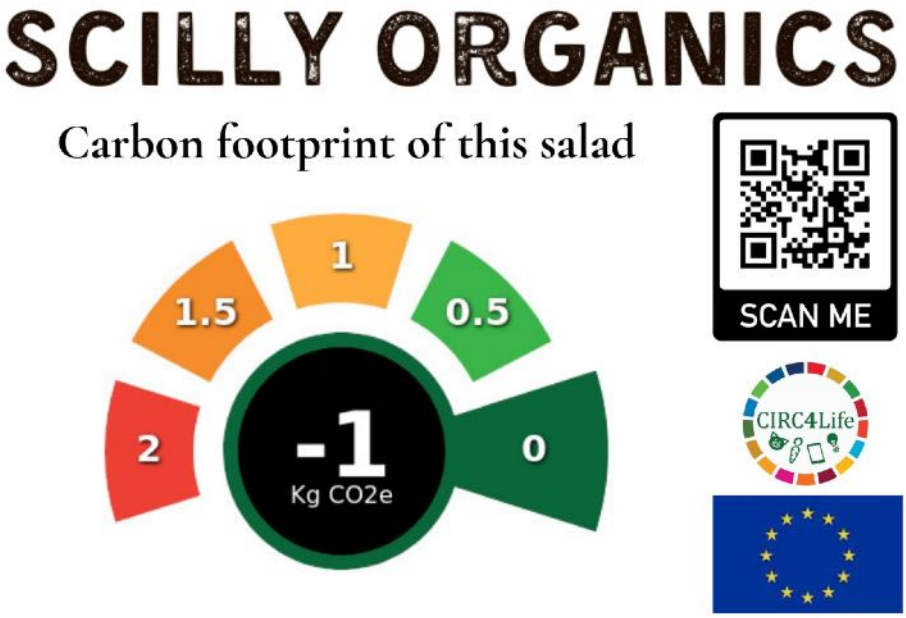


Figure 1: Carbon footprint of Scilly Organics salad bags

1. Understanding of eco labels

To assess the understanding of customer's knowledge of new eco labels produced by Scilly Organics, based on calculations from the LCA and carbon footprint studies. These were calculated for bags of salad and potatoes. Separate labels were created for LCA and carbon footprints. Refer to Figure 1 for an example of the labels.

The labels also had a QR code linking to more detailed information about the calculations behind the labels.

Respondents overwhelmingly understood the meaning of the label (80%), and nearly 90% said they would be positively influenced by buying products with a positive eco label (i.e. below average carbon footprint – in the green zone on the label).

Due to a technical error on the survey (only realised when the survey was closed), most respondents didn't see the question on the LCA label, so the responses were not statistically valid.

This makes the case for eco labels on products and the importance of both promoting and understanding of the environmental values of products to customers.

2. Packaging

This question assessed customers views on packaging, specifically how important the packaging materials is to purchase decisions. Compostable, plant-based packaging was offered as an option, and over 75% of respondents found this to be an important factor for purchasing.

Given that these types of packaging currently cost more than conventional plastic bags, customers were asked whether they would pay up to £0.20 (EUR 0.23) per bag of salad to cover the extra costs of packaging. Nearly 50% said they would, and a further 47% said they probably would.

To make alternative packaging a reality, both the environmental values and financial costs must be looked at positively by customers. This survey underlines that, for Scilly Organics customers at least, a move to compostable plant-based packaging would be supported.

3. Social impacts

Results from the Social LCA (S-LCA) study described the social impacts of Scilly Organics. This is described in full in Deliverable 1.2, and a summary is written on Scilly Organics website https://scillyorganics.com/circular_economy/ . The survey referred to that information and asked respondents how important the social impacts of products were when making purchases. Over 65% said they did pay attention to social impacts of products.

Figure 2: Seven Stones pub, St Martin's, Isles of Scilly

This summarises the importance of displaying social impacts for in product information. It is however quite a difficult metric to score and display on product labels, so needs some consideration on the best way to enhance consumers understanding of the issue.

See Appendix 1 for full survey results.

2.1.2 Feedback from businesses

In August 2019, business surveys were undertaken with business customers of Scilly Organics, to understand their understanding of Circular Economy, what they were currently doing in terms of reducing their environmental impact, and exploring further opportunities to reduce their impacts. By engaging other businesses in the supply chain, the impacts of Circular Economy can be increased.

The interviews were conducted face to face and followed an interview rather than survey format. This was conducted as part of WP7 (Living Lab) activities, but has direct synergies with T6.4.

1. Seven Stones Inn

This is the local pub on St Martin's, Isles of Scilly, close to the farm where Scilly Organics is located. The farm supplies the pub regularly with salads. The pub serves meals and drinks every day from April to October, mostly to visitors to the Island.

The questions were asked on three key areas:

- **Food**

The pub uses local food (from the Isles of Scilly) where it can, but the majority of its food is bought in from mainland UK. It would like to use more local food, but finds various barriers, including cost, continuity, transport, weather and availability.

There are opportunities for the business to engage more with its customers to promote the value of sustainable food, and change the menu options it offers to feature more local food dishes. It can also look at engaging with more local suppliers of food and drinks to increase the availability.

A lot of discussion focussed on the understanding of customers into the environmental impact of food, and how much they are willing to pay for it.

- **Waste and resources**

The business has a range of waste products, commonly cardboard, food, plastic, glass and metal cans. Most items are recycled, but some cannot be within the bounds of the waste and recycling system provided (which is run by the Council of the Isles of Scilly).

The materials currently not recycled include some plastics (thin, single use) and food waste.

Opportunities identified to reduce the impacts of waste include reducing food waste in the kitchen and from diners, working with the local council to compost food waste, and working with suppliers to reduce the amount of non-recyclable packaging. The pub was very willing to invest in solutions and notes that waste and recycling management is a significant cost in terms of time and resources.

- **Energy**

Electricity is the main source of energy use in the pub, primarily in the kitchen and for fridges and freezers. The business has already implemented an energy efficiency strategy, helped by an EU-funded project, *Smart Energy Islands*. Examples of behaviour change include turning lights and cookers off when not needed, reducing fridge and freezer capacity when not needed, and ensuring dishwashers are only turned on when full.

The next stage is to install an array of solar PV panels to produce electricity for the business and reduce its carbon footprint.

Note: 2021 update

Since doing the interview, Seven Stones has installed 15kW of solar PV panels, estimated to produce enough electricity for 35-50% of its annual needs. They are actively looking for a 100% renewable electricity supply for the remaining purchased electricity.

An electric vehicle has been purchased, which is charged from the solar panels.

2. Coastguards Cafe

Coastguards Cafe is another customer of Scilly Organics, also supplying salad and other vegetables for nearly 20 years, on the island of St Agnes, Isles of Scilly. The same process was done with the Cafe, asking the same questions and in the same style as with the Seven Stones Inn. Interview done in August 2019.

- **Food**

Figure 3: Coastguards Cafe, St Agnes, Isles of Scilly

The ethos of the cafe is strongly geared towards using local and regional food. Around 30% of the food served is produced on the Isles of Scilly, and a further 25% from the nearest mainland county, Cornwall.

Main barriers to using more local food are availability and continuity. Opportunities to increasing the amount of local produce include engagement with customers, research in to more availability, and whether higher value meals can be sold. It's recognised that there is a strong demand for local food and drinks from visitors on holiday. A map showing where local food is from was recognised as being a good opportunity for increasing the demand for local food.

- **Waste**

In common with Seven Stones Inn, the Cafe is limited in its recycling by the capabilities of the Council of the Isles of Scilly's waste system. A lot of waste is recycled, including plastic bottles, paper, card, metal cans and glass bottles. But food waste and thin plastics currently can't be recycled; together these make up around 44% of the Cafe's waste.

Opportunities exist mostly in two spheres. Firstly, working with suppliers to find alternative packaging materials, such as no polystyrene boxes, less plastic packaging, and biodegradable milk cartons. Secondly, improvements to the waste system, in particular provision of food waste composting. This would radically alter the amount of waste produced, cutting overall waste by 20-30%.

The Cafe is aware that the current state of play is less than ideal, and is keen to see changes. It also recognises it can make some internal changes such as changing portion sizes and menu options.

- **Energy**

The Cafe only uses electricity as its energy source. The business has already implemented energy saving practices, using advice through the Smart Islands Project, such as using LED lighting, ensuring dishwashers are full, and turning off devices and lighting when not needed.

Renewable energy generation (probably from solar panels) is being investigated, subject to additional funding to make the project feasible. A switch to a 100% renewable energy electricity tariff is also recommended as a way to quickly reduce the Cafe's carbon footprint.

2.1.3 Innovation camps

As part of Task 7.3, two Open Innovation Camps were held. The first OIC in Krakow, Poland in November 2018 was structured to bring together various actors in one room to discuss potential solutions to the Scilly Organics business model, and by extension the potential of Circular Economy to small (or 'micro') farms. Note that this OIC content and outputs included elements of WP6 (Demos) and WP7 (Living Labs) as the WPs are very complimentary.

Participants in the workshop on 'Micro farming' included academics, industry experts, Circular Economy actors, and sustainability consultants. The aim was to test new business ideas that fitted with the CEBMs derived by CIRC4Life. It was a good opportunity to look in detail at the possibilities of new developments for the business, within the bounds of a Circular Economy context.

In the end some ideas were taken up – such as food processing (apple juice), 'peer learning' (carbon consultancy), and waste (enhanced recycling). Other ideas proved not to be possible for Scilly Organics, including community composting, cider production, and more eco tourism. They are however good ideas that could be taken up by other small farms making the transition to circularity. Every farm is in a different position in terms of the amount of land, capital, people and time it has to invest in new business solutions.

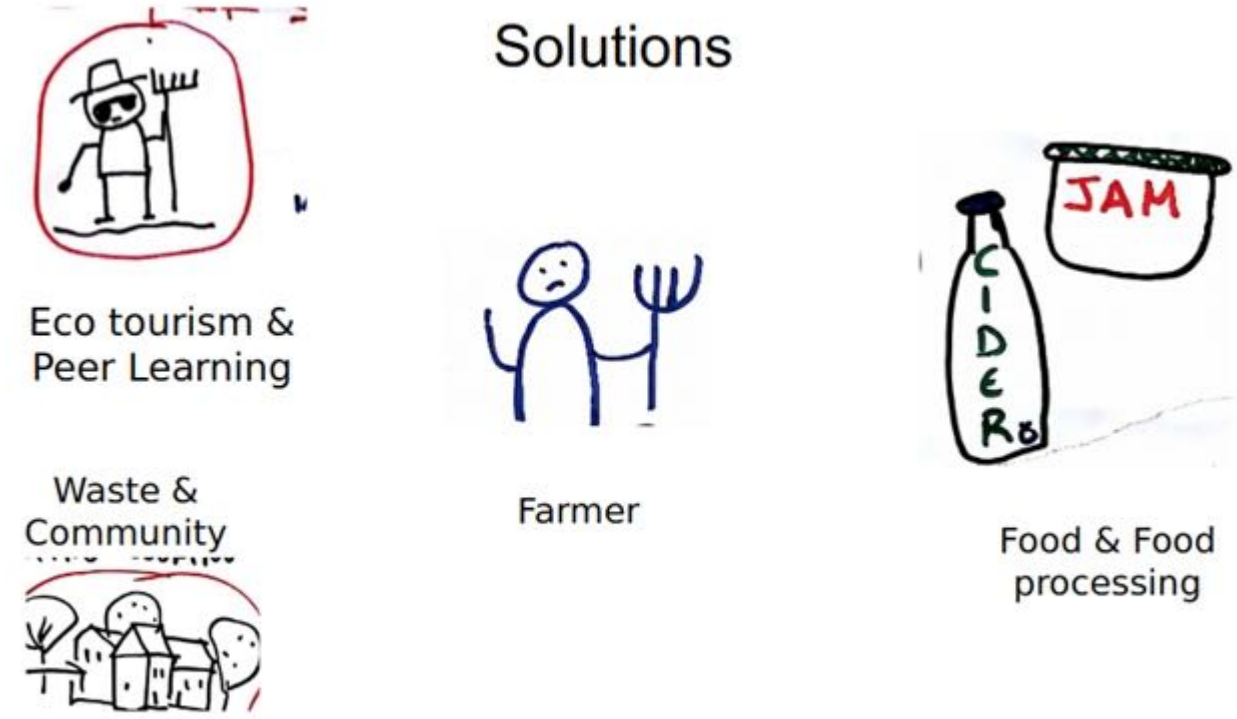


Figure 4: Drawing of key outputs from OIC micro farming workshop

Figure 4: outputs from OIC micro farming workshop

The second Innovation Camp was held online in May 2021 (for reasons of Coronavirus). The focus of this workshop was validation of the CEBMs. This was completed by way of presentation by JS, and then validation by participants through the online portal Howspace.

The two slides below summarise the achievements and limitations of Demonstration 3, presented by JS. Further results will be discussed below in the results and learnings, Section 2.1.4.

Following presentations of the Demo by JS, feedback from participants was positive about Demo 3, which is shown in detail in Appendix 8. There were five key questions of participants about key aspects of the Demo, results all positive. A summary of results are:

- Co-creation: majority agree or strongly agreed
- Sustainable Consumption: majority agree
- Collaborative Recycling and Reuse: majority agree or strongly agreed
- New products and services: majority agree
- Successful transition to circular economy: majority agree or strongly agreed

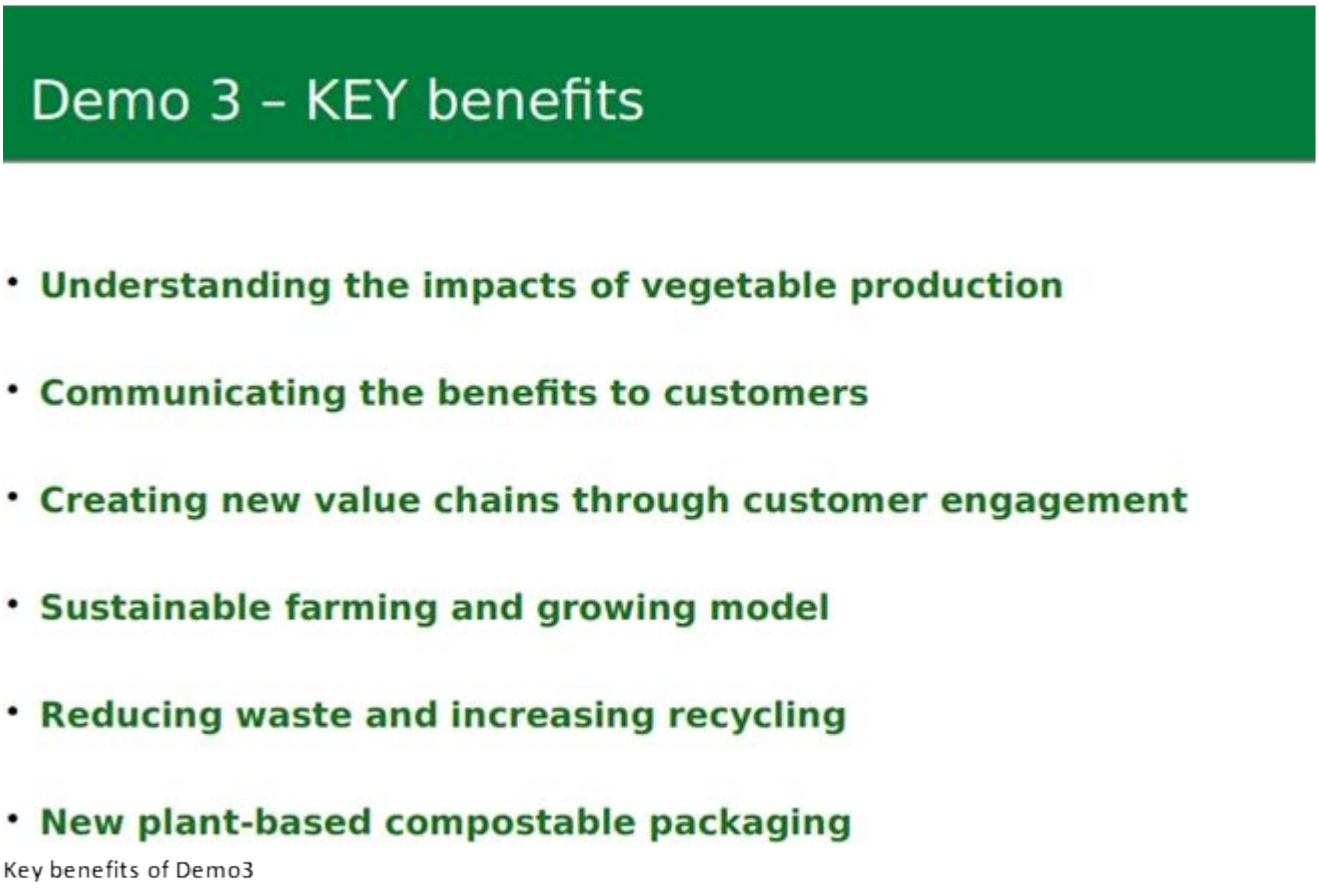


Figure 4a: key benefits of Demo 3

Figure 4b: limitations of Demo 3

2.1.3 New products and services

1. Apple juice

Scilly Organics has around 0.5ha (1 acre) of orchard, mostly containing apple trees. Fresh apples are sold direct to customers, but some apples cannot be sold due to blemishes, or size issues. Therefore, excess apples are without a direct market and would otherwise be wasted. To address this, and based on the feedback of customers and from participants in the OIC, Scilly Organics started to produce apple juice. This is now sold locally and has received positive feedback from customers. This is a direct outcome of the co-creation process.

2. Farm Carbon Consultancy

Another part of the business of JS is helping farmers and growers to understand the carbon footprint of their farms. To do this business owner Jonathan Smith co-created the Farm Carbon Calculator in 2009, which is now one of the leading UK calculators for farmers and growers https://calculator.farmcarbontoolkit.org.uk/ . This free online tool calculates the carbon impact of all processes on farms, giving users a comprehensive and understandable report.

Following demand from users of the Farm Carbon Calculator, JS created a new company, Farm Carbon Consultancy Ltd, which in partnership with Farm Carbon Toolkit now provides a comprehensive service to farmers and growers to assist them in taking steps to reduce their carbon footprint, including measurement, verification and Carbon Action Plans.

https://farmcarbontoolkit.org.uk/what-we-do/

This has been very successful and has seen the company work with over 30 companies so far and now employs four full time staff.

The creation of Farm Carbon Consultancy was not solely as a result of the CIRC4Life project. However the realisation of the importance and need for services to support farmers on their carbon journey in more depth did arise from learnings in this project. The approach taken by the carbon consultancy is very complimentary to the application of circular economy in farming.

2.1.4 Nutritional density of food

During spring and summer 2021, Scilly Organics has been part of the GRFFN citizen science project and has been measuring the nutritional content of various crops grown on the farm. Whilst these results are not scientifically validated, and not yet conclusive, initial indications are showing positive signs that across various crops the nutritional content of food grown using the system used on this farm is producing nutritious crops. See Figure 8 for information.

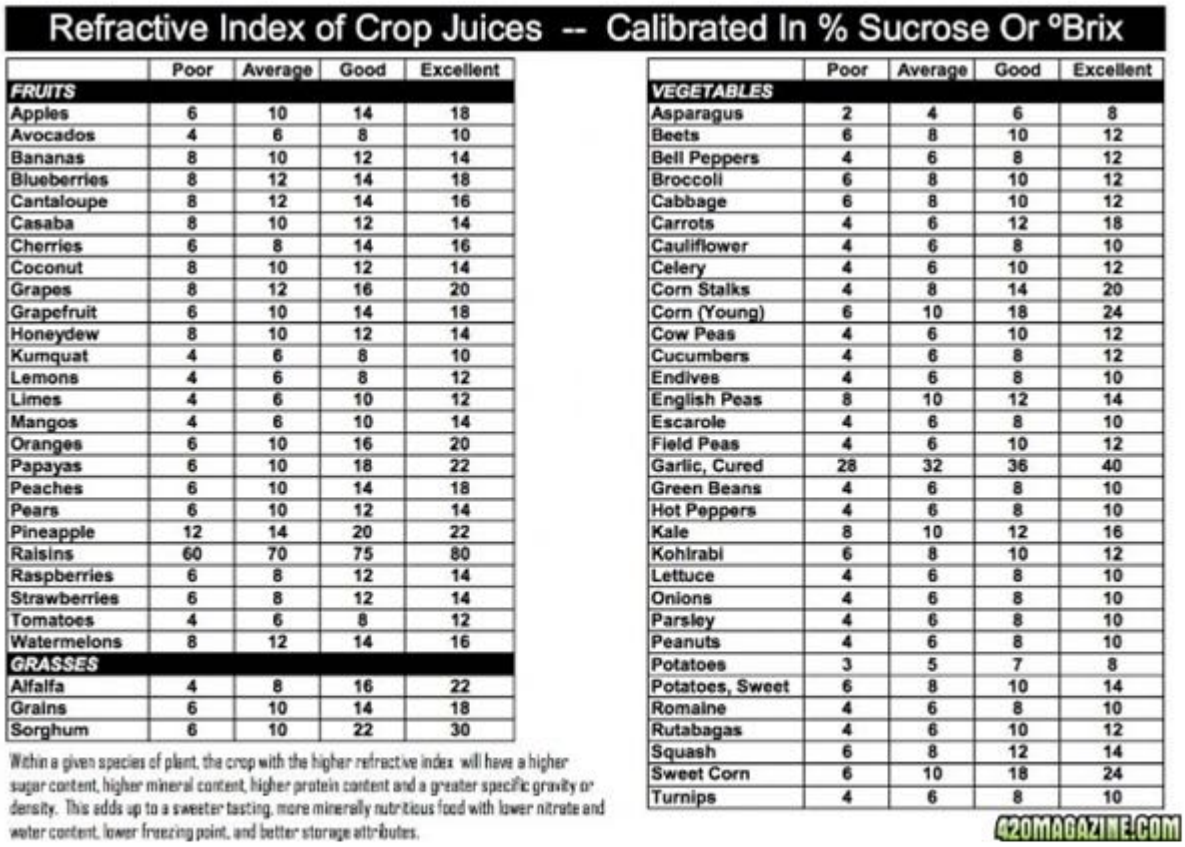
In conjunction with the Growing Real Food for Nutrition Project (GRFFN), which aims to "Learn how to grow, measure and promote the benefits of nutrient dense food". Working with professional vegetable and fruit growers in a citizen science project, from the UK and across many other countries, it is using simple measurements to make a proxy assessment of the nutritional content of food.

The tool used is an inexpensive Brix meter, or refractometer, such as in Figure 7 below. This measures the nutritional content of food by placing a few drops of juice direct from the food – such as a carrot, tomato or apple. By measuring the sugar content of this juice, measured in degrees Brix, the nutritional content is determined against a scale researched in the United States by Dr Carey Reams (Figure 9).

Figure 7: A Brix meter

Crop	Variety	Brix value 0-32	Brix table category
Apple	Adams Pearmain	20	excellent
Chard	Swiss	6	
Potato	Sarpo Mira	7	good
PSB	Cardinal	8	average
Carrots	Napoli	9	Average-good
	Nantes	9	Average-good
Cucumber	Passandra	4.5	Poor
Tomato	Bartelly	8	Good
Tomato	Bartelly	10.5/11	Good
Potatoes	Nicola	5	
Strawberries	(multiple)	7 to 11	Average-good
Courgette	Zuboda	3	
Lettuce	Maureen	3	

Figure 8: Initial results of nutritional density of food from Scilly Organics



Refractive Index of Crop Juices -- Calibrated In % Sucrose Or ºBrix

	Poor	Average	Good	Excellent
FRUITS				
Apples	6	10	14	18
Avocados	4	6	8	10
Bananas	8	10	12	14
Blueberries	8	12	14	18
Cantaloupe	8	12	14	16
Casaba	8	10	12	14
Cherries	6	8	14	16
Coconut	8	10	12	14
Grapes	8	12	16	20
Grapefruit	6	10	14	18
Honeydew	8	10	12	14
Kumquat	4	6	8	10
Lemons	4	6	8	12
Limes	4	6	10	12
Mangos	4	6	10	14
Oranges	6	10	16	20
Papayas	6	10	18	22
Peaches	6	10	14	18
Pears	6	10	12	14
Pineapple	12	14	20	22
Raisins	60	70	75	80
Raspberries	6	8	12	14
Strawberries	6	8	12	14
Tomatoes	4	6	8	12
Watermelons	8	12	14	16
GRASSES				
Alfalfa	4	8	16	22
Grains	6	10	14	18
Sorghum	6	10	22	30

Within a given species of plant, the crop with the higher refractive index will have a higher sugar content, higher mineral content, higher protein content and a greater specific gravity or density. This adds up to a sweeter tasting, more minerally nutritious food with lower nitrate and water content, lower freezing point, and better storage attributes.

	Poor	Average	Good	Excellent
VEGETABLES				
Asparagus	2	4	6	8
Beets	6	8	10	12
Bell Peppers	4	6	8	12
Broccoli	6	8	10	12
Cabbage	6	8	10	12
Carrots	4	6	12	18
Cauliflower	4	6	8	10
Celery	4	6	10	12
Corn Stalks	4	8	14	20
Corn (Young)	6	10	18	24
Cow Peas	4	6	10	12
Cucumbers	4	6	8	12
Endives	4	6	8	10
English Peas	8	10	12	14
Escarole	4	6	8	10
Field Peas	4	6	10	12
Garlic, Cured	28	32	36	40
Green Beans	4	6	8	10
Hot Peppers	4	6	8	10
Kale	8	10	12	16
Kohlrabi	6	8	10	12
Lettuce	4	6	8	10
Onions	4	6	8	10
Parsley	4	6	8	10
Peanuts	4	6	8	10
Potatoes	3	5	7	8
Potatoes, Sweet	6	8	10	14
Romaine	4	6	8	10
Rutabagas	4	6	10	12
Squash	6	8	12	14
Sweet Corn	6	10	18	24
Turnips	4	6	8	10

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Figure 9: Brix chart values

From this project it is recognised that such preliminary methods of gauging an understanding of nutritional quality of food could have several potential benefits for businesses in the farming and growing sector, including:

- A link between human health and the quality of food products
- An ability for businesses to communicate with customers about health implications of products, using a recognised metric
- A measure to improve on the nutrition of products on farm – for instance how improving soil quality impacts on nutrient density
- Potentially a new metric as an output of farms, alongside other environmental and social metrics

This latter point is an interesting discussion. Food production post World War 2 has been focussed on two key farm metrics – production (in tonnes per acre/hectare), and the financial return (in £/$/EUR per acre/hectare). These measurements of output have limitations, not least the lack of any acknowledgement of any impact on people or our environment. What is becoming clear is that the impacts of food production need to be fully recognised, and indeed a farming and food production system can be enabled that offers multiple outputs.

An example of this low impact food production future could include key farm metrics such as:

- Carbon footprint per hectare
- Natural capital per hectare
- Biodiversity impact per hectare
- Social capital impact of the business
- Nutrient density per kg/tonne of food
- Financial returns – including payments for 'public goods' and carbon sequestration

Scilly Organics will continue to measure the nutrient density of its food, and report this to customers via its website and possibly on labels. The business sees this is as important future direction.

2.1.5 Results, lessons learnt and further recommendations

There are several key results and lessons learned from this CEBM, from this Demo. Wider recommendations to industry will be explored after this.

From the Co-creation CEBM1, the following results and observations are made:

- The use of eco labels on products works, subject to engagement with customers and good explanation online. If done with integrity, this is a positive way of promoting the eco impacts of products in a way that offers customers an easy choice.
- Social impacts of products matter to customers. Methods of displaying this to customers should be explored, but this is not so easy to explain as the environmental impacts. It is suggested that this project could have found ways to visualise these impacts more clearly.
- Packaging and use of plastics are a big issue for consumers. People are willing to pay extra for compostable, plant-based packaging. This is explored further in CEBM3.
- Working with supply chain partners – both upstream and downstream is valuable for two reasons: to engage businesses in creating solutions for your own business (e.g. reduced packaging and product impact), and to multiply the impact of Circular Economy right through supply chains.

The work with a cafe and restaurant buying from Scilly Organics was positive. One observation was that reducing the energy impacts of the business was relatively easy to make significant differences with.

One improvement could have been to have the time and resources to work in more depth with more supply chain partners, particularly those upstream. Not only would this have enhanced our understanding of the necessary changes in supply chains, it would have led to greater impacts for the project and a more complete solution to exploit as an industry solution.

- New products can add value to the business, and development of these is strengthened through the co-creation process. There is a big market for new services in the Circular Economy arena, and businesses on a journey towards circularity can see financial drivers and new markets as strong reasons to act.

Figure 10: summary of benefits to farm businesses from Circular Economy

The recommendations for other businesses, and further work for industry can be summed up in Figure 10, from a presentation by JS from the 2nd OIC:

3 Demonstration of sustainable consumption

3.1 Objectives

The second CEBM aimed to demonstrate sustainable production and consumption of vegetables. This CEBM is at the core of sustainable fruit and vegetable production. Some of the key aspects implemented to achieve this are as follows:

- The LCA study and carbon footprint analysis undertaken in Task 1.2, in the early part of the project, underpins measurement of social and environmental impacts of products. In the case of Scilly Organics, this was tried on salad and potatoes, two common crops sold by the company.
- Information from these studies were used to inform management plans aiming to reduce carbon footprint and use of resources, whilst improving the social impacts of the business.
- Environmental and social impacts of products were communicated to consumers through the company's website, and on product labels. Eco-credits per se were not used.

3.1.1 Activities

Life Cycle Assessment (LCA) and Carbon Footprint study

LCA studies show how products have an impact on a wide range of environmental and social issues, such as climate change or human health, which can occur at different product life cycle stages, from materials used, farming processes, packaging, transportation, product reuse, recycling, and disposal.

Carbon footprint studies focus more specifically on carbon emissions and, in the case of farms, also carbon sequestration (absorption) in soils and biomass.

The results of both these studies, performed as part of Task 1.2, are shown in full in Appendix 2.

E-LCA and S-LCA studies were performed once. Headline results are shown below in Figures 11 and 12:

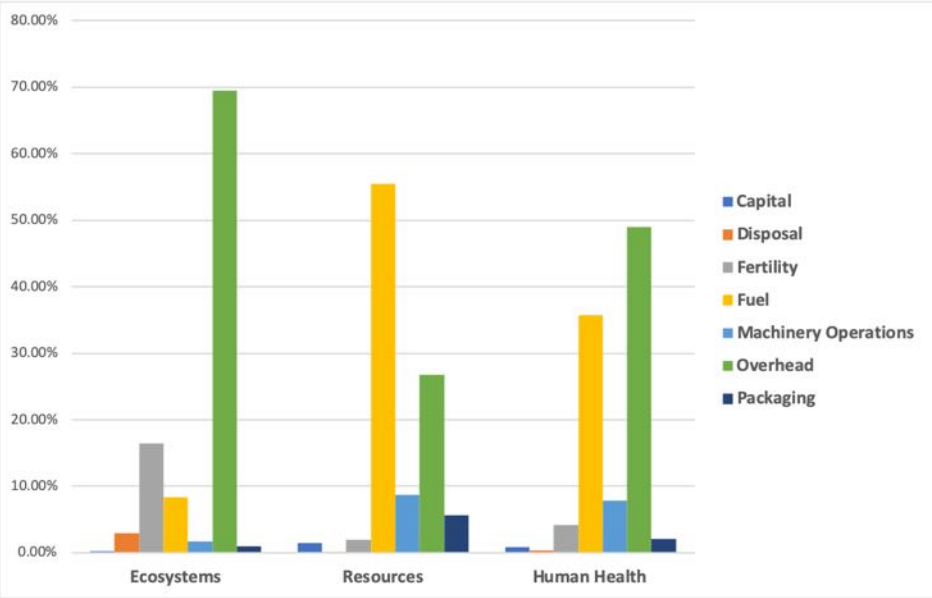


Figure 11: Life cycle impact results for organic potatoes from Scilly Organics in 2018

Environmental LCA results

Impact category	Amount	Unit
Ecosystems - Agricultural land occupation	0.01611	points
Ecosystems - Climate Change	0.00244	points
Ecosystems - Freshwater ecotoxicity	2.31E-06	points
Ecosystems - Freshwater eutrophication	4.11E-06	points
Ecosystems - Marine ecotoxicity	4.54E-07	points
Ecosystems - Natural land transformation	0.00029	points
Ecosystems - Terrestrial acidification	9.93E-06	points
Ecosystems - Terrestrial ecotoxicity	9.78E-06	points
Ecosystems - Urban land occupation	0.00014	points
Human Health - Climate Change	0.00286	points
Human Health - Human toxicity	0.00046	points
Human Health - Ionising radiation	3.59E-06	points
Human Health - Ozone depletion	7.69E-07	points
Human Health - Particulate matter formation	0.00308	points
Human Health - Photochemical oxidant formation	1.24E-06	points
Resources - Fossil depletion	0.02023	points
Resources - Metal depletion	0.00188	points
Total	0.04752	points

Figure 12: Total environmental impact results – single score of Scilly Organics organic potatoes (per potato)

Deliverable 1.2 included the following description of E-LCA of Scilly Organics (written by NTU). The open source software openLCA, version 1.8 was used as the calculation tool, for conducting the life cycle assessment for this study. The ecoinvent 3.5 database was used for the life cycle inventory and the ReCiPe Endpoint (Heirarchist) method was chosen as the life cycle impact assessment method.

“Overall, the LCA shows the electricity consumption (Overhead) and Fuel (production and consumptions) are the major contributors for the environmental performance of the organic potato life cycles, considering the total amount of consumed electricity (181 kWh) and Fuel (257 Litres) in 2018 are already relatively low, and both materials can’t be influenced by JS organic farm. Therefore, the third contribution, green manures and compost production are highlighted, the main contributors from which are emissions of diesel burning and electricity consumption of agricultural machines (i.e. mulching, sowing, tillage and harrowing). Main pollutants are nitrate to water, Dinitrogen monoxide, nitrogen oxides that emitted to air.

However, major data related to the green manure process are from the Ecoinvent database that may not fully represent this specifically analysed case, as more suitable for intensive farm conditions, and this process in particular will be subjected to further refinement.

The aggregated single score of Human Health, Ecosystems, and Resources for the functional unit, i.e. one organic potato (approx. 150g, the same weight as a bag of salad) is 0.04752 points, which is the value of eco-point for JS Organic farm demonstrator in CIRC4Life project. This eco-point value is rounded up as 0.05 Points for clear understanding purpose for the general consumers. Also, the eco-point value will be used to support the eco-credit calculations for the farm food products.”

Eco-point = 0.05 Points (per 150g of potato)

The Environmental LCA report from NTU concludes:

Overall, the LCA shows the electricity consumption (Overhead) and Fuel (production and consumptions) are the major contributors for the environmental performance of the organic potato life cycles, considering the total amount of consumed electricity (181 kWh) and Fuel (257 Litres) in 2018 are already relatively low, and both materials can’t be influenced by JS organic farm. Therefore, the third contributors, green organic manure compost and production are highlighted, the main contributors from which are emissions of diesel burning and electricity consumption of agricultural machines (i.e. mulching, sowing, tillage and harrowing). Main pollutants are nitrate to water, Dinitrogen monoxide, nitrogen oxides that emitted to air. However, major data related to the green manure process are from the Ecoinvent database that may not fully represent this specifically analysed case, as more suitable for intensive farm conditions, and this process in particular will be subjected to further refinement.

The process was repeated for salad and calculated by NTU on 20/02/20. The mix of salad grown at Scilly Organics is largely comprised of various varieties of lettuce, with some other salad crops such as rocket and mizuna. These are hand mixed and bagged at the farm, sold as a ready to eat salad in bags of 150g in weight.

The Executive Summary reads:

"This document reports the eco-point results of organic salad. The total eco-point is 0.57. LCA midpoint results and endpoint results of the product are also presented."

Eco-point = 0.57 Points (per 1kg of salad)

It should be noted that one would expect the Eco points (and carbon footprint) of salad to be higher, because of the nature of the crop. Whilst 1 ha of potatoes might yield anything up to 50 tonnes, 1 ha of salad for mixed leaves would likely yield no more than 15 tonnes per hectare. In addition you could expect salad to require more input resources, labour and harvest activities.

Social LCA

Stakeholder	**Subcategory**	**Impact category**	**Growing of vegetables (UK)**	**Scilly Organic Production**	**Comparison %**
Workers	Fair salary	Fair Salary	3.354	3.257	-2.9%
	Equal opportunities / Discrimination	Gender wage gap	2.009	1.546	-23%
	Health and Safety	Fatal accidents	0.250	0.226	-9.7%
Local Community	Access to material resources	Industrial water depletion	0.906	0.857	-5.4
	Access to material resources	Biomass consumption	2.089	1.821	-12.8%
Consumers	Health and Safety	Violations of mandatory health and safety standards - violations of laws and employment regulations	0.976	0.797	-17.6%

Figure 13: summary of S-LCA results

Deliverable 1.2 included the following statement of the S-LCA of Scilly Organics (written by CIRCE):

"Scilly Organics' commitment to deliver fair and healthy products is easily reflected in a better social performance with respect of its own sector. Issues associated to the average wage, gender gap, women in the labour force, fatal accidents at the workplace, usage of industrial water and biomass are better assessed in terms of risk level. Several of them, also are identified as of high importance from the company's perspective."

Carbon footprint

Carbon footprint reports were undertaken twice, once in 2018 and again in 2020.

Farm Carbon Cutting Toolkit

Published on *Farm Carbon Cutting Toolkit* (https://farmcarbontoolkit.org.uk)

Scilly Organics 2018

Emissions

	CO_2e (kg/year)	% total emissions
Fuel	1,148	27.45%
Materials	626	14.97%
Capital Items	1,670	39.93%
Livestock	0	0.00%
Fertility	642	15.35%
Agro-chemicals	0	0.00%
Distribution	0	0.00%
Waste	96	2.30%
Total:	4,182	100%

Sequestration

	CO_2 (kg/year)	% total sequestration
Field Margins	111	0.17%
Soil Organic Matter	36,035	55.82%
Orchards & Vineyard	240	0.37%
Wetland	0	0.00%
Woodland & Hedges	23,154	35.86%
Woodland (detailed analysis)	5,020	7.78%
Total	64,560	100.00%

Figure 14: Scilly Organics carbon footprint 2018

	Carbon balance (tonnes of CO2e per year)
Total	-60.38
Per hectare	-23.22
Per tonne of product	-17.25

Figure 15: Carbon balance of Scilly Organics in 2018

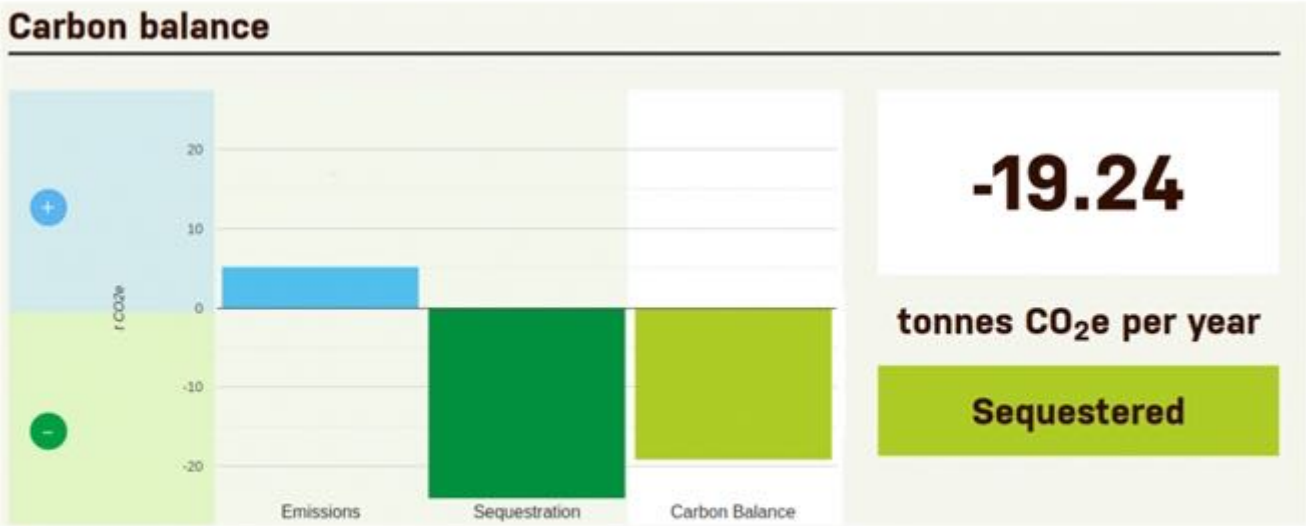


Figure 16: Carbon balance of Scilly Organics in 2020

Figure 16: Breakdown of carbon footprint in 2020

Emissions	tonnes CO_2e	%
Land Use	1.62	31.39%
Fuels	0.86	16.60%
Materials	0.15	2.94%
Inventory	1.84	35.62%
Crops	0.60	11.69%
Waste	0.09	1.74%
Distribution	0.00	0.01%
Total	**5.17**	**100%**

Sequestration	tonnes CO_2e	%
Field Margins (Uncultivated)	-0.95	3.90%
Hedgerows	-2.36	9.66%
Other (E.g. Recycling)	-0.77	3.17%
Perennial Crops	-12.73	52.15%
Soil Organic Matter	-2.30	9.41%
Woodland	-5.30	21.71%
Total	**-24.41**	**100%**

Figure 17: Breakdown of carbon footprint in 2020

Comparing carbon footprints between 2018 and 2020, from Figures 14 to 17, the following observations are made:

- The carbon balance for both years is net negative – i.e. more carbon is being sequestered than emitted. This is a very encouraging picture
- Overall carbon balance went down in 2020, though is still -19 tonnes of CO2 for a year
- The main reason for the change was reduced sequestration in farm soils. The reason for this isn't fully clear, but is being taken seriously
- Any carbon footprint that is net negative is a success story for a business

Changes implemented in the business

On the basis of the impact analysis results, several areas of work have been identified that should deliver improvements to the environmental and social impacts of Scilly Organics. They have been divided in to short term (1-2 years), medium term (2-5 years) and long term (5-10 years), starting from 2018. All summarised in Table 1:

Table 1: summary of changes planned for Scilly Organics

Timeframe	Area	Action
Short term	Soils	Concentrate on increasing soil organic matter Reduce cultivations
	Trees	Plant more trees and manage existing trees well
	Waste	Reduce waste and increasing recycling
	Water	Increase storage capacity Improve efficiency of irrigation
Medium term	Energy	Install solar panels and batteries on the farm
	Perennial plants	Plant more trees, including agroforestry and orchards
	Crop management	Improve crop rotation to increase soil fertility and organic matter
	Biodiversity	Improve habitats on farm to increase biodiversity
	Materials	Move to 100% plant-based and home compostable packaging
	Social	Improve pay and training for workers, with greater sense of ownership in the business
Long term	Tractors	Investigate electric tractor solutions
	Energy	Move to zero fossil fuel inputs
	Materials	Recycle 100% of all plastics Minimise use of plastics

These will be made available on the company's website by the end of 2021, to be more transparent about the steps the business is taking to improve its environmental and social impacts.

An example of implementation of medium term aims is in the installation of an off-grid solar panel and battery storage system on farm, which will provide zero carbon electricity for lighting, tools, charging, and other electronic devices. As the farm is off the electricity grid, this was a cost effective solution to providing power in the farm. In time it is hoped this will help provide a power source for an electric tractor.

Figure 17b: Solar panels installed at Scilly Organics in 2021

Communication of sustainability to the consumer

A key part of this journey towards Sustainable Production, has been to communicate the results, values and wider issues with customers. This is complimentary to the Co-Creation CEBM.

In other Demonstrations, such as LED lighting, this CEBM is actually called Sustainable Consumption, and indeed this is a part of the Sustainable Production CEBM; you can't have one without the other! However, in Demo 3 we felt the emphasis should be on Sustainable Production because farming is a production system and the emphasis should be on making the whole system sustainable.

Website

On the Scilly Organics website, the project LCA and carbon footprint studies have been summarised for customers and stakeholders in an accessible way. This was also

released as a blog and posted on social media so as to raise awareness of the CIRC4Life project, its outputs, and the implications for customers
https://scillyorganics.com/circular_economy/

Labels

The following labels were trialled on packaging of two Scilly Organics products - potatoes and salad.

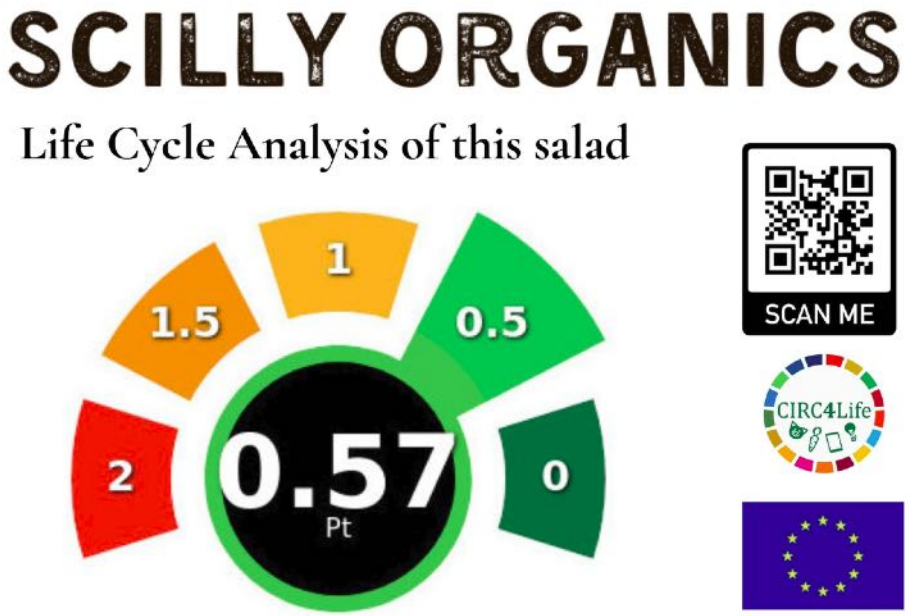


Figure 18: LCA salad label

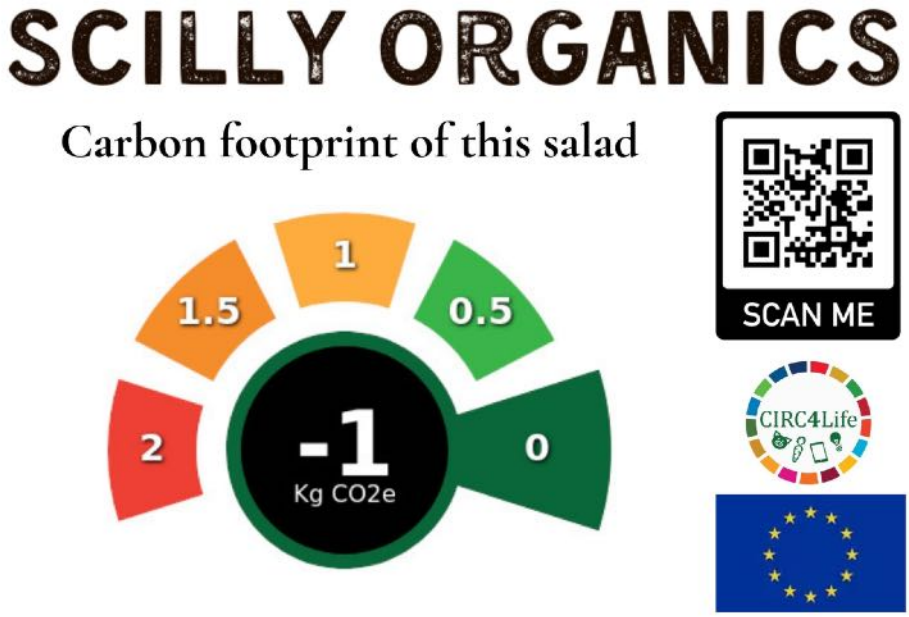


Figure 19: carbon footprint salad label

Two labels were created for putting on products tested in this Demonstration, salad and potatoes. Above shows the examples of labels used on salad bags; Figure 19 shows the value of the carbon footprint (-1kg CO2e per bag of salad), and Figure 18, the LCA label (0.57 Pt per bag of salad). Each salad bag weighs about 150g.

The colour coding depicts how 'good' the values are compared with the industry benchmark average – green being lower, red higher than average. Also on the label is a QR code that links to a webpage giving more details about the Demo, including more in-depth information about the LCA and carbon footprint studies.

The value on the carbon footprint label was derived from the carbon footprint per tonne of product in 2020 (see Figure 17), -6.4 tonnes of CO2. This can also be equated to -6.4 kg of CO2 per kg of product. A bag of salad weighs about 150g, so the carbon footprint is approximately –1kg of CO2 per bag of salad. An average benchmark was somewhat hard to determine as it depends on what the comparison is, but making the assumption that some will be UK grown and some imported, an average of 1kg of CO2 per kg of lettuce was used, using an average of the values presented here https://www.bbc.co.uk/food/articles/carbon.

Values for the LCA labels were determined from the E-LCA study, which provided a value of 0.57 points per 1kg of salad (see section 3.1.1). A benchmark average of 1 point per 1kg of salad was used.

These labels have become integral parts of Scilly Organic packaging, and in 2022 will be rolled out to all products (rather than just salad and potatoes) in a brand refresh. The company believes it is an output that is very valuable for other companies to adopt; however clearly, they would feel much happier promoting products that are below average – so work needs to be done to reduce product impacts first.

The Demo found that consumers were very engaged with the concept (see Survey Results in Appendix 1), and it clearly offers customers a clear guide to choosing lower impact products. This is a positive step in that offers consumers a tangible way of engaging in Sustainable Consumption, and helps producers in being able to market and sell Sustainable Products.

Note that, unlike in other Demos, the use of eco-credits was not used. Eco-credits enable consumers to benefit from Sustainable Consumption, by receiving credits for purchasing low impact products, or doing sustainable practices, such as recycling. However, this was considered difficult to implement in vegetables, both in terms of measurement and for labelling and IT infrastructure in a small business.

Further engagement with customers and partners was conducted through the Showcase event. See section 5 for further details.

3.1.2 Results, lessons learnt and further recommendations

The understanding of LCA, social and carbon impacts of production have brought significant benefits to Scilly Organics in this CEBM. They fall in to two broad categories:

1. Understanding the largest impacts of the business, and opportunities to reduce those impacts. The output is an Impact Reduction Plan, resulting in a plan reduce environmental impacts, improve social impacts and reduce costs.
2. Communicating the impacts of Sustainable Production through product labels and online, enabling Sustainable Consumption by customers.

Lessons learnt from this CEBM, for improvement in future work include:

1. Use of LCA results requires significant work to make the results understandable by anyone not familiar with the concept.
2. Social impacts are important to understand, but require work to present results in a clear way. The nature of the metrics makes that a challenge.
3. Doing 'before and after' LCA analyses would have been advantageous in proving the impact of changes made through the project.
4. Eco-credits will not be able to use in all situations. Where they are used, two key additional concepts are required:
    - Context – what does it mean compared with the average, and the total impact of all purchases over a year
    - System – ideally a person's purchases of products and services would all be added up so that their total impacts are calculated (eco credits). This was tested in the EU funded FP7 project MyEcoCost https://www.myecocost.org/mec?btnPageTurn=HOME&userLocale=en-GB,en%3bq=0.5

    In Demo 3 eco-credits were not used, despite it being the initial plan to do so. This was primarily for two reasons:

    - The technology needed to implement eco credits was not necessarily available at Scilly Organics' outlets, unlike in say a supermarket. For instance such a system requires coding on packaging or shelf label, electricity to run dynamic lavelling systems, and customers to be familiar with the technology necessary to read such codes.
    - The actual credits gained are difficult to translate in a food product setting. What is being credited is hard to define, unlike when someone recycles an electronic product, for example – as demonstrated successfully in Demo 2 with Recyclia and Indumetal in Spain https://www.circ4life.eu/demo2.

      How this translates in to food production is more difficult. For instance, customers cannot come back to 'recycle' vegetables. Whether they should be rewarded for buying the vegetables from Scilly Organics is debatable, but would not drive the consumer behaviour change as such that eco credits are aiming to facilitate.

Recommendations

For other farming businesses we recommend the following as being positive actions for businesses moving towards circularity:

- Calculate the environmental impacts of production of all farm products, wither individually or collectively. Carbon footprinting has been demonstrated to be the easiest and cheapest way to start, with LCA giving a more in depth look in to the business.
- Formulate an Action Plan to reduce the carbon and other environmental impacts of the business, divided in to short, medium- and long-term actions. Be ambitious, but make them achievable too.
- Communicate with your customers both current impacts of production, as well as plans for further work on reducing impacts.
- Engagement with customers and stakeholders can be on different levels, including product packaging/labels, websites and social media, and events. Use all opportunities to discuss the reasons for doing it and positive impacts on customers.

4 Demonstration of collaborative reuse and recycling

4.1 Objectives

Waste reduction, reuse and recycling, or CEBM 3, has been demonstrated by Scilly Organics. The objectives were to demonstrate:

- Waste streams produced in the business, and opportunities to treat waste products more sustainably
- How to use organic waste by-products positively on farm, and quantify the environmental impacts of different opportunities
- Understand best practice in waste management of materials, and opportunities to implement more sustainable practices
- Develop a Brokerage System to link buyers and sellers of produce that has low market value, or is considered a waste – to reduce the amount of food wastage
- Investigate and trial new packaging options for fresh produce, focussing on plant based, compostable packaging

4.1.1 Activities

Assessment of the impact of waste

In the carbon footprint study (Task 1.2) the impacts of waste on the overall carbon footprint of Scilly Organics were considered. In carbon terms this is actually very small, at 0.09 tonnes CO2e per year, a mere 1.74% of overall emissions (see Figure 20). However, it is still a significant resource use and waste issue, so nonetheless in the context of Circular Economy it is considered very important to look in to further.

Emissions	tonnes CO_2e	%
Land Use	1.62	31.39%
Fuels	0.86	16.60%
Materials	0.15	2.94%
Inventory	1.84	35.62%
Crops	0.60	11.69%
Waste	0.09	1.74%
Distribution	0.00	0.01%
Total	**5.17**	**100%**

Creating and using more compost

Figure 20

Compost is made at Scilly Organics using crop wastes, grass, weeds and seaweed. The materials are all sourced locally, most from the farm itself. Compost is made over 3-9 months, depending on the season (shorter in summer, longer in winter) and turned 2-3 times during this time to ensure aeration and more even biodegrading of material (see Figure 21a).

The result is quality compost, used particularly to fertilise soil for high value crops such as tomatoes, cucumbers and grapes. Around 4 tonnes of compost a year is made and used on the farm (Figure 21b). The aim is to increase the amount made – organic growers will rarely complain of having too much compost! Compost improves soil health, fertility, organic matter levels, biodiversity and water retention.

No organic wastes of any sort leave the farm, it is all used on site. Even woodchips from chipped tree and hedge branches are used for various applications.

Packaging trial

Single use plastic packaging is a challenging issue for fruit and vegetable farms, as much fresh produce requires packaging in order to transport, present, protect and preserve fresh produce. Without it national and global supply chains would not work, and much food could be wasted before it gets to the shelf. Even in small businesses, such as Scilly Organics, packaging is often necessary – particularly for high value and highly perishable crops such as salad.

Using oil-based thin plastics, usually LDPE or polypropylene, represent a significant resource use and waste issue. These materials are recyclable but are low value and often recycling facilities don’t exist for these materials. Therefore, the amount of wastage is high, as well as being based on an unsustainable resource – oil. This is a topic of major concern to many consumers.

There are however new options available for 100% plant-based, fully compostable packaging (both home and industrial compostable). At the moment these have varying costs, availability and performance compared with their conventional plastic counterparts.

To assess the relative merits of available options, we initiated a packaging trial with ten other organic farms in the UK, sending them samples of five different packaging options and asking for their feedback. The business owners were asked to consider the following criteria:

- Transparency – ability to see clearly what is in the bags
- Permeability – limited or no permeability to air, to ensure the produce stays fresh in the bags and doesn't wilt
- Robust – ability to hold together and not tear easily
- Size – the correct size for the produce
- Availability – how easy it is to purchase the bags
- Price – cost per bag
- Environmental credentials – what the bags are made from, where they come from and how they degrade

The bags tested were at least biodegradable, most compostable too. Most also included at least a proportion of plant-based plastic. All bags had to be available to buy from the UK, in small to medium quantities (i.e. not more than 1,000 per order), so that they would be realistic options for businesses to buy. The final options for trial bags came from an extensive list provided by project partners IEIA, then further research and refinement by JS.

An understanding of what is biodegradable and compostable was provided by project partners IEIA, and can be read in full in Appendix 7. Significant differences are apparent between these types of plastics, and are often not well understood. The perceived 'holy grail' material is home compostable plastic.

A summary of IEIA's report is provided here:

"The bio-based packaging as an alternative solution of fossil-based bags has some pros and cons. The performed LCA analysis shows that investigated bio-based packaging, in the production phase, has the biggest impact in all impact categories: GHG, agricultural land transformation and occupation, human toxicity, freshwater ecotoxicity and terrestrial ecotoxicity. The reason for that is that in case of PS and PLA important factors are energy used, chemicals needed for production and corn as raw material. Nevertheless, the bio-based packaging is manufactured from raw materials and while properly managed after the use phase can be composted. This is beneficial from an environmental point of view because of the CO_2 sequestration.

There are several considerations which could influence the results of the LCA analysis performed. Proper use of the waste material gives potential for carbon sequestration. Amount and type of energy used for the production of the packaging's material as well as the amount of material used for the production of the bag (depending on dimensions, thickness and density of the material) will determine the environmental impact.

Therefore, further research in this area is required. Research will be undertaken to deepen the analysis and develop the scenarios to be the subject of the LCA.

The further analysis will allow for the development of recommendations for the Scilly Organics company regarding the use of bio-based packaging."

Figure 22: compostable packaging used by Scilly Organics

All the bags in the packaging trial received positive and negative comments. From this trial, the bags that 'ticked the most number of boxes' for most users, given the criteria were bags 2 (Polybags compostable) and 5 (Econic compostable), though this was considered to be prohibitively expensive for now.

No one bag was considered 'perfect' as all had some drawbacks. All participants found this trial a useful learning process and will continue to search for the most appropriate packaging solutions for their business.

In Scilly Organics the current bag used is Polybags compostable, which is made from at least 30% plant-based material and is home compostable. It has received good feedback from customers and appears to perform well. It is however quite expensive, at £0.16 per bag.

A full summary of the results is shown in Appendix 5.

The manufactured carbon footprint of these alternative plastics is not clear from manufacturers, despite attempts to find them out. Any savings are likely to be small; however there will be significant eco cost savings by avoiding the use of fossil fuels in the raw material manufacture of conventional plastics. Avoided impacts on waste will also be significant, by taking the bags out of the waste stream if consumers simply put the bags in their own compost at home.

Farm plastics

Many farms use a significant amount of plastics, aside from packaging. In horticulture this can include polytunnel covers, ground covers and many plastic-based items like irrigation pipes. Recycling of such materials should be an absolute priority, and indeed they have good recycling potential and value if clean and dry.

Scilly Organics has developed an approach called a Plan for Plastics that includes the following:

- Evaluate the need for every bit of plastic purchased
- Use any plastic bought for as long as possible
- At the end of life recycle as much of it as possible
- Search for plastic alternatives – either plant-based and compostable materials, or different ways to achieve the same outcome

Figure 23: Bundle of old polytunnel plastic going for recycling

Scilly Organics has actively sought out recycling facilities for its farm plastics, in conjunction with nearby growers who also have waste plastics to recycle. Sometimes it is more cost effective for small businesses to club together as recycling companies prefer to pick up minimum amounts of plastic. This has resulted in the amount of plastic going to landfill or energy-from-waste to be reduced by 80%.

Material wastes

Every business buys in materials of various sorts, and nearly all of these have a form of packaging. As much packaging is plastic, this project has looked at the potential to work with suppliers to reduce their packaging, and/or make it more sustainable and compostable.

Examples include substituting bubble wrap and plastic packaging for paper and cardboard, using biodegradable cling wrap, and compostable plastic bags. As the recipient of the waste, it is not unreasonable to ask your suppliers to provide packaging that you can reuse, recycle or compost.

Figure 24: Recycling rates through the Council of the Isles of Scilly

Brokerage Tool

Development of a Brokerage Tool for CIRC4Life was completed in Task 4.7. The Tool was tested in Task 6.4, but the analysis was that Scilly Organics was too small a business to benefit from the use of a Brokerage service. As it happens, only a tiny percentage of food produced by the business is ever unsold.

It is however a potentially useful option for many fruit and vegetable businesses. Not all produce grown can be sold unfortunately for various reasons – market demand, buyer specifications, crop quality, etc. However, if food crops are edible and could have a use, it is right that buyers are sought out for such unsold produce.
'Outgrade produce' is a serious problem for farmers and growers. Often food that does not meet a supermarkets' specification for size, weight or aesthetic appearance will be rejected. If another buyer is not found then this will be diverted to other uses, such as animal feed, composted, or at worst be sent to landfill. Clearly this is a highly undesirable situation for both businesses and society.

Examples of products that could be successfully found new buyers include carrots that could be turned in to soup, baby food, or vegetable crisps, apples that cannot be sold easily could be turned in to juice or cider, or cauliflowers that could be sent to food banks or to feed homeless people in shelters. Some further examples of opportunities to reduce food waste were explored in Task 2.4.

System change – local council

From May 2017 to May 2021, Jonathan Smith also served as a local Councillor for the Council of the Isles of Scilly. During that time, he helped implement a Waste Reduction Strategy for the Islands https://www.scilly.gov.uk/environment-transport/waste-recycling/waste-reduction-strategy.

This includes targets such as:

- Increase recycling rates to 60% by 2030
- Provide food waste composting by 2022
- Reduce waste produced on the Islands by 25% by 2030

Importantly this Strategy enables the framework for waste reduction on the Islands to be put in place, therefore this political action has significant implications for businesses to be able to engage further in waste reduction work themselves.

Preliminary results and findings from Demo 3 were presented to Councillors during an informal workshop session in March 2021, to increase awareness in Circular Economy and empower the Council to make better decisions, strategies and policies to include these principles. JS will follow up with the Council in due course to press for Circular Economy to be a part of the Corporate Plan and Waste Reduction Strategy of the organisation in their next iterations.

4.1.2 Results, lessons learnt and further recommendations

Scilly Organics has increased its recycling rates, including farm plastics, moved towards plant-based compostable packaging, and focussed on producing and using more compost. Further work with supply chain partners, as outlined in CEBM 2, has offered wider opportunities to widen the impact of Circular Economy, moving it beyond the borders of just one business.

Lessons learnt:

- Plant-based compostable plastic bags are still not fully developed as a product, Options exist but are somewhat limited and relatively expensive. Market forces will drive down costs and increase availability over time hopefully.
- Community composting was suggested as a concept during the 1st OIC. Whilst it sounds like a good idea in principle, the reality of creating such a system requires a significant amount of investment, organisation and dealing with legislation. Together these can be quite prohibitive.
- Getting change in supply chains voluntarily is quite difficult. Increased availability and reduced costs of lower impact materials, taxes on single use plastics, and more helpful legislation are needed to make significant changes.

Recommendations:

- Reduce the amount of waste from your business and have a strategy to achieve this
- Recycle as much as possible; if your waste and recycling provider doesn’t take certain items then ask if they can, and/or search out other providers

- Use home compostable plant-based packaging where you can find it. If it’s not available ask suppliers whether they can source it
- Tell customers what you’re doing and why; sometimes it may be necessary to charge a little more for sustainable packaging, so it’s important customers buy in to the concept
- Engage in political actions where necessary as systems can create bottlenecks
- Find new markets for outgrade produce, including Brokerage Tools if appropriate. Extracting value out of waste or under-valued products helps your business and generates less waste.
- Seek out new suppliers, or ask existing ones, who supply recyclable and/or compostable materials with goods you buy in

5 Showcase event

5.1 Online showcase event

There was intended to be a physical showcase at Scilly Organics during spring/summer 2021. The event had to be postponed due to UK Covid restrictions, so the decision was taken to hold the main Showcase event online instead. It was further intended to add a physical event at a later time (summer 2021) but staffing problems at Scilly Organics prevented this happening unfortunately.

In May 2021, JS hosted an online showcase event for Demo 3, *Circular Economy in organic vegetable growing*. The target audience was general, including vegetable growers, sustainability experts, and interested individuals. The event had 41 participants, mostly from the UK but also some other European countries.

Figure 25: online showcase event poster

The format of the event was structured to lead participants through a journey of what Circular Economy is, set the context of the project, and then through how each of the CEBMs was applied in Demo 3. It included some polls to gauge feedback from participants, and there was a Question and Answer session at the end.

The full presentation can be seen here https://zoom.us/rec/share/kvwB6ulR5bCfGB2bXa5ATCbK6h3O4zWm6gA3DAY2r6WLGhpiVS--mUlb7CHXPNKj.faOJwMtvKbFZRyH7?startTime=1620809342000

A part of the event included the showing of the video produced by Scilly Organics about how the project was applied to the business:

Figure 26: screenshot of Scilly Organics Circular Economy video

The video can be seen here https://www.youtube.com/watch?v=-OgoB28Cks0&t=2s

For a copy of questions, chat and feedback please see Appendix 6. Questions showed a high level of engagement and resulted in good discussion. Feedback from the event was very good, especially of the video.

In Appendix 9 there is a link to the Circular Economy Handbook for farmers and growers, produced by JS.

6 Conclusions

The CIRC4Life Project and Demo 3 in particular have given Scilly Organics the chance to test in real life Circular Economy solutions. As a ‘large scale demonstration project’, these Demos have been at the core of CIRC4Life, and allow for testing, scaling up and engagement of external stakeholders.

An understanding of Sustainable Production, through LCA and carbon footprints, are pivotal to creating a business that not only minimises its environmental impacts but also offers consumers the chance to engage in Sustainable Consumption. The communication of environmental and social impacts of products to customers is a key part of this work, along with a strategy to reduce environmental and social impacts of products.
Co-creation and engagement with customers and partners showed a deep appreciation and desire for sustainable products, and a real interest in Circular Economy. Working with supply chain partners can multiply the impact of the approach, as well as create deeper connections, with likely enhanced business benefits. Co-creation has also shown us a significant business benefit in creation of apple juice and new consultancy services.

A deep dive in to waste and recycling has made us examine carefully our waste system and the opportunities to reduce waste in the first place. Trialling alternative packaging, as a move away from oil-based plastics has been a popular move with customers, but surprisingly difficult to achieve. Feedback from other growers in the industry has been particularly useful in making progress in this area.

As important as reporting the successes of this Demo is to recognise the learnings and things that either didn’t work, or could have been done better. Failure is where learning happens! Each CEBM section has ‘lessons learned’, which sum up how we would try to do things differently in the future.

Overall Scilly Organics has benefitted significantly from Demo 3, and has enjoyed the process of testing Circular Economy solutions in its business. It is very keen to share learnings, and encourage others in the industry to make a move towards circularity.

Major outputs from the project from JS include the use of LCA and carbon foot printing, Deliverable 6.3, the video of Circular Economy in Scilly Organics, a Handbook for farmers and growers, and resources on the websites of CIRC4Life and Scilly Organics.

7 Appendices

Appendix 1 - survey results

Survey on sustainable vegetable production

Background

Scilly Organics, with the support of RISE and MMM, ran a survey with Scilly Organics customers to engage with them on our sustainable practices, as well as to assess their understanding of the Carbon Footprint and the Eco-cost labels.

The survey was originally designed to be taken by customers who visited Scilly Organics stall. Both labels were supposed to be tested at the stall, the first label (Carbon Footprint) during the first two weeks of testing in September, following by the second label (Eco-Costs) for two weeks.

Due to Covid-19, we were only able to do the testing online with visitors/customers who previously visited the stall. Fortunately, many of these customers are known to the business, so could be engaged via email.

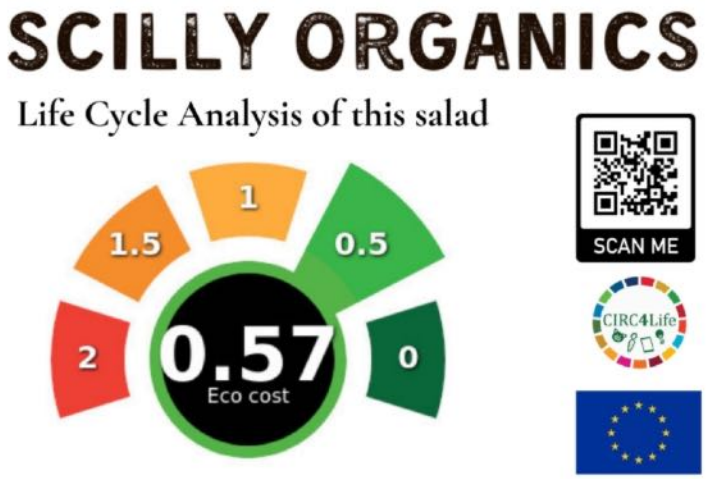
94,7 % of respondents (36 respondents) answered the label they saw was the Carbon Footprint label

Only 2,3% saw the eco-cost label (2 respondents)

Profile

- Age- respondents are age between 20 and 70 years old (very diversified in age categories)
- Gender- 60% of women and 40% of men answered the survey.
- Education: most respondents have a high level of education (70% have a university degree, master, postgraduate or PhD).
- Residence: 57,5% of respondents live in mainland UK, 37.5% live in Isles of Scilly,5% live elsewhere
- Environmental and social impact awareness: 75% of respondents declared they usually or always pay attention to their environmental footprint when buying a product.20% sometimes do. Only 5% rarely do so.

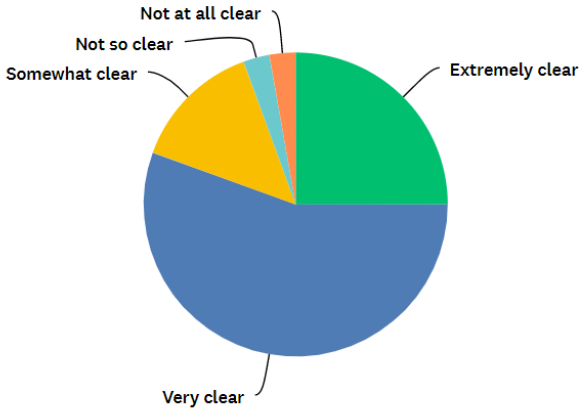
1. Carbon Footprint label



For 80.56 % of respondents the label was very or extremely clear. For 13.89% of respondents the label was somewhat clear. However, for 5.56 % of respondents, the label was not clear.

How clear is this label to you?

Answered: 36 Skipped: 4



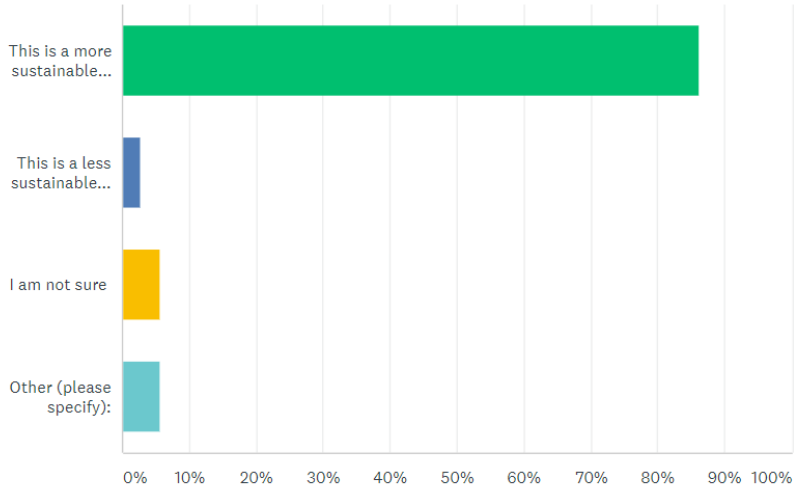
ANSWER CHOICES	RESPONSES	
Extremely clear	25.00%	9
Very clear	55.56%	20
Somewhat clear	13.89%	5
Not so clear	2.78%	1
Not at all clear	2.78%	1
TOTAL		36

Most respondents (86,11%) understand the meaning of the label. This is proven by the fact they correctly answered the below question.

Only 2,89% of respondents did not answer properly.

The carbon footprint of this salad is - 1kg of CO2. What does this meant to you?

Answered: 36 Skipped: 4



In addition, 88.89% of respondents declared they are likely or very likely would be influenced by the footprint of the salad when buying it.

Packaging

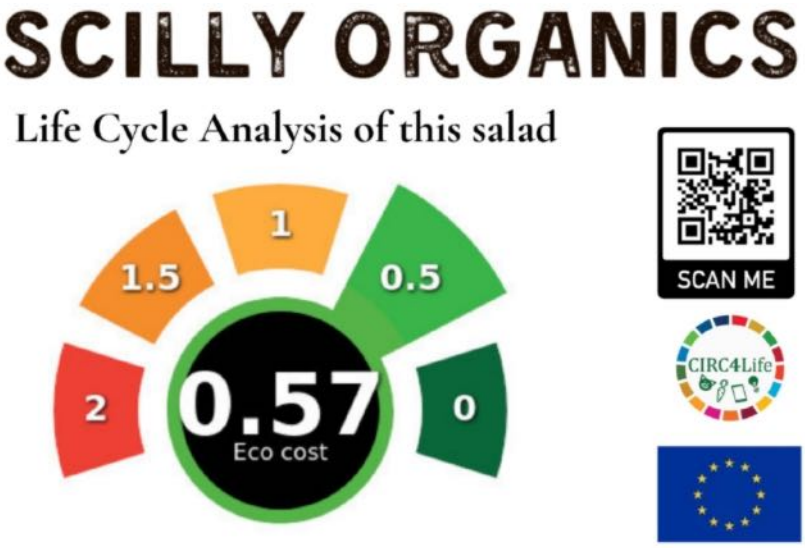
For 77,78% of respondents, the type of packaging material is an important purchasing factor. For 22.22% of respondents this would be somewhat important.

47,22% of respondents declared they would pay an additional fee of 20p to buy a compostable bag instead of a regular one. 41,67% said they probably would and 2,78% said they probably would not. 8,33% answered they would not know.

Social impacts

66,57% of respondents declared they always or usually pay attention to the social impacts of products when buying them.

2. Eco-cost label



Unfortunately, only one respondent was able to see this label and answered the question.

We are therefore not able to make an analysis of this label.

Appendix 2 – description of Task 6.4

Task 6.4 Demonstration of CEBM with vegetable food (M19-M33), demonstrated by JS and IEIA.

This task will demonstrate three approaches to vegetable production by JS, a small-scale vegetable farm in the UK. The demonstration will be based on Scilly Organics in the UK. The Task will be split in to three parts:

1. **Demonstration of co-creation and sustainable consumption of vegetables, enabling consumers' requirements to form the basis of the production system and the increased purchase of vegetables with low impacts.**

• Use dedicated co-creation focus groups (coupled with Task 3.5) to undertake a detailed analysis of the needs and desires of different actors in vegetable supply chains, including consumers, researchers, policy makers, producers, processors, distributors, retailers and waste managers, to demonstrate the key purchase decisions of key groups:

- Consumers: motivations for purchase patterns, ethical/financial values, requirements for product specifications

- Producers: reasons for current models, opportunities for change, and ability to adapt
- Other actors in supply chain: ability to adapt to changing consumer requirements
- Identify mechanisms to enable direct interaction between consumers and businesses in the vegetable supply chain, to ensure long-term continuity, and ability to scrutinise effectiveness

• Using the outcomes of the co-creation focus groups, develop new markets for vegetables. This will involve:

- Actors creating low impact vegetable products, using innovative products, price mechanisms and product placement
- Explore methods of engaging consumers in understanding the benefits of low impact vegetable products, e.g. embedding of product's impact information in barcodes that can be read on apps, and labelling on product packaging
- Assess existing methods of enabling consumer awareness of low impact lifestyles and product purchases, for example myEcoCost. Assess pros and cons of existing schemes, and how CIRC4Life approach can add value

• Demonstrate the impacts to consumers - including on health, of sustainable consumption of low-impact vegetables, and also the benefits on societal health of wide scale adoption of low-impact vegetable production and consumption.

2. Demonstration of sustainable production of vegetables in Scilly Organics, enabling reduced environmental, social and cultural impacts ('impacts'), whilst creating new Circular Economy Business Models (CEBM) that create enhanced economic sustainability.

• Demonstrate a 'before and after' model of a transition towards a CEBM for vegetable production and retail, supported by data from Sustainable Impact Analysis in Task 1.2, including financial impacts

• Using data from Task 1.2, the LCA will be conducted to evaluate the environmental impacts of selected CEBMs through the product life cycle. The necessary method, such as carbon footprint, PEF, ReciPe etc. will be utilised

• Analysis of existing practices of organic food production, based on interviews. and the possibilities of implementation of sustainable vegetable production (after changes). Identification of examples of sustainable vegetable production (after changes), based on interviews.

• Using the new Decision Making Tool demonstrate how it enables businesses to reduce the impacts of their products, by identifying areas to reduce impacts and make informed decisions on routes to reducing impacts

• Demonstrate how supply chain length can be reduced through different retail options, and how consumers can have closer connections to farms, such as Community Supported Agriculture, direct supply, and co-creation of products.

3. Demonstration of waste reduction, reuse and recycling in vegetable production, leading to less food waste produced, by-products being turned in to useful products, and any waste produced being treated sustainably.

• Demonstrate the current waste streams created from vegetable production, including material and food waste products, assessing how the waste products could be treated more sustainably

• How organic waste by-products (e.g. crop waste, manure, etc.) can be turned in to fertility and/or energy sources on farm, through composting, cultivations and anaerobic digestion. Use of Decision Making Tool to demonstrate and quantify impacts. User can use the developed tool to view the eco-information of different products online to select more environmental products.

• Analysis of existing practices of sustainable use of current waste streams, based on interviews.

• Analysis of the possibilities of implementation of sustainable use of current waste streams, based on interviews.

• Recognition of good practice examples of sustainable use of current waste streams, based on interviews

• Ensure mechanisms exist to recycle all material items from farms, reducing the amount of waste going to landfill. Quantify the impacts of materials not going through recycling streams.

• Demonstrate how positive waste measures can impact the consumers' Eco-Points, further driving incentives to reduce, reuse and recycle.

• Develop a Brokerage system to provide opportunities to connect producers and users of vegetable waste:
- Farm out-grade produce to processors, retailers and consumers
- All actors to offer excess food to charities, food banks, homeless shelters, etc.
- All sectors with anaerobic digestion operators, to generate energy from waste

• Demonstrate the impacts of different packaging materials, especially on waste management
For all the above CEBM's the approach will also be linked to other products, showing how CEBM is applicable to other sectors and scales

D6.4 : On site demonstration of CEBM for vegetable foods
The demonstration of CEBM with vegetable food includes:
(1) demonstration of three approaches to vegetable production.
(2) demonstration of co-creation and sustainable consumption of vegetables, enabling consumer´s requirements to form the basis of the production system and the increased purchase of vegetable with low impact.
(3) demonstration of sustainable production of vegetables in Scilly Organics, enabling reduced environmental, social and cultural impacts, whilst creating new CEBM that create enhanced economic sustainability.
(4) demonstration of waste reduction, reuse and recycling in vegetable production, leading to less food waste produced, by-products being turned in to useful products, and any waste produced being treated sustainability.

The location for the on-site demonstration is the Scilly Organics farm, United Kingdom (Linked to Task 6.4)

Appendix 3 – link to Deliverable 1.2

Full results of carbon footprint, S-LCA and E-LCA an be found in Deliverable 1.2 here https://25cd04c9-5fc8-4b44-8c3c-9ad39fc8bbac.usrfiles.com/ugd/25cd04_12398d4cc36e4b41934e10d807ad00a5.pdf

Appendix 5 - results of Packaging Trial

Packaging trial

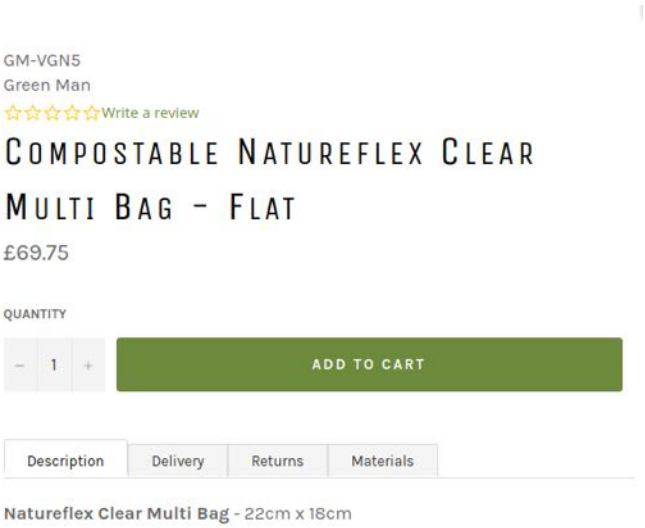
As part of Task 6.4, a trial of alternative packaging was conducted amongst organic vegetable growers. The aim was to test alternatives to oil based single use ('conventional') plastics, which are commonly used in the horticultural industry as packaging – particularly for highly perishable leafy crops such as salads, kale, chard, pak choi, spinach, lettuce and herbs.

In order or replace conventional plastics, any replacements for should have particular qualities that growers are looking for, which include:

- Transparency – ability to see clearly what is in the bags
- Permeability – limited or no permeability to air, to ensure the produce stays fresh in the bags and doesn't wilt
- Robust – ability to hold together and not tear easily
- Size – the correct size for the produce
- Availability – how easy it is to purchase the bags
- Price – cost per bag
- Environmental credentials – what the bags are made from, where they come from and how they degrade

Samples of five different bags were sent out to ten UK organic vegetable growers as free samples. These growers then tested the bags with their produce, and collated responses from staff and customers. Resonses were received and anonymised; a summary of all responses is given underneath each bag number. Many of the themes were common across all responses received.

Bag 1: Natureflex clear



Made from	**Compostable?**	**Size (cm)**	**Cost per bag** (ex VAT)
Wood pulp	Yes - home	18 x 22	£0.07

https://www.greenmanpackaging.com/collections/biodegradable-compostable-food-bags/products/natureflex-clear-pla-multi-bag-22cm-x-18cm

Summary of comments on Bag 1:

Positive

- Great on look and freshness.
- Good strength bag.
- Professional finish for small bags of mixed salads.
- No labels or branding – which enables the grower to add their own.
- Would look good displaying edible flowers or mixed salads with lots of interesting leaves – high value product would then justify the cost of the individual bags.
- See through is great
- Ethical product in theory, though couldn't find much information on the website about the source of the wood pulp – is the forest sustainably managed?

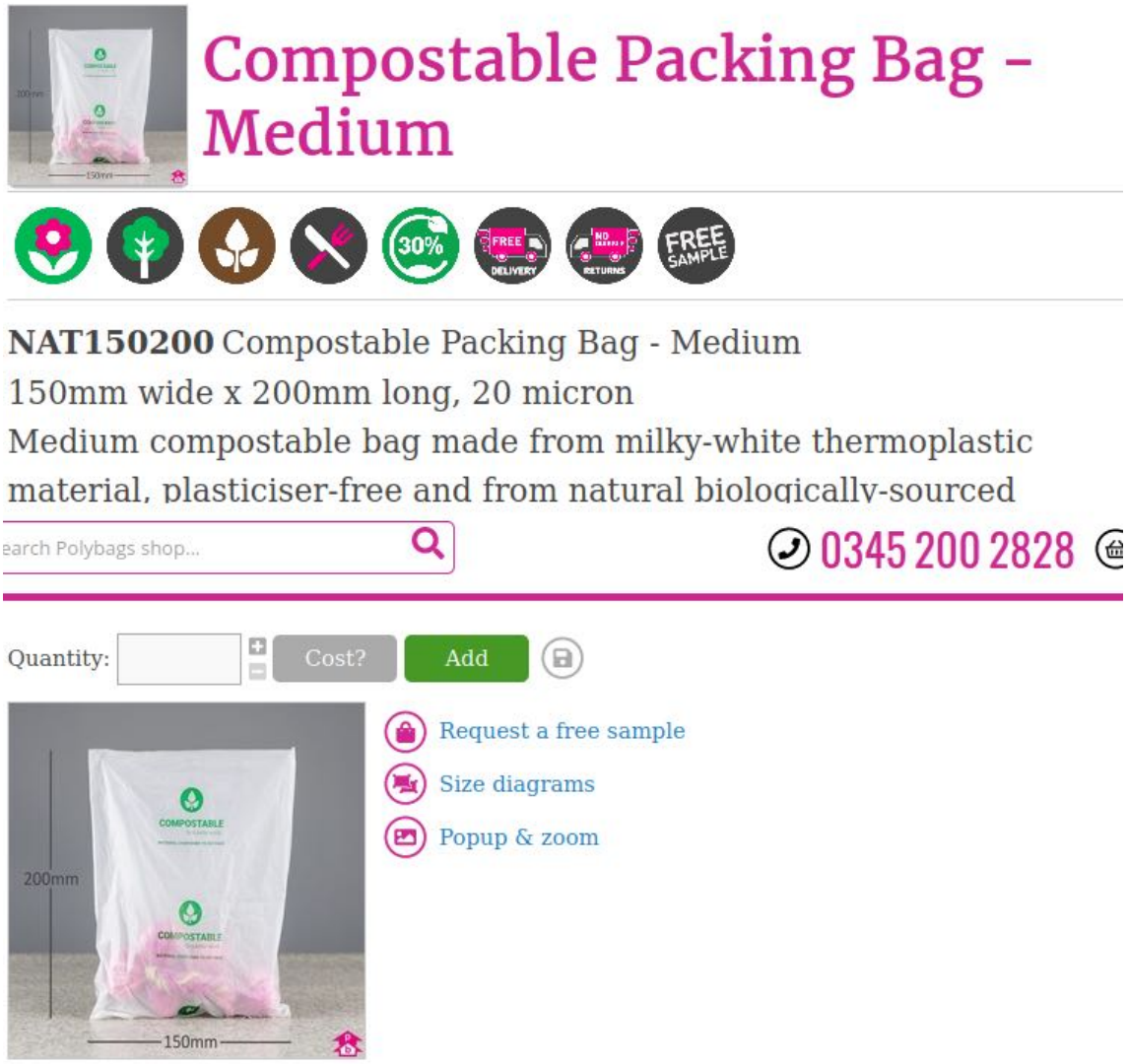
Negative

- It would be useful to have compostable written on bag as easy to mistake for plastic.
- Size not very useful for doing salad and cooking greens (too small – ther sizes not yet available).
- Unsure whether customers would want to compost at home as it looks convincingly like plastic and has no information stating so.
- Seal breaks quite easily
- Its size and structure is similar to that of a paper bag
- Material doesn't like getting wet
- A problem if bags over filled

Bag 2: Polybags compostable (medium)

Made from	**Compostable?**	**Size (cm)**	**Cost per bag** (ex VAT)
'Biologically sourced polymers'	Yes - home	15 x 20	£0.10

https://www.polybags.co.uk/shop/compostable-packing-bag-medium_p1692.htm



Summary of comments on Bag 2:

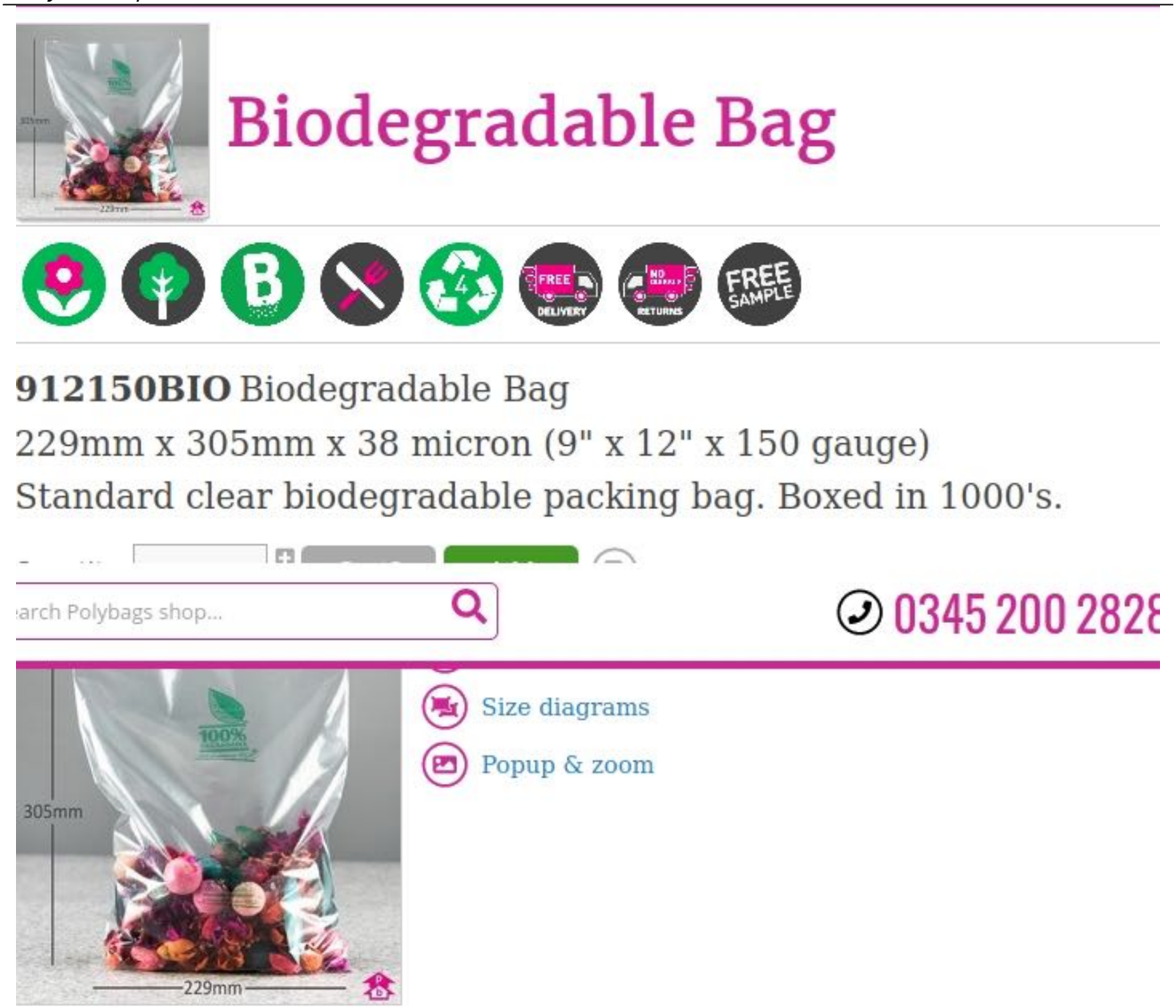
Positive

- Nice feel to the bag.
- Clearly compostable and was felt that customers would be happy to put these on their own compost heap.
- Looks professional
- Good for certain greens

Negative

- Slightly concerned about the translucency of the bag – feel it would not display the produce as well as a clear bag.
- Lacks strength and stretches out of shape easily which can look a bit messy.
- Different sizes would be better for some larger vegetables
- It states ‘to be used within 6 months of delivery’ and has very specific storage requirements which would be an issue if buying in large quantities to save on cost per bag.
- Unsure how well these would last if produce was packed wet.
- Questionable ethics – uses oil based plastic
- Doesn’t keep salad fresh for as long as conventional plastic.
- Quite expensive
- Not so popular with some customers

Bag 3: Polybags biodegradable



Made from	**Compostable?**	**Size (cm)**	**Cost per bag** (ex VAT)
Oil based	No, biodegradable	23 x 30	£0.03

https://www.polybags.co.uk/shop/biodegradable-bag_p87.htm

Summary of comments on Bag 3:

Positive

- Looks and feels good
- Low cost (relatively)
- Good size
- Easy to close
- Keep produce fresh
- Better than plastic but not the holy grail!

Negative

- It's 100% oil based plastic – against the ethics of some companies
- Confusing – this is biodegrdable, not compostable. Many don't know the difference, or their ethics
- Doesn't compost

Bag 4: Bio Bag biodegradable

Made from	**Compostable?**	**Size (cm)**	**Cost per bag** (ex VAT)
'Natural resources'	Yes, home	30 x 40	£0.08

https://www.bhgsltd.co.uk/biobag-biodegradable-clear-produce-bags-p-1893.html?zenid=1aa1kscos0sgpdd745639kk352

Summary of comments on Bag 4:

Positive

- Good for some greens
- Wicketed – easy to handle
- Ethics probably quite strong
- Could be used for catering supplies where retail aesthetics are less important

Negative:

- Salad wilts in them
- Large bags – unsuitable for many crops
- Lacks strength and stretched out of shape very easily which looks a bit messy.
- Not clear they're compostable
- Material sourcing – not clear where it's from
- Problem if bag is wet?
- Not popular with customers
- Would look bad on retail display

Bag 5: EcoClear (medium)

Made from	**Compostable?**	**Size (cm)**	**Cost per bag** (ex VAT)
'Renewable resources'	Yes, home	20 x 28	£0.20*

EcoClear™ Fresh Produce Bag: Medium - 100 bags

$38.30 NZD

Shipping calculated at checkout.

Quantity

1

ADD TO CART

Stand out to your customers as a leader in sustainable business practices.

This bag is a high clarity moisture-resistant compostable film called EcoClear™ which has been developed to provide a cost effective eco-friendly solution for packing fresh salad greens. It's low oxygen and moisture barriers make it ideal for packing fresh produce that require a shelf life of approximately 10 days. If you're not sure about your product's suitability, contact us for more info.

This bag is clear, with dimensions 200 mm x 285 mm (film is 50 microns thick).

These bags can be cut down to a required size and resealed, if you have a appropriate sealing machine.

Is this your first time using Econic? No Econic bag is suitable for high temperature liquids such as sous vide cooking, or adding boiling water to. Do not bring your Econic packaging into contact with Dry Ice. Econic is not designed for storing liquids.

Always test your products in Econic by using a Sample Pack prior to full ordering to check Econic is right for your product's needs: https://econicpackaging.com/products/sample-pack

* Bags are manufactured in New Zealand, so shipping must be added

https://econicpackaging.com/products/compostable-fresh-produce-bag-medium

Summary of comments on Bag 5:

Positive

- Good bag for many greens
- Home compostable – though not very clear
- Useful size
- Good strength and shape
- Sealable

Negative:

- Shipping from New Zealand not good for transport!
- Very expensive – probably unviable
- Not quite translucent
- Not very clear what the bags are made from

Results and commentary

Growers need bags which are high performance for high value crops, transparent, have high ethics and are cost effective. Whilst all participants in this trial have strong motivations to move away from conventional plastics, as business owners they need solutions that work for them on all of the above requirements. In that sense this is a tough challenge, and one of the main reasons conventional plastic bags are still the dominant material in horticultural packaging of highly perishable vegetables.

From this trial, the bags that 'ticked the most number of boxes' for most users, given the above criteria were bags 2 and 5, though 5 was considered to be prohibitively expensive (this may reduce in time).

No one bag was considered 'perfect' as all had some drawbacks. All participants found this trial a useful learning process and will continue to search for the most appropriate packaging solutions for their business.

Other options

Since the start of the study two significant products have been discovered:

Tipa

https://tipa-corp.com/application/open-bag-wicketed/

This product is closer to the 'holy grail' than all other bags. It is clear, home compostable, robust and in a variety of sizes, with the option for printing. However, at present it is only available in quantities of 25,000, but in the near future should be available in quantities of 1,000. Price: not yet known.

Polybags

https://www.polybags.co.uk/shop/clear-compostable-packing-bag-medium_p1971.htm

This is a variation on bag 4, but slightly different size and clearer. The cost is around £0.16 per bag.

Prices

A note on price comparison of all bags. All prices quoted here are in GBP, are sourced from UK, and exclude VAT. Price per bag decreases for larger orders.

By way of comparison on prices, 'conventional' plastic lettuce bags cost around £0.02 per bag, for example these: https://www.carterspackaging.com/Shop/Category/Non-Wicketed-Perforated-Produce-Bags

Appendix 6

Feedback, chat and questions from Showcase event 12th May

Chat, questions and feedback from the CIRC4Life webinar Circular economy in organic vegetable growing, 12th May 2021

Great video!

Very good movie!!!

Nice video, very informative.

Well, done Jonathan!

Beautiful farm, nice video!

Nice video! The island is very beautiful

Jonathan, out of curiosity - we all know that people say sustainability is important, but what does it mean in practice? Do you see the impact of your activities on e.g. the purchasing choices of your customers?

Really impressive, Jonathan!

Cuba is a good example of going from heavily industrialised agro destroying the soil quality to the restauration work done after the fall of Soviet Union (loss of their largest customer for sugar etc.).

Can you say a little more about porganic and carbon levels in your soil, ie how much they've imp

With composting, are you collecting compost inputs from other island sources, or is it only your own farm inputs? Can you say how much they've improved year on year? and have you analysed the nutrient values of your vegetables?

Hello, could you tell us more about the ‘home compostable’ bio plastic bags? Thanks

So, regulation is actually inhibiting recycling?

Would be very interesting to hear feedback also from your customers engaged in the co-creation process - are any of them present now here? And also, a follow-up question about co-creation: have you collaborated with other farmers on Scilly, and can you share the experiencies? How about other stakeholders?

Why not participate in development of soil covering fabrics ”accelerated” with nutrients? Excess leaves as a material?

Labels and glue compostable? Ideas for future products?

Sorry but I have to drop off. This has been excellent - thank you. Will the recording be sent out after the event?

How do you see what the main challenges of moving towards more circular business models are for microfarmers? Have you experienced through your demonstration activities that CEBMs create new business opportunities for your business? You talk about plastics, how about biowaste, is this an issue?

Excellent session! Thank you so much!

Do you consider seaweed to be an acceptable component of a circular economy? Is it not an input?

Scilly is a very specific (and beautiful!) ecosystem, and you, Jonathan, is one of the forerunners in sustainability, but also the islanders are also very sustainable and well-aware. Do you think your experiences apply to the "mainland farming" as well, or would you say that Scilly is sort of more "ready" for CE?

What do you think were the main barriers in terms of regulation? What should policy makers focus on in order to favor this kind of circular business models?

1. what issues do you see arising when you think about scaling up? 2. do you have any comparable figure of CO2e used with an average supermarket salad bag? Thank you

Q for Hanna or Karin, could you tell us more about the eco-points and rewards system please?

Following on from previous external compost inputs: would it be fair to say that regulation has created barriers to common sense and practical action? Is starch the key ingredient in creating planet-based plastics? You mentioned wood as a source, is there starch involved in that source?

What is your take aways from CIRC4Life? What will you take over after the project is completed, and what will you discard?

I have to leave you unfortunately. Many thanks Jonathan and RISE for the very insightful webinar!

https://static1.squarespace.com/static/544dc5a1e4b07e8995e3effa/t/54e4d927e4b0aaf066abfcf0/1424283943008/Cowspiracy-Infographic-Metric.png

Thank you!

Thanks for a very good session!!!

Appendix 7

Report by IEIA:

LCA of packagings for fresh greenery

This is the internal report on the environmental performance of the production of different types of packaging for fresh greenery. The aim of analysis carried out is to compare these packaging in their production phase in the context of its sustainability.

LCA of thermoplastic materials

The analysis are based on data from Sima Pro inventory (Ecoinvent 3 data) on the production of four types of material:

- Polyester-complexed starch biopolymer,
- Polylactide granulate,
- Polyethylene, high density, granulate,
- Polyethylene, low density, granulate.

Polyester-complexed starch biopolymer

Ecoinvent inventory refers to the production of 1 kg granulate modified starch. The inventories is based on calculations and extrapolations using highly aggregated background data from the environmental product declaration of Materbi - range of bio-based plastics produced by NOVAMONT in Terni, Italy which are biodegradable and compostable. Included processes in the inventory of modified starch granulate are the production of input materials corn starch and fossil components (plasticizers and complexing agents), transports of input materials, energy consumption in the processing and packaging at plant as well as waste treatment.

Polylactide production, granulate

Ecoinvent inventory refers to the production of 1 kg PLA. It is based on data from the world largest PLA plant. The inventories include the LCI data from the report of the producer NatureWorks - plant site in Nebraska. In the publication only ag-

gregated data are reported. The data has been splitted up in maize production, energy use, transport and waste water treatment. The infrastructure has been added. In the published data from the plant in Nebraska the carbon dioxide emissions are offset by wind power certificates. This is not an intrinsic property of the PLA production, but specific to this plant. It is why in this process for the electricity production the UCTE Mix has been choosen. If the polymer is produced by NatreWorks in Nebraska the specific process should be used.

Polyethylene, high density, granulate
Ecoinvent inventory refers to the production of 1 kg of high-density polyethylene (HDPE). Data are derived from the Eco-profiles of the 24 European production sites. Not included are the values reported for: recyclable wastes, amount of air / N2 / O2 consumed, unspecified metal emission to air and to water, mercaptan emission to air, unspecified CFC/HCFC emission to air, dioxin to water. The amount of "sulphur (bonded)" is assumed to be included into the amount of raw oil. Inventory include aggregated data for all processes from raw material extraction until delivery at plant.

Polyethylene, low density, granulate
Ecoinvent inventory refers to the production of the 2 kg of low-density polyethylene (LDPE). Data are derived from the Eco-profiles of the 24 European production sites. Not included are the values reported for: recyclable wastes, amount of air / N2 / O2 consumed, unspecified metal emission to air and to water, mercaptan emission to air, unspecified CFC/HCFC emission to air, dioxin to water. The amount of "sulphur (bonded)" is assumed to be included into the amount of raw oil. Inventory includes: aggregated data for all processes from raw material extraction until delivery at plant.
The results presented in this section refer only to the environmental impact of the production of the material from which the bags for fresh vegetables will be produced. The functional unit is 1 kg of the material.
There were analysed following impacts of above mentioned materials.

- Greenhouse gases emission expressed in CO2 equivalent.
- Agricultural land transformation and occupation.
- Human toxicity (risk of cancer).
- Freshwater ecotoxicity and Terrestrial ecotoxicity
- Damage to resources availability.

For the Figure 1 (GHG emission) the analysis was conducted according to the method: Greenhouse gas Protocol V1.01.

For the rest of impacts the analysis were performed with the use of life cycle impact assessment method - ReCiPe method - which translates emissions and resource extractions into a limited number of environmental impact score.

In the Figures: 2 (GHG emission),3 (Natural land transformation and Agricultural land occupation),4 (Human toxicity) ,5 (Freshwater ecotoxicity and Terrestrial ecotoxicity) characterisation factors were derived at midpoint level (ReCiPe Midpoint (E) V1.12) including 18 midpoint indicators.

In the Figure 6 (Damage to resources availability) the analysis was performed for one of the three endpoint indicators (ReCiPe Endpoint (E) V1.12) - damage to resources availability. Converting midpoints to endpoints simplifies the interpretation of the LCIA results. However, with each aggregation step, uncertainty in the results increases.

Approaches to greenhouse gases emission indicators calculation

In the classical LCA method (as defined in ISO 14044) and the global mass balances as proposed by the IPCC the temporary storage of carbon in bio-based products are not taken into account. The main reason is that the same CO2 emission (or part of it) which is absorbed by plants is released later in time. In some publications/approaches there are many proposals to introduce a discounting system for delayed CO2 emission. Widely applied specification of PAS 2050 and the ILCD Handbook, specifying the credit for carbon sequestration as 'optional' in LCA. These optional calculations give rather different results compared to the baseline LCA method. These optional calculations are not fully in line with the global carbon mass balances.

The Figure 1 presents the calculation of GHG emission by two natural-based materials: polylactide, polyester-complexed starch biopolymer and polyethylene materials of low and high density. In this calculation the storage of CO2 by plants was taken into account was presented as negative values on the figure. The Figure 2 presents the calculation of GHG emission according to classical method. The GHG emission from the fossil fuels' combustion expressed as CO2 equivalent is higher for polylactic material than for others. Environmental impact potentials concern midpoint level (17 impact categories).

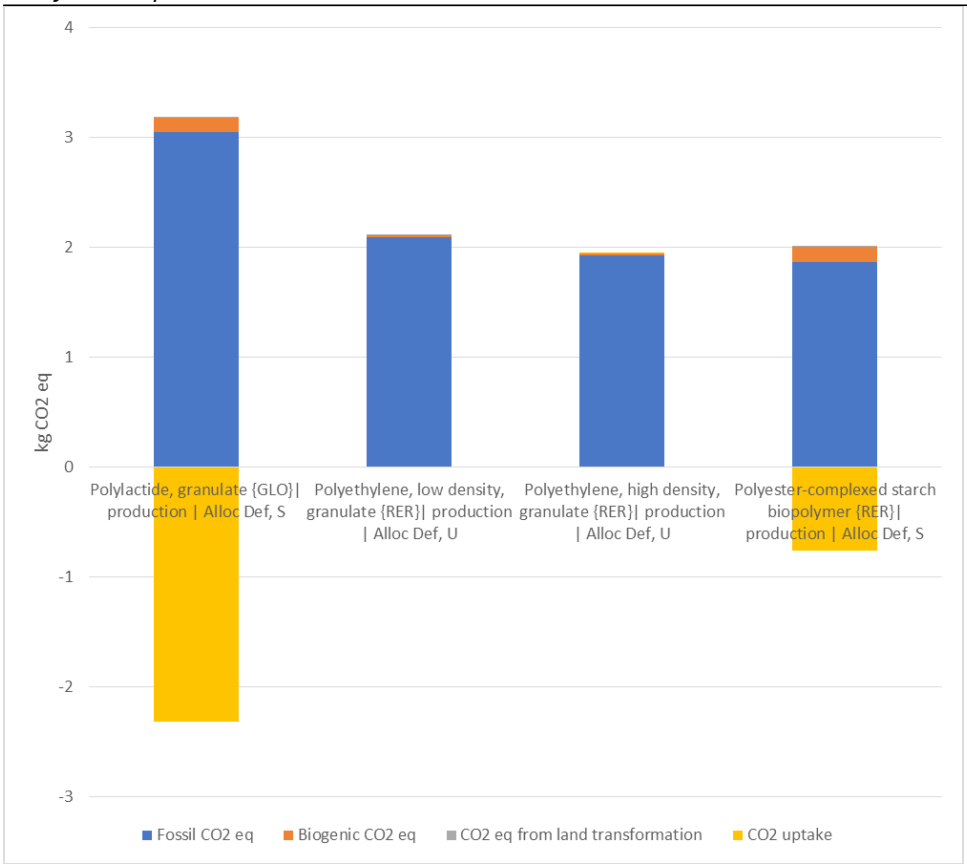


Figure 1 Polymer materials, Greenhouse gas emission, greenhouse gas Protocol V1.01 / C02 eq (kg)

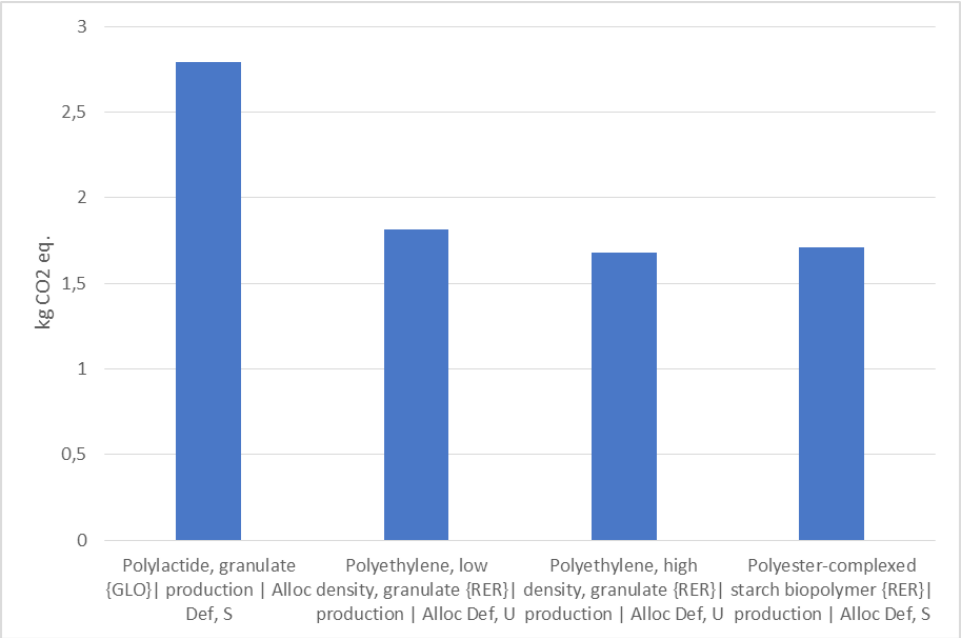


Figure 2 Polymer materials, GHG ReCiPe Midpoint (E) V1.12 / Europe Recipe E

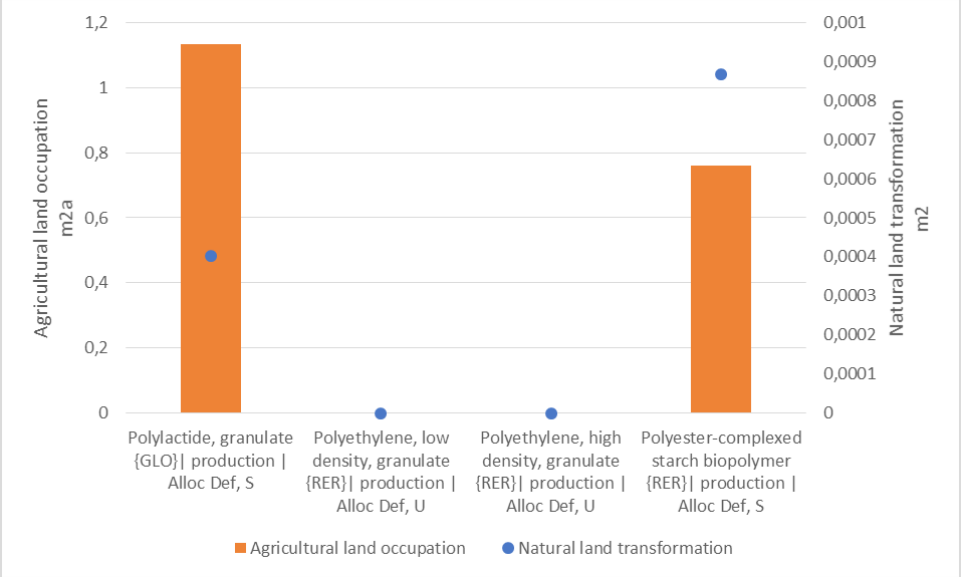


Figure 3 Polymer materials, Natural land transformation and Agricultural land occupation ReCiPe Midpoint (E) V1.12 / Europe Recipe E

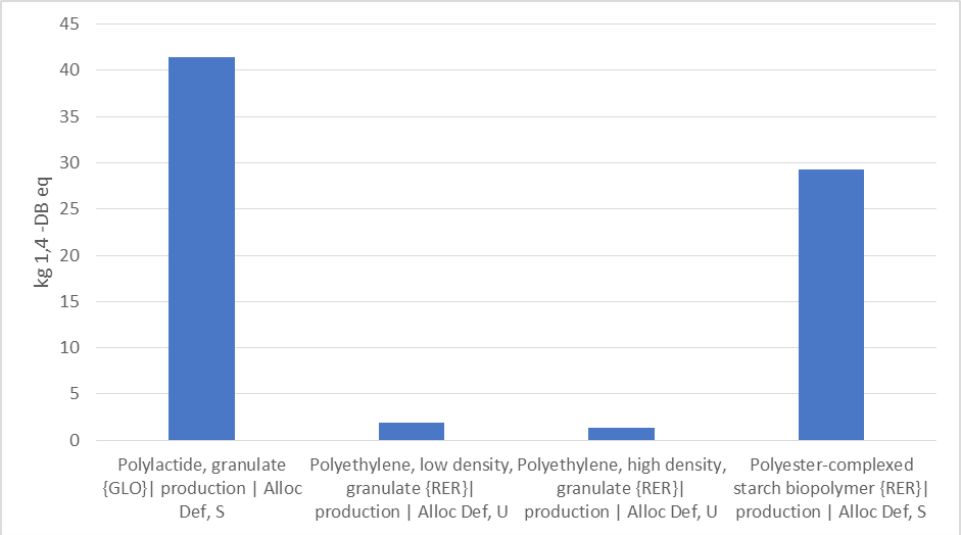


Figure 4 Polymer materials, Human toxicity, ReCiPe Midpoint (E) V1.12 / Europe Recipe E

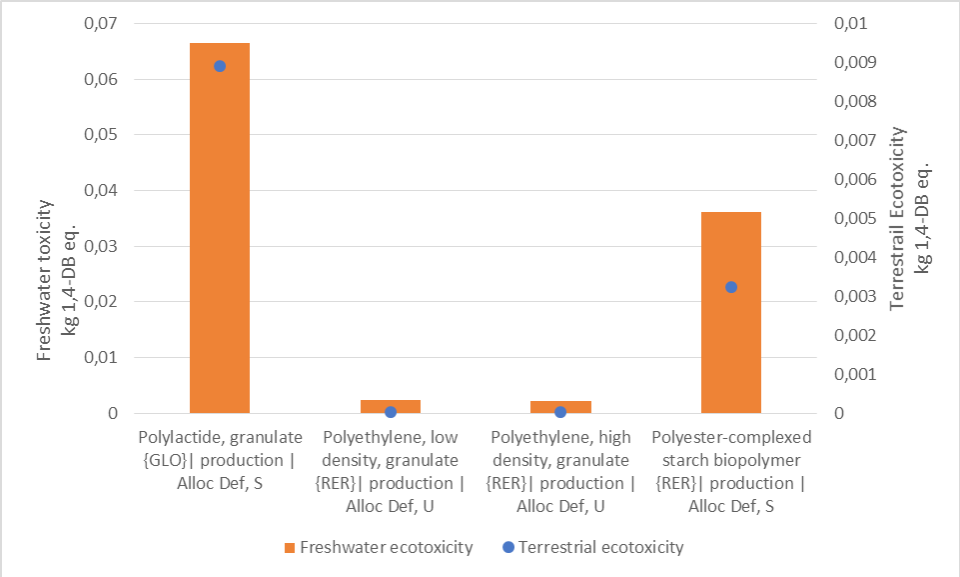


Figure 5 Polymer materials, Freshwater ecotoxicity and Terrestrial ecotoxicity, ReCiPe Midpoint (E) V1.12 / Europe Recipe E

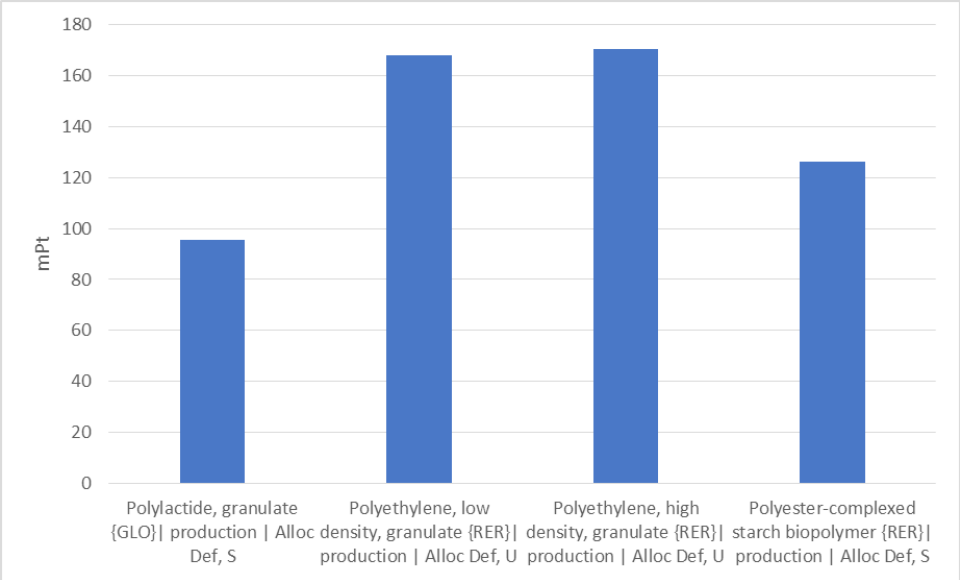


Figure 6 Polymer materialsl, Damage to resources availability ReCiPe Endpoint (E) V1.12 / Europe Recipe E

LCA of packaging bags for fresh greenery

Conduction of further LCA analysis referring to the production of packaging bags for fresh greenery is very complex. The analyses were carried out for bags with dimensions: 22 cm x 18 cm. The functional unit is 1 packaging bag. Obtaining good functional quality of the bags depends on the appropriate parameters including thickness, density and weight of the material.

For the analysis of the environmental impact of bags there were set following assumptions:

- Bags made of polyethylene, high density (HDPE) - 10 um thickness
- Bags made of polyethylene, low density (LDPE) – 20 um thickness
- Bags made of polylactid acid – 10 um thickness (high uncertainty)
- Bags made of starch – polyester – 15 um thickness

For the calculations data on transport and energy used were based on literature which includes scenarios prepared for Great Britain (this will need to be to be revised/remodeled).

On the presented figure the description/mark: PE bag means the bags were produced from LDPE.

There were used the same methods like for the analysis of materials (Section 1.1).

For the Figure 7 (GHG emission) the analysis was conducted according to the method: Greenhouse gas Protocol V1.01. For the rest of impacts the analysis were performed with the use of life cycle impact assessment method - RECIPE: Europe Recipe E.

In the Figures: 8 (GHG emission),9 (Natural land transformation and Agricultural land occupation),10 (Human toxicity) ,11 (Freshwater ecotoxicity and Terrestrial ecotoxicity) characterisation factors were derived at midpoint level (ReCiPe Midpoint (E) V1.12) including 18 midpoint indicators.

In the Figure 12 (Damage to resources availability) the analysis was performed for one of the three endpoint indicators (ReCiPe Endpoint (E) V1.12) - damage to resources availability.

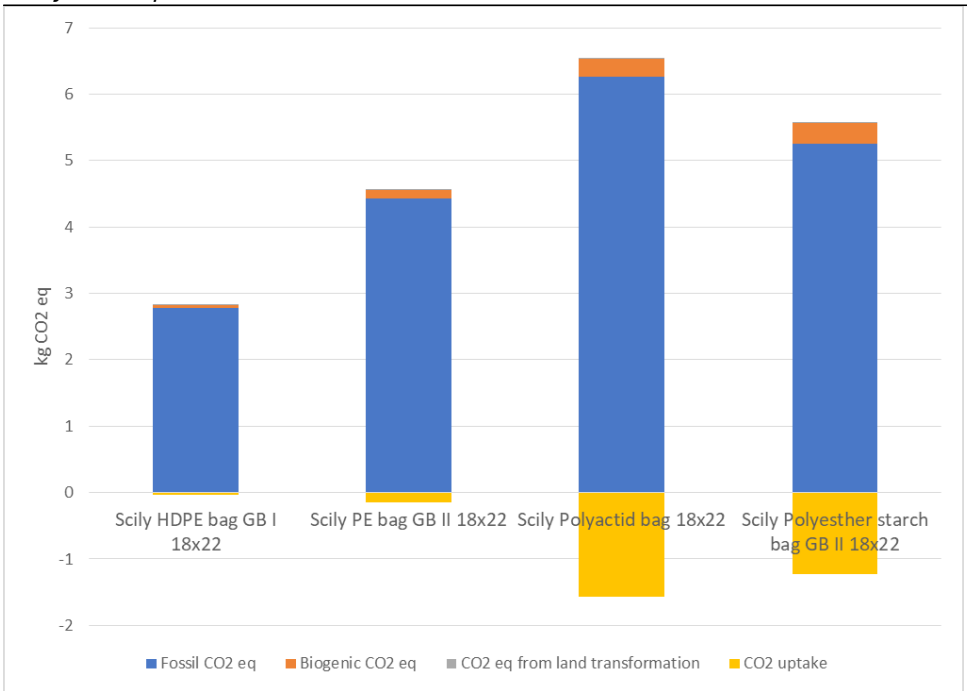


Figure 7 Packaging, Greenhouse Gas Protocol V1.01 / C02 eq (kg)

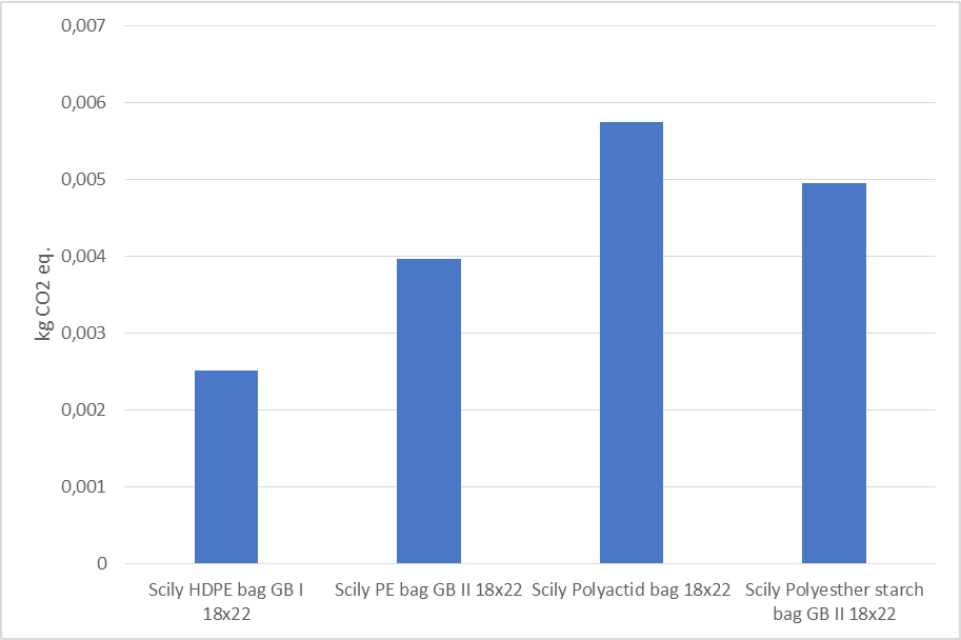


Figure 8 Packaging GHG ReCiPe Midpoint (E) V1.12 / Europe Recipe E

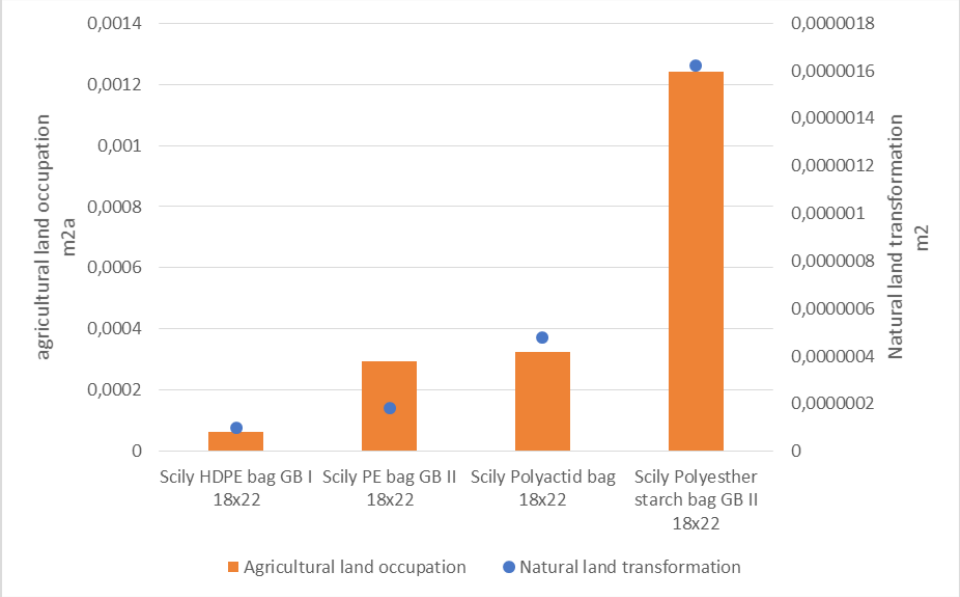


Figure 9 Packaging, Agricultural land transformation and occupation ReCiPe Midpoint (E) V1.12 / Europe Recipe E

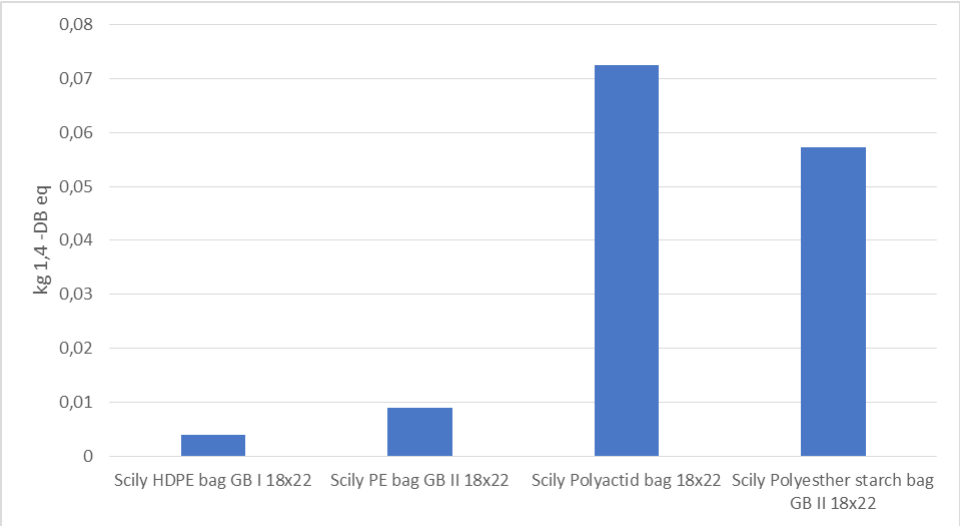


Figure 10 Packaging, Human toxicity, ReCiPe Midpoint (E) V1.12 / Europe Recipe E

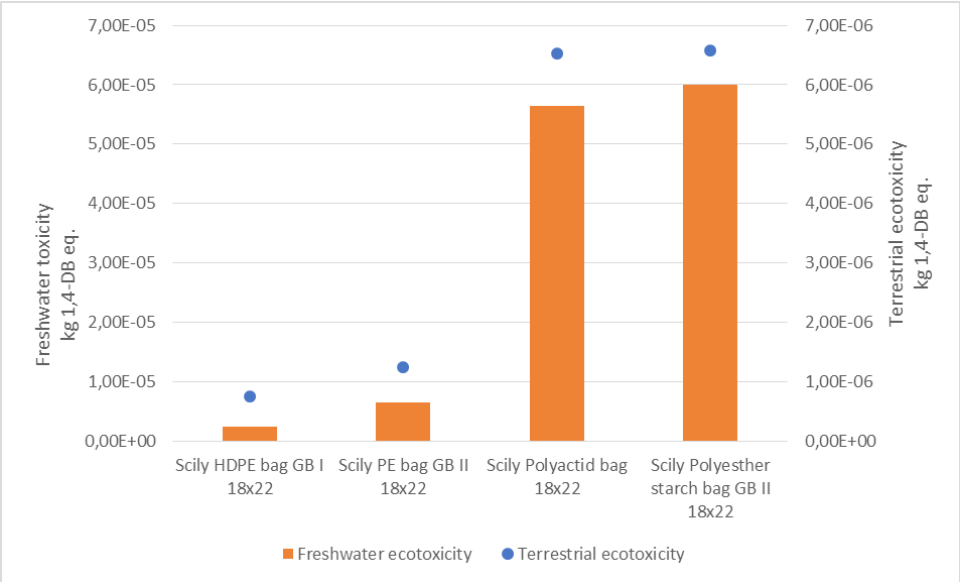


Figure 11 Packaging Freshwater ecotoxicity and Terrestral ecotoxicity, ReCiPe Midpoint (E) V1.12 / Europe Recipe E

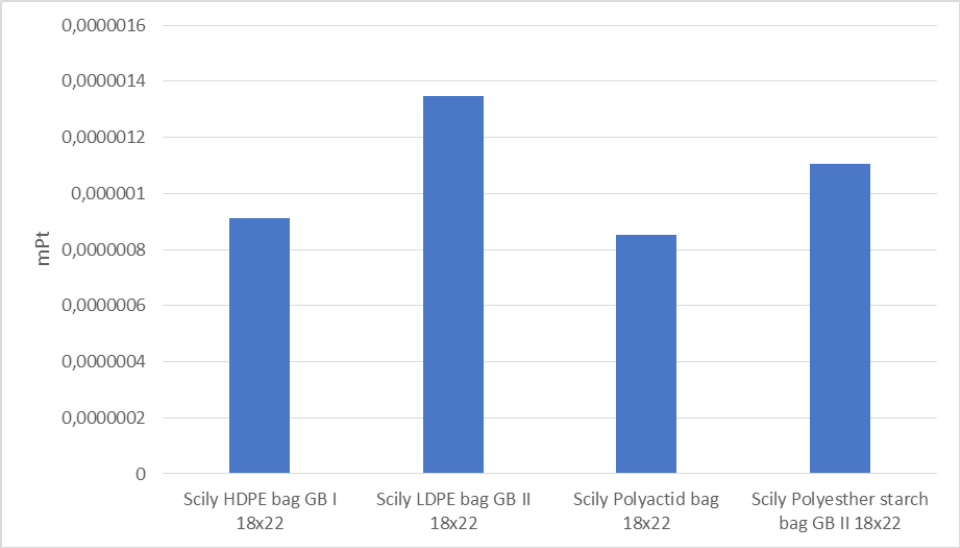


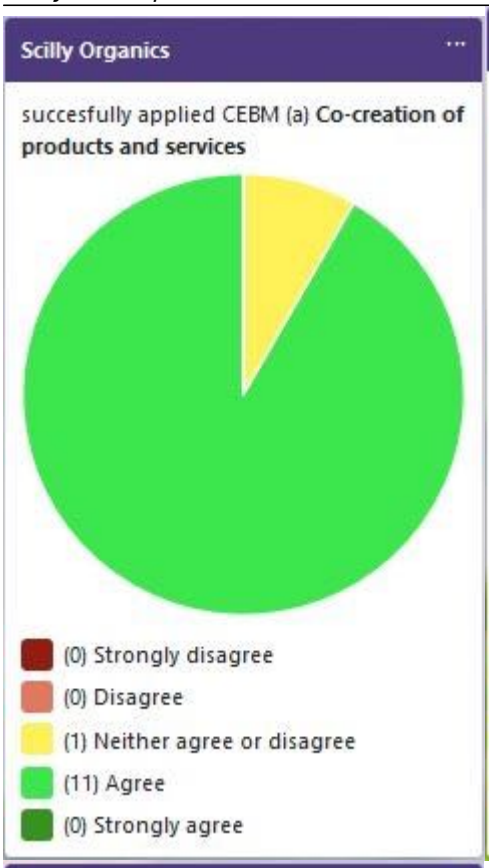
Figure 12 Packaging, Resources ReCiPe Endpoint (E) V1.12 / Europe Recipe E

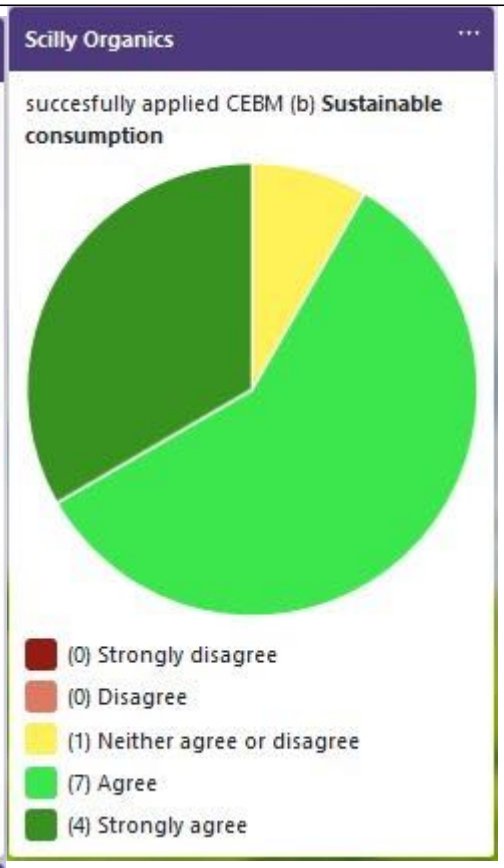
Appendix 8

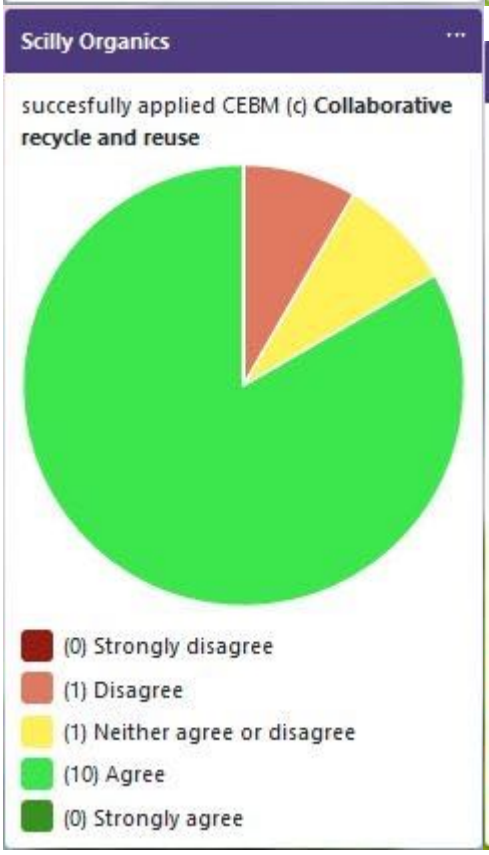
Material from the 2nd OIC in May 2021

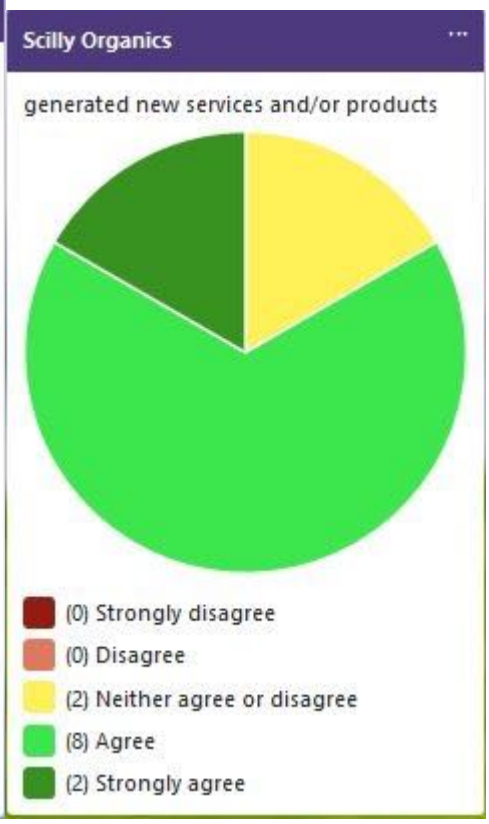
1. Drawings summarising the presentations from the event

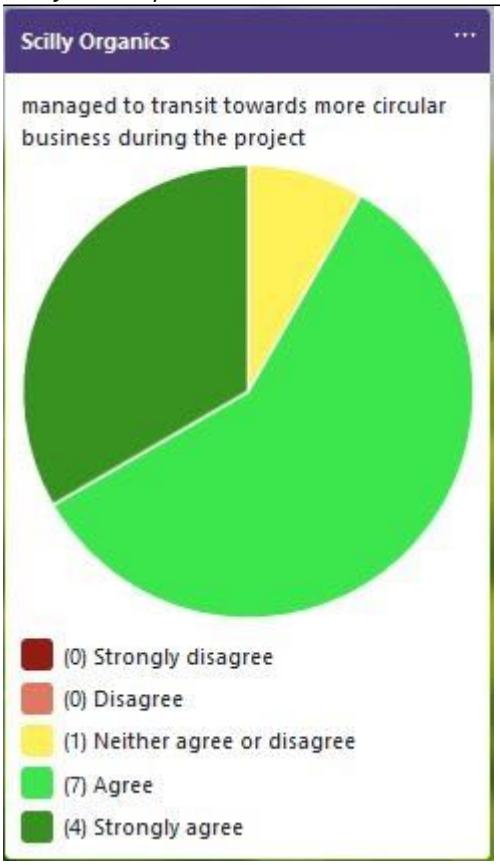
2. Results from voting on Howspace during the Innovation Camp as validation of Demo 3


Scilly Organics
succesfully applied CEBM (a) Co-creation of products and services
(0) Strongly disagree
(0) Disagree
(1) Neither agree or disagree
(11) Agree
(0) Strongly agree


Scilly Organics
succesfully applied CEBM (b) Sustainable consumption
(0) Strongly disagree
(0) Disagree
(1) Neither agree or disagree
(7) Agree
(4) Strongly agree


Scilly Organics
succesfully applied CEBM (c) Collaborative recycle and reuse
(0) Strongly disagree
(1) Disagree
(1) Neither agree or disagree
(10) Agree
(0) Strongly agree


Scilly Organics
generated new services and/or products
(0) Strongly disagree
(0) Disagree
(2) Neither agree or disagree
(8) Agree
(2) Strongly agree



Appendix 9

The Handbook for farmers and growers, written by JS, will be published on this webpage:
https://scillyorganics.com/circular_economy/

It will include learnings from the project, experiences in Scilly Organics and practical tips for farmers, written in an accessible way. It is a free resource.