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The Peter Mitchell Churchill Fellowship to motivate Australian businesses to innovate and become world-leaders in the upcycled food sector.

Francesca Goodman-Smith,
February 2024

2024

THE WINSTON CHURCHILL MEMORIAL TRUST OF AUSTRALIA

Report by Francesca Goodman-Smith, 2022 Churchill Fellow

Peter Mitchell Churchill Fellowship to motivate Australian businesses to innovate and become world-leaders in the upcycled food sector.

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f.goodman-smith

Francesca Goodman-Smith,
Churchill Fellow 2022

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Undertaking this Fellowship has been an incredible privilege. Having the opportunity to meet and learn from so many inspiring leaders in the food waste sector was the highlight of my career to date.

I would like to thank the Winston Churchill Memorial Trust for this incredible opportunity and pay particular thanks to the sponsorship of Peter Mitchell, who believed in the potential of young people to make change in Australia.

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Lastly, I would like to thank my wonderful friends and family for their years of support and encouragement. They inspire me everyday to be passionate and dream big.

Visiting Rodenburg potato starch factory to see their creations from potato waste

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I live and work on the land of the Yuggera people.

PROJECT OVERVIEW

Food waste is a global challenge, we are experiencing the impacts locally here in Australia with 7.6m tonnes of food going to waste each year, costing our economy $36bn[1]. Food waste contributes to climate change, and as we see more extreme weather events, those impacts are felt strongly by our farmers and growers, and we all see this reflected in the rising cost of food. Something must change.

One solution is upcycling. Upcycling is the process of converting food that would otherwise be wasted into new food products.

Upcycling can help to:

- Reduce food waste
- Increase food supply through using more of the food that is grown
- Deliver increased value to farmers, growers and manufacturers by converting a 'waste cost' into a valuable resource
- Provide consumers with more sustainable food choices.

The underlying challenge in Australia is that there are pockets of activity but there is no underpinning system that supports upcycling. It takes significant effort to create the relationships, supply chains, consumer demand and retailer acceptance and by learning from our international counterparts we can help to bring the isolated pieces together in Australia and make it easier for businesses to take advantage of the upcycled food opportunity. I investigated ways to enable a thriving upcycled food sector in Australia by learning from companies, researchers and not-for-profit organisations across the USA, UK and Europe.

By growing our knowledge, skills and tools across policy, industry and consumer levels we can maximise the opportunity of upcycled food (forecast to be worth USD97bn globally by 2031[2]) for Australia, which will not only help us to take action on climate change, but also support resilience and growth for our hugely important food industry. It will take our efforts away from individual companies trialling their own solution to everyone working towards the same goal of making Australia one of the world's most sustainable food systems.

KEYWORDS

Food waste; upcycled food; sustainable food systems; value-adding; valorisation; circular economy.

1 FIAL. The National Food Waste Strategy Feasibility Study – Final Report. 2021 [cited 2023 Oct 12]. Available from: https://workdrive.zohopublic.com.au/external/06152b9ff5971843391f39fc4d32a847e56fb907c167a4a645887b0a4bc43000

2 Upcycled Food Products Market [Internet]. Allied Market Research [cited 2024 Feb 3]. Available from: https://www.alliedmarketresearch.com/upcycled-food-products-market-A53592

KEY DEFINITIONS

TERM	DEFINITION	SOURCE
Food Waste[3]	Fractions of "food and inedible parts of food removed from the food supply chain" to be recovered or disposed (including - composted, crops ploughed in/not harvested, anaerobic digestion, bioenergy production, co-generation, incineration, disposal to sewer, landfill or discarded to sea)	Fusions[4]
Food Loss	Food loss refers to the decrease in edible food mass throughout the part of the supply chain that specifically leads to edible food for human consumption. Food losses take place at production, postharvest and processing stages in the food supply chain.	FAO[5]
Upcycled Food	Upcycled foods use ingredients that otherwise would not have gone to human consumption, are procured and produced using verifiable supply chains, and have a positive impact on the environment.	Upcycle Foods Definition Task Force[6]
Byproduct	A substance or object, resulting from a production process, the primary aim of which is not the production of that item.	Fusions[4]
Surplus	Food that goes unsold or unused by a business or that goes uneaten at home – including food and inedible parts that are donated, fed to animals, repurposed to produce other products, and all of the destinations represented in food waste.	ReFED[7]
Valorisation	Fractions of "food and inedible parts of food removed from the food supply chain" to be reused or recycled (animal feed , biobased materials and biochemical processing)	Fusions[4]

ACCRONYMS

NAME	ACRONYM
Upcycled Food Association	UFA
Where Food Comes From	WFCF
Sustainable Development Goal	SDG
United Nations	UN
Consumer Packaged Goods	CPG
Research and Development	R&D
United States of America	USA
United Kingdom	UK

3 In this report the term 'Food Waste' is being used to describe both Food Loss and Food Waste referring to the decrease in edible food mass throughout the part of the supply chain. Food losses take place at production, postharvest and processing stages in the food supply chain. Food waste occurs at the end of the food chain (retail and final consumption) (FAO, 2011).

4 FUSIONS.[Internet]. 2014 [cited 2024 Jan 15]. Available from: http://www.eu-fusions.org/phocadownload/Publications/FUSIONS%20Definitional%20Framework%20for%20Food%20Waste%202014.pdf

5 Food and agriculture organisation of the united nations. [Internet] 2011 [cited 2023 September 10]. Available from : https://www.fao.org/3/i2697e/i2697e.pdf

6 Defining upcycled foods - center for health law and policy innovation [Internet]. 2020 [cited 2023 Sept 10]. Available from: https://chlpi.org/wp-content/uploads/2013/12/Upcycled-Food_Definition.pdf

7 ReFED. Food waste problem [Internet]. 2023 [cited 2024 Jan 15]. Available from: https://refed.org/food-waste/the-problem/

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Executive Summary

'Upcycling' is the process of transforming food that would have otherwise been lost or wasted into new products. It plays a crucial role in achieving United Nations (UN) Sustainable Development Goal 12.3 (SDG 12.3), *'to halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses'* by 2030. [8]

This Winston Churchill Fellowship was designed to engage with experts on upcycling and harness this knowledge to propel the sector forward in Australia. Over the course of eight weeks, I visited the United States of America (USA), United Kingdom (UK), the Netherlands, Portugal and France to engage with 14 companies, 11 research and sector support organisations, and three organisations involved in policy. I also attended four food waste events including the 2023 ReFED Food Waste Solutions Summit.

8 Sustainable consumption and production [Internet]. United Nations; [cited 2023 Oct 14]. Available from: https://www.un.org/sustainabledevelopment/sustainable-consumption-production/

The Fellowship was designed to:

- Undertake industry site visits to observe upcycled food companies in practice and learn from their experience.
- Collaborate with the Upcycled Food Association (UFA) and certification body Where Food Comes from (WFCF) on the expansion of USA-based pioneering upcycled food certification to Australia.
- Visit Research and Development (R&D) facilities where significant upcycled food research and product development occurs.
- Discuss how upcycled foods can more overtly be included in global targets and standards (i.e., UN SDG 12.3).
- Engage with leading upcycled food businesses and industry experts by attending various international events.

Key findings identified during the Fellowship

Lessons learned from leading upcycled food companies

Upcycling food waste into new food products is an effective way to reduce food waste and increase food supply. There are two primary food waste streams that companies are upcycling into new products. These include byproducts (arising from manufacturing processes and agriculture side streams (i.e., cacao fruit) that are not currently/commonly used in the human food supply chain) and food surplus (food waste arising from overproduction of food and lack of access to primary markets). Some key learnings from international companies are:

- Raising consumer awareness and demand for upcycled foods is essential.
- Partnerships between innovative, agile companies and bigger companies with scale are essential (i.e., private label opportunities with retailers, sales of ingredients to large food service and food ingredient manufacturers).
- Paying producers for upcycled input materials is critical to demonstrate the value of the material and incentivise investment in maintaining food safe ingredients that enable the necessary supply chains.
- Actors at every stage of the food supply chain should consider their opportunity to participate in the upcycled food sector.
- Harness innovation from the culinary sector to demonstrate the full potential of over-looked foods.
- Include environmental messaging on-pack, where legislation permits.
- Investigate opportunities for hospitality and food service businesses to procure upcycled ingredients.
- Industry should utilise research support services.

There are opportunities for actors at each stage of the food supply chain to be involved in either supplying upcycled food inputs or purchasing upcycled foods and ingredients.

Opportunities to expand upcycled food certification to Australia

The introduction of the Upcycled Certified® for upcycled products and ingredients (in the USA and Canada) raised the profile of the upcycled food sector both nationally and internationally. As of November 2023, an average of 390,000 tonnes of food waste per annum have been diverted. Overall, 91 companies have certified a total of 460 products and ingredients.[9] The certification provides a recognisable mark for consumers to identify upcycled products and third-party verification to create credibility for the sector. Consumer demand for more sustainable products is growing and it is important to assist consumers in identifying the right products, including upcycled products. There is potential to roll the certification out in Australia and discussions with the Upcycled Food Association and certification body, Where Food Comes From, indicated that there are several mechanisms to enact this. As a result of this, I am now working with colleagues to prepare a proposal to bring the certification to Australia.

9 Impact [Internet]. 2023 [cited 2023 Oct 11]. Available from: https://www.upcycledfood.org/impact

The role of research, development, and innovation

Upcycled foods utilise ingredients that might not otherwise end up in the human food supply chain. Due to this, companies often require assistance with product development to understand how to use these novel inputs, understand nutritional attributes/ benefits, or formulate ingredients for the food industry. Research is also required on cross-cutting topics to advance impact for the whole sector (i.e., food safety, consumer acceptance, policy interventions and technology development). Companies can access research and innovation support from universities, private R&D companies, technology companies and not-for-profit organisations. Australian companies have access to a similar ecosystem of R&D support. We are in a leading position as End Food Waste Co-operative Research Centre is the largest research organisation dedicated to food waste globally. There are learnings we can take from research and innovation support targeted at upcycling internationally to advance the research approaches we take in Australia. Food Valley in the Netherlands has an 'Upcycling Community' to explore opportunities for the sector, Drexel University in the USA are home to 'Drexel Food Lab' and provide product development support to create upcycled foods and the Waste and Resources Action Program in the UK administered a grant program specifically for upcycling. Upcycled food companies should maximise access to support services to bridge gaps that the industry need to overcome to be successful.

Policy recommendations for the upcycled food sector

Enabling policy settings can help to reduce barriers and create opportunities for the upcycled food sector. It is essential that a common language is used to describe the concept of upcycling within a region in order to communicate the movement clearly. This has been demonstrated in the USA with strong adoption of the term 'upcycled'. Guidance is available in the form of the food waste hierarchy and guidance on interpreting the UN Sustainable Development Goal (SDG) 12.3 to help organisations prioritise food waste reduction activities. Upcycling should be explicitly named in these guidance documents as a food waste 'retention' activity as food is retained within the human food supply chain and counts towards achieving the SDG. The USA EPA's Wasted Food Scale is a step in this direction which includes and defines upcycled food[10]. It will become increasingly important to calculate greenhouse gas emissions associated with upcycling and have considerations embedded in future iterations of the Upcycled Certified®. An international working group should be created to work on appropriate methods. It is challenging for companies to navigate relevant regulations as upcycled foods and ingredients are not specified in regulations. It is recommended that policymakers assess how to enable upcycled foods within their jurisdiction (i.e., procurement, grants etc.) and that regulators develop a legal definition of upcycled foods to create more certainty around how these foods will be governed. Jurisdictions with pre-market approval processes for novel foods should consider how to amend their regimes to enable upcycled foods. We are seeing promising policy signals that include and support upcycling, for example with the proposed bipartisan NO TIME TO Waste Act[11] Bill in the USA. Broader adoption of policies that increase the potential to divert food waste and lessen environmental impacts through upcycling should be encouraged.

10 Wasted Food Scale. [Internet]. 2023 [cited 2023 Nov 15]. Available from: https://www.epa.gov/sustainable-management-food/wasted-food-scale

11 U.S. senator Christopher Coons of Delaware [Internet]. 2023 [cited 2024 Jan 14]. Available from: https://www.coons.senate.gov/news/press-releases/senators-coons-moran-and-reps-pingree-lawler-unveil-no-time-to-waste-act-to-combat-american-food-loss-and-waste

Francesca Goodman-Smith visiting Nijsen food to feed facility in the Netherlands

RECOMMENDATIONS FOR AUSTRALIA:

1. Adopt a food waste hierarchy including upcycling
2. Form an upcycling community/network
3. Adopt shared terminology for upcycling
4. Identify opportunities for upcycling at every stage of the food supply chain
5. Foster partnerships between large food companies and upcycled food companies
6. Educate consumers about upcycling and the links to the environment/ climate change
7. Adopt an upcycled food certification

These findings will influence my work at End Food Waste Australia, informing my guidance to industry, research and development proposals and future food waste strategy development.

01

Introduction

‘Upcycling’ is the process of transforming food waste into new products. It has benefits for businesses, the environment, and society and will play a crucial role in Australia’s commitment to the United Nations (UN) of halving food waste by 2030[12]. However, the path to transforming unavoidable portions of Australia’s 7.6 million tonnes per year of food waste into products is not always clear.

Australia wastes

7.6 million

tonnes of food per year

Upcycling is not a new phenomenon, in fact one of Australia’s national foods ‘Vegemite’ is a pioneering example of upcycled food, taking spent brewer’s yeast and converting this into an iconic spread. The movement and emphasis around upcycling has gained recent traction through businesses that are looking to contribute to a more circular food system where food is not wasted, instead it is used as a feedstock for another cycle[13]. Consumer demand is also growing for more sustainable food choices and awareness for upcycled foods is rising, with consumer awareness for upcycling as high as 85% of surveyed populations[14].

12 Sustainable consumption and production [Internet]. United Nations; [cited 2023 Oct 14]. Available from: https://www.un.org/sustainabledevelopment/sustainable-consumption-production/

13 Food and the circular economy – deep dive [Internet]. The Ellen McArthur Foundation [cited 2024 Feb 25]. Available from: https://www.ellenmacarthurfoundation.org/food-and-the-circular-economy-deep-dive

14 Grasso S and Asioli D, 2020. Consumer preferences for upcycled ingredients: A case study with biscuits, Food Quality and Preference, Volume 84, https://doi.org/10.1016/j.foodqual.2020.103951.

Upcycling food that would otherwise go to waste retains this food in the human food supply chain and ensures that the resources that went into production are not wasted. Upcycling maximises the potential of the food grown globally and creates opportunities for more of this food to be eaten.

The Upcycled Food Association (UFA) was established in the United States of America (USA) in 2019 to advocate and build a community around the growing sector (forecast to be worth USD 97bn by 2031[15]). The UFA then went on to establish a certification program for upcycled products and ingredients which is currently available in Canada and the USA with ~500 products donning the certification. The certification helps to tell the story of where food comes from and increases market demand for upcycled products.

There is also growing momentum across the United Kingdom (UK) and Europe towards the UN Sustainable Development Goal (SDG) 12.3 target of halving food waste with many examples of upcycling that Australia can learn from.

1.1. Project Objectives

This Winston Churchill Fellowship was designed to engage with experts on upcycled food and help develop mechanisms to propel the sector forward. The Fellowship ran from May to July 2023 and included visits to the USA, UK, Netherlands, France, and Portugal.

The Fellowship was designed to:

- Undertake industry site visits to observe upcycled food companies in practice and learn from their experience.
- Collaborate with the Upcycled Food Association and certifying body, Where Food Comes From, on the expansion of USA-based pioneering upcycled food certification to Australia.
- Visit research and development (R&D) facilities where significant upcycled food research and product development occurs.
- Discuss how upcycled foods can more overtly be included in global targets and standards (i.e. UN SDG 12.3).
- Engage with leading upcycled food businesses and industry experts by attending various international events.

The findings set out in Section 5 align with each of the five key objectives of the Fellowship.

1.2. Upcycling Industry Background

1.2.1. How the upcycled food sector evolved in the United States

informed by discussions with Ben Gray, Co-founder, Upcycled Food Association

The 'upcycled food movement' has been happening in diffuse ways across the food supply chain for many years. Before 2019 each brand or company had to independently describe what they were doing to take ingredients that would otherwise go to waste and turn these into new products. Some companies chose to promote this, and others were not sure how to communicate this or whether it was an attribute their customers were interested in.

15 Upcycled Food Products Market [Internet]. Allied Market Research [cited 2024 Feb 3]. Available from: https://www.alliedmarketresearch.com/upcycled-food-products-market-A53592

In 2019, the founders of the Upcycled Food Association, Turner Wyatt and Ben Gray connected with a few brands who were creating upcycled foods and didn't have a collective voice. The idea of having consistent communication from an authoritative body was appealing to the industry and UFA was born[16].


Ben Gray, UFA

The key benefits of creating a community for upcycling were:

- Establishing recognition of the upcycled food industry
- Opportunities for companies to learn from each other
- Creating a certification to educate consumers
- Enabling partnerships
- National communication and promotion of upcycling
- Access to research, data, and insights on the industry

Work began to define the term 'upcycled' led by industry, policy, and academic experts. The definition was essential in driving education around the concept and creating a collective voice.

The definition of upcycled food agreed upon by the UFA Definition Taskforce is:

> *"Upcycled foods use ingredients that otherwise would not have gone to human consumption, are procured and produced using verifiable supply chains, and have a positive impact on the environment."*[17]

Since 2019, there has been diffusion of innovation in the marketplace with over 260 companies now part of UFA[18]. Initially, there were plenty of small brands experimenting in different sectors of the market. Larger food and beverage companies are now partnering with smaller players to deliver more sustainable solutions and retailers are looking for upcycled ingredients for their private label products (i.e., retailer Kroger partnering with upcycled food start-up Renewal Mill on private label baking mixes). Large multi-national manufacturers are looking for ingredients to improve the nutrition and sustainability of their products (i.e., Kerry Ingredients partnering with pioneering upcycled food company Upcycled Food, Inc. on an upcycled protein crisp).

In 2020, the advent of a product and ingredient certification, Upcycled Certified®, in the USA and later in Canada, created a clear value-add position for upcycled products and ingredients. The credibility of the certification has been a multiplier and a facilitator in growing the industry and the demand for upcycled solutions.

In September 2023, Senators Coons (D-DE) and Moran (R-KS) introduced the bipartisan NO TIME TO Waste Act[19] Bill. The proposed Act includes the Upcycled Food Association's definition of upcycled foods, funding for research measuring the impact of the upcycled industry, and funding for a national food waste prevention education campaign that specifically highlights upcycled food as one important solution.

16 Upcycled Food Association, Foundation, and Certification [Internet]. 2023 [cited 2023 Oct 11]. Available from: https://www.upcycledfood.org/

17 Defining upcycled foods - center for health law and policy innovation [Internet]. 2020 [cited 2023 Sept 10]. Available from: https://chlpi.org/wp-content/uploads/2013/12/Upcycled-Food_Definition.pdf

18 Member directory [Internet]. 2023[cited 2023 Oct 11]. Available from: https://www.upcycledfood.org/member-directory

19 U.S. senator Christopher Coons of Delaware [Internet]. 2023 [cited 2024 Jan 14]. Available from: https://www.coons.senate.gov/news/press-releases/senators-coons-moran-and-reps-pingree-lawler-unveil-no-time-to-waste-act-to-combat-american-food-loss-and-waste

1.2.2. How the upcycled food sector evolved in the UK and Europe

informed by discussions with Toine Timmermans, Director, Food Waste Free United (Netherlands), and the Waste and Resources Action Program (UK)

The UK and Europe have been leaders in the fight against food waste for the last two decades[20]. Setting progressive national and international food waste reduction policies, targets[21] and voluntary agreement programs[22,23] for businesses. The Food Waste and Recovery Hierarchy has been instrumental in the prioritisation of food waste reduction activities and hence substantial focus has been placed on reduction and prevention. Waste management in the form of anaerobic digestion and composting has also received significant government support and attention. However, in recent years there has been a shift towards circular thinking for the food system. The Ellen McArthur Foundation launched the Food Redesign Program which sought to define a circular economy for food[24].

Toine Timmermans, Food Waste Free United

Valorisation opportunities span the entire food supply chain and have been around for a long time as a means to make food production more efficient (i.e., creating sausages from meat off cuts). However, there have been challenges, using surplus to create new products is often not competitive with the alternative of sourcing ingredients through conventional supply chains. Upcycling can be more challenging, more expensive, and may involve more risk. However, where the food industry saw the barriers, chefs saw the opportunity. One such example is Food Waste Free United which worked with large Dutch catering company Hutten to create an upcycled food product. Hutten then invested 2 million Euro in building the 'Food Waste Factory', an upcycled food kitchen, to bring their upcycling activities to life[25].

Building a relationship with national governments and the European Commission is crucial as policy settings, regulations, and incentives push the food sector towards different reduction, valorisation, and management solutions for food waste.

20 History of the Courtauld Commitment [Internet]. WRAP [cited 2024 Feb 25]. Available from: https://wrap.org.uk/taking-action/food-drink/initiatives/courtauld-commitment/history-courtauld-commitment#:~:text=The%20first%20Courtauld%20Commitment%20was,and%20powerful%20vehicle%20for%20change.

21 Food waste reduction targets [Internet]. 2023 [cited 2023 Oct 21]. Available from: https://food.ec.europa.eu/safety/food-waste/eu-actions-against-food-waste/food-waste-reduction-targets_en

22 Bedrijven [Internet]. 2022 [cited 2023 Nov 21]. Available from: https://samentegenvoedselverspilling.nl/bedrijven/#stakeholders

23 The Courtauld Commitment 2030 [Internet]. [cited 2023 Oct 2]. Available from: https://wrap.org.uk/taking-action/food-drink/initiatives/courtauld-commitment

24 Big Food Redesign Challenge: It's time to redesign food for nature to thrive [Internet]. [cited 2023 Oct 23]. Available from: https://www.ellenmacarthurfoundation.org/the-big-food-redesign-challenge/overview#:~:text=The%20Big%20Food%20Redesign%20study,%2C%20people%2C%20and%20the%20environment.

25 Verspilling de Wereld Uit [Internet]. 2023 [cited 2023 Nov 12]. Available from: https://deverspillingsfabriek.nl/

1.2.3. Current status in Australia and the need for this project

In Australia, there is building interest in the opportunity of upcycling across the food and beverage industry. The End Food Waste Co-operative Research Centre (CRC)[26] runs an industry-led research and development (R&D) Program on food waste transformation (TRANSFORM). So far, thirty-six upcycled food product prototypes have been developed or refined through R&D activities[27]. The sector is beginning to develop with retailers, food manufacturers, and start-ups exploring opportunities to launch products. For example, retailer Harris Farm Markets has a 'repurposeful range' where short-dated ingredients are upcycled instore (i.e., wilted herbs are made into pesto). Manufacturers such as Kerry in Australia has set targets to explore the use of upcycled foods in their business and start-ups such as the Leaf Protein Co, Grainstone and I am Grounded are building their brands around creating upcycled foods and ingredients from byproducts and surplus, namely leafy-green waste, brewer's spent grain and coffee fruit respectively. Australia has great foundations to enable a thriving upcycled food sector including a national food waste strategy, substantial R&D funding in the order of $120m (through End Food Waste CRC), an industry Voluntary Agreement Program to support businesses to take actions to reduce food waste (the Australian Food Pact), and science and research capability (including food pilot plants) at universities, government research departments and Australia's national science organisation CSIRO. Although we have the building blocks to enable a successful upcycled food sector, the opportunity remains largely untapped due to a lack of education for companies and consumers about upcycled food, limited examples of commercial success, and deficiency of a specific upcycled food community to build common-purpose and advocate for opportunities. This project enabled me to visit global leaders in upcycling, to understand what is in place to support the sector elsewhere in the world and what we can do in Australia to develop our own upcycled food sector.

1.2.4. Summary of regional differences

Table 1 - Summary of regional differences for the upcycled food sector

	UNITED STATES	EUROPE AND UNITED KINGDOM	AUSTRALIA
Funding	Lack of Government funding, more venture capital and philanthropic funding.	Limited government funding, R&D + innovation funds & grants.	Strong State and Federal government funding.
Terminology	Term 'upcycled' is defined and commonly used.	Term 'upcycled' is not commonly used, many other descriptors exist i.e, co-products, valorisation, side-streams.	The use of the term 'upcycled' is increasing.
Business leaders	Significant activity driven by start-ups/ entrepreneurs. Larger companies now getting involved in partnerships.	Many start-ups (>100). Larger companies leading in impact.	More start-ups/ entrepreneurs.
Certification/ association	Certification available and trade association established.	No certification, Food Valley (Netherlands) have an upcycling community.	No certification and no trade association or community.

26 Transform [Internet]. 2023 [cited 2024 Jan 15]. Available from: https://endfoodwaste.com.au/transform/

27 EFWA. 2022/23 annual report [Internet]. 2024 [cited 2024 Jan 15]. Available from: https://endfoodwaste.com.au/2022-23-annual-report/

02

Itinerary

In order to achieve the objectives of this project I undertook an 8-week expedition to the USA, UK and Europe to:

- work with the UFA to investigate adoption of the Upcycled Certification in Australia;
- learn from the international upcycled food sector to support Australian businesses; and
- work with international bodies to incentivise the contribution of upcycling to national and global targets.

Table 2 – Itinerary

DATE OF VISIT		PLACE	INSTITUTE/ORGANISATION VISITED
From	To		
15 May	19 May	St Louis, Missouri	ReFed Conference EverGrain/AB InBev Sue Marshall, NETZRO Anna Hammond, Matriark Jeremy and Adam Kaye, The Spare Food Co

DATE OF VISIT		PLACE	INSTITUTE/ORGANISATION VISITED
22 May	29 May	Bay Area, California	◉ Caroline Cotto, Renewal Mill ◉ Maddison Gurrola and Carol Borba, Mattson ◉ Angie Crone, (CEO) Upcycled Food Association ◉ Dan Kurzrock, (Upcycled Foods Inc.) ◉ Dr Edward Spang, University of California Davis ◉ Kayla Abe, Shuggies Trash Pies
30 May	3 June	Boston, Massachusetts	◉ Food and Society Conference
4 June	6 June	Philadelphia, Pennsylvania	◉ Dr Jonathan Deutsch and Rachel Sherman, Drexel University ◉ Michael Ochefsky, Bacon Jam ◉ Dr Sidd Bhatt, Penn State University
7th June	13th June	Denver, Colorado	◉ Ben Gray, Upcycled Food Association ◉ Jackie Bowen, Clean Label Project ◉ Kathryn Britton, Where Food Comes From ◉ Joe Dickson, Merryfield ◉ Sullivan's Scrap Kitchen
14th June	20th June	Banbury, UK	Waste and Resources Action Program (WRAP): • Harriet Lamb, CEO • Richard Swannell, Director of Impact and Growth • Michael Jones, International Partnerships Manager • Jen Emerton, Head of Account Management • Kate Groves, Commercial Manager • Sue Riley, Senior Sector Specialist – Food Waste • Tom Quested, Interim Strategic Technical Manager – Food ◉ Amanda McCarthy, BRCGS – Technical Operations Manager
27th June	9th July	Netherlands	◉ Toine Timmermans, Food Waste Free United ◉ Food Fellows/ Harvest House ◉ Food Waste Factory/ Hutten ◉ Rodenburg ◉ Food Valley ◉ Nijsen ◉ Food2Food event ◉ Food waste DocuScience event
10th July	14th July	Lisbon, Portugal	◉ Sem Restaurant, Lisbon
15th July	21st July	Paris and Bordeaux, France	◉ Liz Goodwin, World Resources Institute ◉ Clementine O'Connor, UNEP ◉ Julien Lesage, Hubcycle ◉ Manon Ledoux, Green Spot Technologies ◉ Thomas Candeal, International Food Waste Coalition

Summaries of stakeholders visited are available at Appendix A.

Place	Institute/Organisation visited
St Louis, Missouri, USA	• ReFED Conference • EverGrain
San Francisco, California, USA	• Renewal Mill • Mattson • Upcycled Food Association • Upcycled Foods Inc. • University of California Davis • Shuggies Trash Pies
New York, USA	• The Spare Food Co • Matriark
Boston, Massachusetts, USA	• Food and Society Conference
Philadelphia, Pennsylvania, USA	• Drexel University • Penn State University
Denver, Colorado , USA	• Where Food Comes From • Sullivan's Scrap Kitchen

Place	Institute/Organisation visited
Banbury, UK	• Waste and Resources Action Program • Brand Reputation through Compliance, BRCGS

Place	Institute/Organisation visited
Lisbon, Portugal	• Sem Restaurant

Place	Institute/Organisation visited
Bordeaux, France	• World Resources Institute
Paris, France	• UN Environment Program • International Food Waste Coalition
Avignon, France	• Hubcycle
Ramonville-Saint-Agne, France	• Green Spot Technologies

Place	Institute/Organisation visited
Netherlands	• Food Waste Free United • Food Fellows/ Harvest House • Food Waste Factory/ Hutten • Rodenburg • Food Valley • Nijsen

03

Findings and Discussion

Report Outline

This project was a fact-finding mission. Over eight weeks, I engaged with 14 companies, 11 research and sector support organisations, and three organisations involved in policy.

Addressing the objectives of this project, the following section outlines the lessons learned from these interactions:

1. Lessons learned from leading upcycled food companies
2. Opportunities to expand the upcycled food certification to Australia.
3. The role of research, development, and innovation
4. Policy recommendations for the upcycled food sector

This report will cover these four key themes and also present a summary of key events attended.

3.1. Lessons learned from leading international upcycled food companies

Upcycling food waste into new food products is an effective way to reduce food waste and increase food supply.

A key objective of this Fellowship was to ***undertake industry site visits to observe upcycled food companies in practice and learn from their experience.***

There are various opportunities for businesses to leverage in regard to upcycled foods. This section focusses on four key opportunities:

- Upcycling byproducts
- Upcycling food surplus
- Upcycling opportunities across the food supply chain
- Upcycling opportunities for the hospitality sector

3.1.1. Upcycling byproducts

There is a significant opportunity to create upcycled foods using byproducts that are generated from food manufacturing processes as a normal part of production (i.e., brewers spent grain) but are not yet considered primary products in the human food system. Pioneering companies have created businesses focussed on upcycling byproducts including Renewal Mill (USA), Upcycled Foods, Inc. (formerly ReGrained) (USA), Hubcycle (France), and EverGrain (USA). Here I present a series of case studies to illustrate opportunities for industry.

RENEWAL MILL, USA

Renewal Mill is a leading upcycled food company in the USA that got their start by partnering with a tofu manufacturer that was producing ~50T/week of soybean pulp waste. This wet pulp was going to animal feed however collection was inconsistent. The byproduct, known as Okara, spoils within four hours and required one full-time staff member to manage. To overcome transportation issues and process the product as quickly as possible Renewal Mill placed their processing equipment onsite at the tofu factory. The processing is conducted by site staff and Renewal Mill pays for the processing (per pound) but not for the raw material.

Renewal Mill manufacturing, USA

Okara is incredibly nutritious, containing 60% fibre and 20% protein. When dried and milled the product performs like flour and is also naturally gluten-free. Okara flour is a novel ingredient that Renewal Mill first started promoting in 2018. It is nearly impossible to sell a product that people aren't familiar with. Therefore, they formulated consumer packaged goods (CPG) products to demonstrate the ingredient to consumers and build demand. Investors were also hesitant and wanted to see success stories to provide confidence to invest. However, for

Renewal Mill producing CPG is a short-term approach to build momentum for their ingredients business to scale toward large ingredient supply partnerships i.e., partnerships with large multinational food producers, as well as large retail partners like Kroger and Whole Foods Market for use in private label.

Products that Renewal Mill has collaborated on with retailers and other CPG brands include:

- Simple Truth Kroger (4 products)
- Whole Foods cake mix – market brand (3 products)
- Sur La Table – market brand (6 products)
- Seven Sunday's cereal
- Pulp Pantry chips
- Fancypants Baking Company cookies

Some steps to success identified by Renewal Mill were:

- Creating 'mock-up' products with the target company's packaging
- Following up with a regular cadence (i.e., every two weeks)
- Finding an internal champion within the company (customer)
- Finding the decision-maker in the customer's organisation. The R&D team is usually the primary contact, but they aren't always able to drive change within the company.

Supply and demand are hard to achieve with upcycled ingredients. In the beginning, there is too much supply. Therefore, it makes sense to incrementally bring on new supply partners. Renewal Mill began by self-packing, then moved to co-packing and they are now seeking to outsource their logistics. Once a certain scale is reached it becomes important to outsource services. Now Renewal Mill is also an offtake partner for full-service waste collection companies. These companies handle all of the manufacturers' waste (organic and inorganic), and Renewal Mill can plug into their services by offering to take their edible byproducts (food waste) and upcycle it for customers.

Renewal Mill have overcome challenges around logistics, processing, marketing a novel food ingredient and building a pioneering upcycled foods brand. Their success to date in building partnerships with large retailers not only demonstrates significant interest in their products, but also growing momentum for upcycled foods in mainstream markets.

UPCYCLED FOODS, INC., USA

Upcycled Foods, Inc. (UP, Inc.), formerly known by their first ingredient brand ReGrained, was set up to support innovation from concept to communication. Their initial commercial focus is on upcycling spent brewers grain which they transform into a series of products and ingredients. They source material from breweries within a close proximity and process centrally using their patented technology to create a highly nutritious "SuperGrain$^{+®}$" ingredient that can be used in a range of food applications (i.e., pasta, bread, snack foods).

Their founding vision was to be an ingredients company, however, they started with CPG products to raise awareness for their product and generate near-term cash flow to fund the longer ingredient sales cycles. However, they ultimately found that their resources over-indexed towards servicing the retail business, to the detriment of their long-term vision for maximising impact through business-to-business ingredient development. During COVID-19

it was evident that they couldn't do both and are now focusing all their energy on ingredients with the aspiration to maximise purpose and profit. UP, Inc. estimates that today 80-90% of the business community now is aware of upcycling compared to 10% they reported at Expo West in 2015. Therefore, they took the step to align with the business-to-business (B2B) market to catalyse the progression of this awareness into action.

Dan Kurzrock, UP, Inc.

Partnerships with big brands are essential in enabling scale. In July 2022, they partnered with Kerry North America to launch an upcycled protein crisp. Both parties saw opportunities to deepen their existing customer-supplier relationship and look for ways to combine capabilities to create value-added solutions. The crisps were developed using ReGrained SuperGrain+®, UP, Inc.'s proprietary ingredient created from upcycled brewers' spent grain. The goal of this first product was to develop a value-added solution that could be easily formulated into foods to add flavour, improve texture and naturally fortify nutrition. The crisp and finished food products made using them are also eligible for upcycled food certification. Production cycles and time to commercialise are a challenge. To fast-track this, UP, Inc. found it makes sense to work directly with manufacturers approved by the company. It is important to establish push with an ecosystem of manufacturers and pull with the brands.

By consolidating their offering to focus on B2B opportunities, UP, Inc. have been able to develop solutions for large companies that will enable them to upcycle larger volumes of food waste. Retail products are important to raise awareness however UP, Inc. identified that they achieve more impact through producing ingredients for large food and beverage or food service companies.

HUBCYCLE, FRANCE

Hubcycle is another innovative upcycled ingredient business, based in France. They are managing to achieve 1.5T carbon savings/T of byproduct. They have worked on valorising over 600 byproduct streams[28]. They can offer a more sustainable product for the same price as a conventional one and believe that to scale you ultimately need to be cheaper. Their sales pipeline highlights that there is enough demand for upcycled ingredients and that reaching sufficient scale is achievable. Their goal is for each ingredient to be 20% cheaper than conventional ingredients[29]. Currently, Hubcycle has 15 employees and is estimating a workforce of 40-50 by the end of 2024. At present, they are using co-manufacturers to valorise side streams, however, eventually to achieve quality and scale it may be useful to have their own manufacturing capacity.


Julien Lesage, Hubcycle

28 Our Expertise [Internet]. Hubcycle [accessed 2024 Feb 03]. Available from: https://www.hubcycled.com/en/notre-expertise/

29 Our Expertise [Internet]. Hubcycle [accessed 2024 Feb 03]. Available from: https://www.hubcycled.com/en/notre-expertise/

Their rule of thumb regarding infrastructure investment is:

>10,000 Tonnes
start to have an economy of scale to justify investment in a factory

<10,000 Tonnes
doesn't justify investment in a factory

Hubcycle believe there is always a solution and it comes down to how the costs are shared between the raw material supplier and the customer and how logistics are structured. They find that logistics are usually no more than 10% of the cost of production and noted that when people identify logistics as the barrier they are taking a 'waste' mindset and not seeing the value of the byproduct.

It is often tempting for companies to valorise their own side streams however, often they miss the value i.e., they identify one or two side streams when there may be 10. The largest value side streams are often used by a different industry.

> *"Giving value to side streams is not rocket science – it's the art of creating market-fits that have matching constraints"*
>
> ***JULIEN LESAGE,*** *CEO – Hubcycle*

Hubcycle believes it is important to reach scale in production first and then scale up marketing efforts, if marketing comes before scale then customers will see the product as niche and unable to satisfy demand. Their working model is to never sell more than 80% of the ingredients they have available to customers. Their sourcing department is as big as their sales department.

Hubcycle works with single material ingredients only i.e., coriander seed. This helps to reduce the risk of allergens and increase traceability. They characterise each ingredient to 80 different data points, which allows food manufacturers to match ingredient specifications to their needs. Once you can provide an ingredient that is more sustainable and cheaper, the next challenge is getting access to decision makers. Often, they will go through the standard procurement process with businesses, however with smaller companies, they identify the decision maker early and go direct to them.

Champion products include:

- Coriander seeds
- Sunflower oil
- Vanilla extract
- Cocoa husk
- Seedcake of golden flax seed – egg white substitute and natural thickening

Through carefully designing their supply chains and business model, Hubcycle have overcome one of the key challenges faced by many upcycled food businesses, price competitiveness. Offering a more sustainable alternative for equal or less cost than conventional ingredients enables greater uptake of these new ingredients.

EVERGRAIN, USA

Colin Powers, EverGrain

An example of byproduct upcycling at scale is AB InBev's spin-off EverGrain. AB InBev is a major beer producer in the USA producing more than 1 million metric tonnes of spent grain per year. They utilise the spent barley grain to create a plant-based protein isolate and can produce three million metric tonnes of protein per year. They use temperature and pH to separate the high protein fraction and high fibre fraction. The high protein fraction goes into plant beverages, bars, and sports supplements. The fibre fraction goes to animal feed, and bio-plastics are being investigated. EverGrain's processing plant is co-located with the brewery with a direct processing line that transports the grain to the plant. The grain contains 80% moisture and is energy-intensive to dry, they use spray-drying technology to do so. Minimising transport was a way to reduce emissions associated with processing. AB InBev invested $100m to build the EverGrain plant with the ambition to create plant-based foods with better nutrition, taste, and sustainability. This is an example of the power large businesses have to capitalise on the upcycled food opportunity and make the investment necessary to advance the sector.

There is a range of different ways to capitalise on the opportunity to upcycle byproducts. Donner et al., (2020)[30] identify five critical success and risk factors for upcycled food businesses to overcome, these include

- Technical and Logistic
- Economic, Financial and Marketing
- Organisational and Spatial
- Institutional and Legal
- Environmental, Social and Cultural

Upcycled food businesses are targeting these factors in different ways and it is useful to understand the breadth of these strategies that have been applied by businesses already.

Table 3 – Summary of considerations for upcycled food manufacturers

	CONSIDERATIONS
Technical and logistic	◉ Manufacturers can upcycle their own waste (AB InBev) ◉ Companies can upcycle waste from elsewhere in the supply chain (Renewal Mill, UP, Inc., Hubcycle) ◉ Outsource production to a co-manufacturer or establish in-house production.

30 Donner M, Verniquet A, Broeze J, Kayser K, De Vries H, 2020. Critical success and risk factors for circular business models valorising agricultural waste and by-products. Resources, conservation & Recycling, volume 165, https://doi.org/10.1016/j.resconrec.2020.105236

	CONSIDERATIONS
Economic, financial and marketing	◉ Present potential customers with products to show the ingredient in application. ◉ Production cycles and time to commercialise are challenging. ◉ Understand when customer review cycles are and plan ahead. ◉ Identify the decision-maker and champions within the customer's organisation ◉ CPG products are often a marketing tool for ingredients to increase uptake and awareness for novel ingredients. ◉ Food ingredients markets are likely to achieve more scale than CPG products. ◉ Partnerships with retailers and large food companies are important i.e., Private label opportunities with retailers (Renewal Mill, UP, Inc.) ◉ Pricing ingredients equal to or cheaper than conventional ingredients will support uptake by large businesses (Hubcycle)
Organisational and spatial	◉ Aggregate from multiple businesses and process centrally (Hubcycle, UP, Inc.) ◉ Co-locate near input material (AB InBev, UP, Inc.) ◉ Onsite processing (Renewal Mill, AB InBev) ◉ Semi-process onsite (i.e, dry step)
Institutional and legal	◉ Larger companies can create spinoffs or partner with smaller players (AB InBev) ◉ Work with retailers' existing manufacturers, approved manufacturer network to reduce contractual barriers (UP, Inc.).
Environmental, social and cultural	◉ Assess awareness and readiness for your ingredient (i.e., Okara is unfamiliar to customers, oat has high demand already).

3.1.2. Upcycling food surplus

Surplus (often horticultural produce) arises from gluts, weather events, overproduction, and strict cosmetic standards. In Australia, one million tonnes of horticulture food surplus are wasted in primary production each year[31]. This presents a significant valorisation opportunity to transform nutritious food that would otherwise not be sold into new food products. Here I present a series of case studies to illustrate opportunities to upcycle nutritious surplus produce into a variety of new food products.

FOOD FELLOWS, NETHERLANDS

Major Dutch grower association Harvest House created their own upcycled food company, Food Fellows to maximise the value of their surplus. Harvest House is the largest grower association in the Netherlands with 72 members and 46 growers.

Their annual tomato and pepper surplus consists of:

Tomatoes

6 million

kg per year waste (2.5%)

Peppers

4 million

kg per year waste (4%)

31 NFWS Feasibility Study: Data Dashboard [Internet]. FIAL [accessed 2024 Feb 25]. Available from: https://www.fial.com.au/sharing-knowledge/food-waste

Food Fellows create upcycled tomato and pepper products for retail, food service, and food manufacturers. They have their own Food Fellows label and have partnered with retailer Lidl on a private label product (one of their biggest sellers) which was awarded the best product by Lidl consumers in 2022. This product is being promoted as 'upcycled' and the communication story resonates around 'made with anti-waste products'. Food Fellows create a tomato puree and a pepper puree that are used in plant-based meats, as an additive to traditional meat products, and in soups. Retailer Albert Heijn started using the tomato puree in their burgers in 2018. The prerogative was to replace the water. Now the composition of the burger patties is 92 percent meat and 8 percent tomato. There was no price change, and they achieved a better product story i.e., no added water. They are not promoting the burger as upcycled directly, however the clean label and waste reductions were strong advantages that encouraged the retailer to make the switch.

Harvest House factory

Heiko Deruiter, Ned Spang and Pablo Juliano, Food Fellows

Food Fellows found that it was much easier to process their own surplus than receive surplus from other growers due to storage and the available supply chain. It is not always easy for growers to undertake valorisation themselves as this requires different processes, technical skills, marketing approaches and customers. However, by creating their own upcycled food brand and investing in onsite processing and leveraging their retail contacts through their fresh produce business they were able to navigate this new market successfully.

MATRIARK, USA

Matriark is a pioneering upcycled food company in the USA. Founder, Anna Hammond, had been directing a healthy eating program in public housing while brokering relationships with farmers to donate their surplus produce into the classes and saw a social and environmental impact business opportunity to divert waste from landfills, create new markets for farmers, and create greater access to healthy food for more people. Anna homed in on developing products for food service as 50% of meals in the USA are consumed there[32]. Matriark produces stock, soups, and sauces from surplus produce and pays farmers for all ingredients they buy. Products are designed around what is being wasted (i.e., carrots, onions, and celery remnants) using methods people would use in their home kitchen but at an industrial scale. Due to this flexible approach to ingredients used, they do not have any issues with inconsistent supply and aim to have 50-80% of every product consisting of upcycled ingredients.

Foodservice operates slowly, sales cycles are every two years and menu cycles are six months. It can be hard to get into the food service supplier network. Larger food service companies such as Compass purchase via food

32 Landais E, Miotto-Plessis M, Bene C, Maitre d'Hotel E, Tuyet Truong M, W Somé J, O Verger E, Consumption of food away from home in low- and middle-income countries: a systematic scoping review, Nutrition Reviews, Volume 81, Issue 6, June 2023, Pages 727–754, https://doi.org/10.1093/nutrit/nuac085

distribution providers i.e., Sysco. A game changer for Matriark was getting into food distribution channels such as Sysco and US Foods. They were invited into an accelerator program by Foodbuy for women and minority-owned businesses which enabled them access to Sysco.

> *"Go for it, do it, we need more of it, big companies need to bring us in. Call out to big companies - it's not just a trend it's a necessity"*
>
> ***Anna Hammond,*** *Matriark*

They recently launched their first retail product to build brand awareness, an upcycled tomato sauce for Whole Foods Market (driven by climate-friendly consumer demand). This was picked up at Expo East by Whole Foods Market within the first hour. Matriark has also created a shelf-stable meal in a carton for food rescue which was funded by Kroger and Danone and is now being purchased by large foodbanks.

Targeting large volumes of food waste in horticulture food surplus, coupled with creating products for food service positions Martiark well to deliver significant impact on reducing food waste.

THE SPARE FOOD CO., USA

We already grow and produce enough food to feed a growing global population. The Spare Food Co. (Spare Food) harnesses overlooked and underused ingredients within the food system and uses culinary innovation to create better-for-people-and-planet foods and drinks to keep the food at its highest value as food for people. Their approach is inspired by global culinary traditions that have been practiced for millennia, the same mindset as using stale bread to make Panzanella or old roosters to make coq au vin. The more innovation happening in the full utilisation space, the more we find ways to use what already exists in the food system. Spare Food asks the question,

Adam Kaye, The Spare Food Co.

> *"Why is the most interesting innovation happening in restaurants and one-off locations and how do we address the massive gulf between that and the manufacturing level?"*
>
> ***Jeremy Kaye,*** *The Spare Food Co.*

Spare Food purchases fresh whey (the nutritionally dense co-product of Greek-style yogurt manufacturing) to produce a sparkling probiotic tonic. They also use food surplus (produce) to create a value-add vegan meal starter for food service operators. There are only four ingredients in their Spare Tonic (beverage) and six surplus vegetables in their Spare Starter.

With little data available about the volume of food that never leaves the farm, Spare Food used a grant from one of the largest US grocery store chains to quantify how much edible surplus is available regionally for purchase and use in their food products. The study focused on the Northeastern USA. Anywhere between 48% and 56% of common commodity vegetables (specifically, onions, tomatoes, zucchini/summer squash, cauliflower, eggplant/aubergine, and bell peppers) generally never leave the farm, and of those, at least 40% are considered edible / food safe for human consumption. This is comparable to Australia, where Australian Bureau of Agricultural and Resource Economics found that of horticulture food loss and waste on-farm, 44% is left on the ground and 26% is ploughed into the ground with the largest cause of waste being environmental factors[33] . Spare Food takes a 'whole crop' approach to purchasing commodity vegetables from growers. This increases yield for growers and provides a supplemental revenue stream while increasing the return on investment (ROI) on all the agricultural inputs. Additionally, Spare Food works with its production partners to utilise as much of the whole plant as possible to create their products, significantly increasing yield (by up to 30%) and reducing waste at the manufacturing level.

Spare Food used the research sector to ensure their products are food-safe and ensure a scalable supply chain. Creating necessary supply chains is the biggest challenge. Finding co-manufacturing partners that could do all the processes in one facility was also challenging. This demonstrates that our food system has become highly efficient but not necessarily effective – and highly wasteful (Greek-style yogurt, for example, is predicated on "wasting" up to 75% of the original milk ingredient to produce the yogurt[34]). Capital infrastructure in this sector is also a challenge and addressing this gap is fundamental to The Spare Food Co.'s investment in building the supply chain infrastructure.

Spare Food Co are taking a systems-based approach to addressing the problem of food surplus through establishing the necessary supply chains and show-casing the value of overlooked ingredients.

Advice for upcycling food surplus:

- Identify foodservice and retail customers
- Identify necessary distribution channels
- Use simple food processing techniques (i.e., creating soups, broths, sauces).
- Pay farmers for their food surplus.
- Consider whole crop purchase arrangements to obtain the best value, or work with existing suppliers to augment their purchases with new ingredient streams.
- Have flexible inclusion rates for upcycled ingredients (i.e., 50-80% of ingredients are upcycled), this will help to overcome supply chain consistency challenges.
- Draw inspiration from the culinary sector to harness the potential of food surplus.

33 Crop loss/waste on Australian horticulture farms 2021–22 [Internet]. Australian Bureau of Agricultural and Resource Economics, [accessed 2024 Feb 04], available from: https://www.agriculture.gov.au/abares/research-topics/surveys/horticulture-crop-loss

34 Acid whey: is the waste product and untapped gold mine?[Internet]. CEN [accessed 2024 Feb 04] available at: https://cen.acs.org/articles/95/i6/Acid-whey-waste-product-untapped.html#:~:text=In%20brief,up%20as%20this%20by%2Dproduct.

3.1.3. Upcycling opportunities across the food supply chain

There are opportunities for actors at each stage of the food supply chain to be involved in either supplying upcycled food inputs or purchasing upcycled foods and ingredients. The table below highlights some of the key opportunities at each supply chain stage.

Table 4 – Opportunities to supply upcycled food inputs and generate demand for upcycled foods across the food supply chain

	 PRIMARY PRODUCTION	 PROCESSING/ MANUFACTURING	 DISTRIBUTION/ RETAIL	 HOSPITALITY/ FOOD SERVICE	 CONSUMER/ HOUSEHOLD
Supply role	**What:** Produce that does not meet cosmetic standards Gluts/ overproduction Damaged produce **How:** Process surplus in-house (i.e. produce shelf-stable product/ ingredients) Sell to third parties who will process the surplus Contract a co-manufacturer	**What:** Byproducts/ coproducts normally discarded Trimmings/ offcuts Mislabelled product/ damaged packaged goods **How:** Process surplus in-house (i.e. produce shelf-stable product/ ingredients) Sell to third parties who will process the surplus Contract a co-manufacturer	**What:** Large quantities of consistent surplus (bread, herbs, produce trimmings) Short dated/ damaged packaged goods **How:** Produce in house Provide surplus to upcycled food companies to use	**What:** Can utilise byproducts and surplus from own operations **How:** Create products (i.e. fermenting vegetable peels)	**What:** Can utilise byproducts and surplus in the home **How:** Dehydrating old fruit, fermenting surplus fruit and veg, making stocks, sauces and soup from surplus.
Demand role	Diversify business by creating upcycled food products to create longer shelf-life offerings	Utilise surplus from primary production Use lower grade produce Utilise byproducts from other food manufacturers/ procure upcycled ingredients	Range upcycled food products Use upcycled ingredients in private label product Funding for start-up innovation Long term supply contracts for upcycled foods companies	Ability to handle variable ingredients Don't have strict labelling requirements Can adapt to change at short notice Can process minimally (i.e. chop, freeze, cook) Procure upcycled ingredients/ products	Purchase upcycled food products and support products that incorporate upcycled food ingredients

3.1.4. Upcycling in the hospitality Sector

The hospitality sector is shifting the dial on upcycled food in a major way. Rework, inventory control, and creating broth from vegetable trimmings and bones are commonplace in most kitchens. However, recently a few bold players in the industry are choosing to hang their hat on their sustainability practices, not just in terms of implementing their own zero waste practices in-house, but also tackling sources of food waste in other supply chains.

SHUGGIES TRASH PIES, USA

Shuggies Trash Pies in San Francisco are a shining beacon of zero food waste excellence. Shuggies upcycle their own food waste, for example, whey from their cheese-making and upcycled oat flour from Renewal Mill are used in their pizza dough. They utilise off-cuts from various meat and plant-based products i.e., seafood heads and vegetable stems. They also source 'ugly' produce from local suppliers such as non-uniform squash and bruised fruit.

Shuggies Trash Pies

Not only are Shuggies transforming the sustainable dining scene, they are also doing extremely well as a new restaurant and were named in Bon Appetit Magazine's top 24 new restaurants for 2023. Calling out 'trash' in the name of the restaurant was deliberate to be somewhat polarising and grab people's attention. Pizza was chosen as a vehicle for the 'trash' messaging as it is an approachable cuisine. Initially, they didn't share all the ways they were reducing waste with their customers, instead including small clues about upcycled ingredients on the menu and trained staff to provide some detail on the waste angle of food when presenting it to customers. Co-owner, Kayla Abe, mentioned, "Even if 40% of people who come in learn a little bit, that is a positive outcome for us".

Shuggies are bringing food waste to the forefront of popular culture and positioning it in a way that is quirky and intriguing and people want to know more.

RESTAURANT SEM, PORTUGAL

Another fantastic showcase of zero food waste dining is Sem Restaurant in Lisbon, Portugal. Owners, George McLeod and Lara Espirito Santo opened Sem in 2021. Their mission is to support regenerative agriculture and to combat food waste. The idea came from the frustration of restaurants throwing away so much. For example, food waste in the hospitality sector makes up 16% of Australia's total food waste[35]. George worked at Silo in London

35 FIAL. The National Food Waste Strategy Feasibility Study – Final Report. 2021 [cited 2023 Oct 12]. Available from: https://workdrive.zohopublic.com.au/external/06152b9ff5971843391f39fc4d32a847e56fb907c167a4a645887b0a4bc43000

run by Douglas McMaster whose view is that "zero waste is just a system with no loose ends"[36]. George decided to take his learnings from Silo and set up Sem. The innovation element of creating something from food some consider as waste is a key driver for George. At Sem, all fresh food is sourced locally from small to medium sized Portuguese farms. They actively support businesses that are change-makers in the food system and also those who are at earlier stages of making changes as well.

Some creative ways the team at Sem is supporting a more sustainable food system are:

- Buying retired cow meat, male billy goats, ex-dairy cows
- Using industrial byproducts
- Purchasing surplus from producers
- Purchasing food during gluts (i.e., white asparagus at the end of the season)
- Paying attention to hyper-seasonal stages of produce
- Building a close relationship with farmers.

The biggest challenges with sourcing upcycled food differently are:

- Consistency is a challenge so let the natural shape shine
- Convincing people that this is the right thing to do
- Sem have a delivery once a week and the menu changes every three weeks. Restaurants operating a la carte menus can run out of ingredients and change the menu the next day, Sem operate a set tasting menu where this is much harder.

In terms of communication and sharing the zero food waste message, Sem has focussed on creating an authentic message whilst treading the line of not wanting to preach. Their view is to let the food do the talking. Staff are trained to gauge how much information and education customers are looking for and use stories about the food as a mode of engagement. The way the menu is written highlights the transformed food.

George McLeod, Sem

36 Douglas McMaster [Internet]. [cited 2023 Nov 15]. Available from: https://www.douglasmcmaster.com/silolondon

Showcase ingredients:

- Zero waste ferments can be made now and used later as an arsenal of flavours that come from lesser-used foods (i.e., stalks and stems).
- Egg whites are wasted in huge volumes in the hospitality industry, particularly in Portugal with the volume of Portuguese tarts produced. Sem create a fermented egg white gorum which acts as a vegetarian substitute for fish sauce.
- Bread miso butter made with surplus bread.
- Dehydrated veg peeling oil.
- Onion skin sauce with honey and butter.
- Garlic skin becomes the consistency of play dough when blended, mix with butter, and made into a thick sauce.

Restaurants are shifting the dial on harnessing the full potential of over-looked ingredients and demonstrating creative techniques to enable maximum utilisation of food.

Fermented foods created from food waste, SEM

Not only can individual restaurants have an impact in showcasing and educating on the unique qualities of ingredients previously considered as waste and procuring byproducts and surplus from other parts of the food supply chain, the wider hospitality and food service sector could play an important role in terms of procurement.

FOOD WASTE FACTORY, NETHERLANDS

Hutten are the 4th largest catering company in the Netherlands. They were drawn to the issue of food waste from their frustration of seeing the food they created for their clients going to waste. In addition to tackling leftover plate-waste from events with their clients, Hutten saw an opportunity to buy in food waste from other parts of the supply chain and use this to create delicious products for their catering business and for retailers. From this, the Food Waste Factory (De Verspillingsfabriek) was born. Food Waste Factory employs people with difficulties obtaining employment to be part of their mission and add value to food that would otherwise go to waste.

Sourcing surplus ingredients at the right place and right time is not easy, and tomatoes are the most reliable upcycled input as they are grown year-round in the Netherlands (with surplus available at less than half the price of fresh tomatoes). They also purchase the tops and tails of tomatoes from a big fast food chain to

John van Heel, Ned Spang, Pablo Juliano, Food Waste Factory

achieve consistent supply. They have partnered with other growers to freeze surplus straight from the field. They produce 16 varieties of Soup for their catering businesses, however, due to ingredient price and availability of ingredients some are not always available. Not every ingredient has an upcycled alternative, however they seek every opportunity to source upcycled inputs.

The main upcycled inputs are:

- Tomato
- Red pepper
- Sweet potato and regular potato
- Mushrooms
- Asparagus

As it is not possible to have an upcycled surplus stream at a consistent percentage it is important to think about the year ahead and sourcing and freezing ingredients when they are available. On the nutritional panel, they do not need to distinguish the upcycled component which makes it easier to adapt to fluctuations in ingredient availability. It took three years to break even on the Food Waste Factory (2015-2018) and it is now a flagship of the business.

John van Heel, Food Waste Factory

INTERNATIONAL FOOD WASTE COALITION, FRANCE

Speaking with Thomas Candeal from the International Food Waste Coalition, there could be a significant opportunity for scale by utilising the food service sector's buying power. The International Food Waste Coalition is a membership organisation for the food service and hospitality sector that supports businesses to reduce their food waste.

Opportunities for the food service and hospitality sector

As the sector prepares meals there is no need for a uniform shape. This means the sector could procure produce that does not meet retail specifications. Wonky vegetables can be difficult to handle in big kitchens as they can take longer to prepare due to a lack of uniformity. However, the sector could adapt recipes for wonky food i.e., no peeling. Whole crop purchase agreements could be an opportunity for the sector to obtain produce for the best value and support farmers to utilise their full crop. This however depends on supply agreements and contracts. Aligning interests between buyer and supplier on food waste reduction is not always straightforward and requires collaboration. There is a big push in the sector to only serve fresh food. If incentives are placed around cooking more fresh veg, then the food service sector would need to look for contracts with primary producers. Another opportunity exists for culinary experts in the Hospitality and Food Service sector to utilise cuts of meat that are unfamiliar to consumers and often not able to be sold in supermarkets.

There are several considerations for use the of upcycled ingredients in food service menus, many of which are linked to food service trends and the complexity of processes.

Figure 1 below presents a framework created in collaboration with Thomas Candeal from the International Food Waste Coalition to help foodservice businesses to assess upcycled food opportunities.

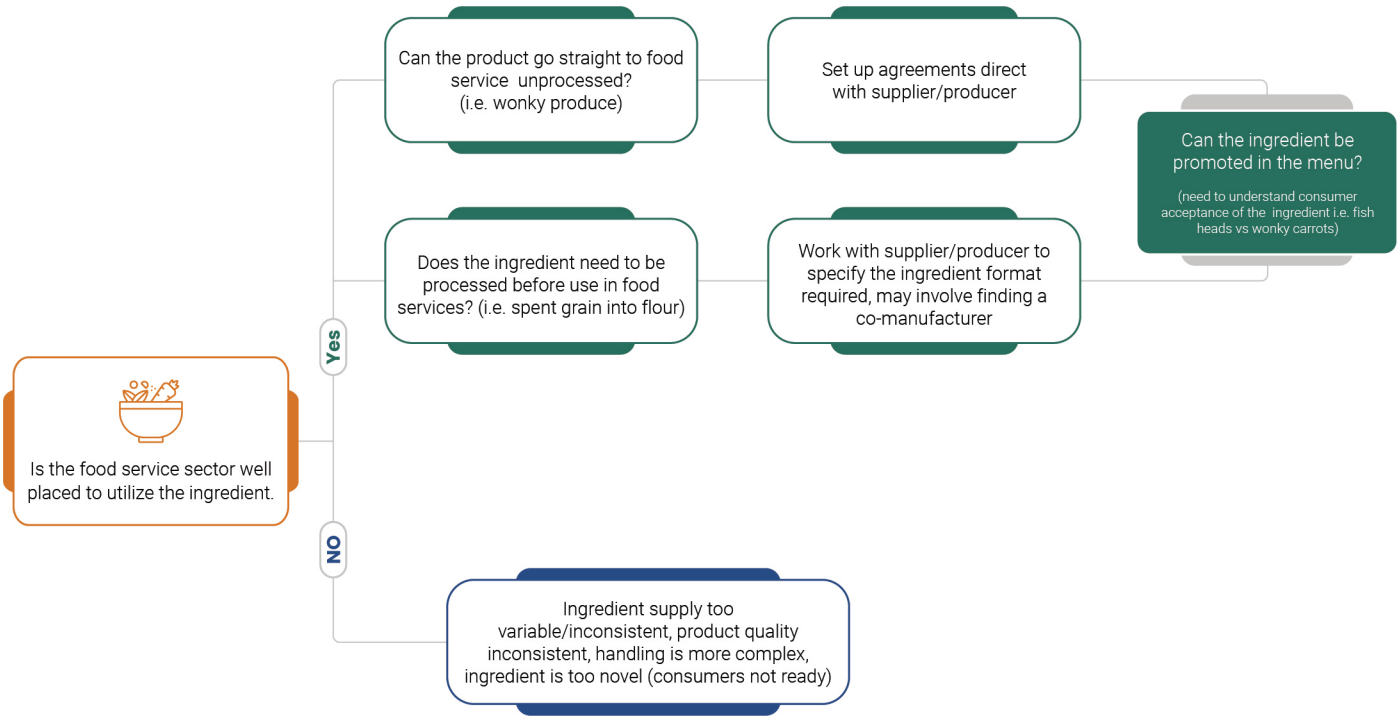


Figure 1 – Decision-making tool for identifying opportunities for upcycling in the hospitality sector

Consider the following:

- What is the allergen profile of the ingredient?
- What are the links to carbon footprint and quality of the meal?
- Does using this ingredient require a new menu to be developed?
- Will consumers be accepting of the ingredient?
- Do the chefs have the cooking expertise to use the ingredient?
- How complex is it to introduce the new ingredient?

RECOMMENDATIONS FOR INDUSTRY:

- Raise consumer awareness and demand for upcycled foods.
- Create partnerships between innovative, agile companies and bigger companies with scale (i.e., private label opportunities with retailers).
- Pay for upcycled input materials to demonstrate the value of the material and enable necessary supply chains.
- Actors at every stage of the food supply chain should consider their opportunity to participate in the upcycled food sector.
- Harness innovation from the culinary sector to demonstrate the full potential of over-looked foods.
- Investigate opportunities for hospitality and food service businesses to procure upcycled ingredients.

3.2. Opportunities to expand the upcycled food certification to Australia

The introduction of a certification Standard for upcycled products and ingredients, Upcycled Certified®, shifted the dial and raised the profile of the upcycled food sector both nationally in the USA and internationally. As of November 2023, an average of 390,000 Tonnes of food waste per annum are diverted. Overall, 91 companies have certified a total of 460 products and ingredients[37]. These products are stocked by retailers including Kroger, Whole Foods and Sprouts. The certification program helps to bring credibility and visibility to the sector and allows brands to describe the complex concept of upcycling consistently to the consumer.

Upcycled certification in use

A key objective of this Fellowship was to ***collaborate with the Upcycled Food Association and certifying body Where Food Comes From on the expansion of US-based pioneering upcycled food certification to Australia.***

This section covers four key themes:

1. Details of the Upcycled Certified Standard
2. Learnings from implementing the Standard in the USA and Canada
3. Certification Expansion
4. A content analysis of on-pack labelling and claims

3.2.1. Details of the Upcycled Certified Standard

In 2020, a global Standard for upcycled food was developed (by a committee convened by the Upcycled Food Association (UFA)) to certify products and ingredients as upcycled. The goal was to create a certification scheme that would communicate and educate the consumer on the use of upcycled ingredients. There are a lot of certifications on the market, however the UFA saw it as essential to obtain third-party verification when establishing a market for these novel products. A team of diverse stakeholders from across the food sector (upcycled food companies, academics, policy and regulatory experts) came together to develop the certification standard (the Standard). Development of the Standard was an iterative process that drew guidance from standards such as, Non-GMO Project Verified and Organic Certified.

The Standard is verified[38],[39] by USA-based certification body Where Food Comes From, Inc. (WFCF). WFCF has experience verifying a wide range of food and feed products against a number of national and global standards including Non-GMO Project Verified and Organic Certified.

37 Impact [Internet]. 2023 [cited 2023 Oct 11]. Available from: https://www.upcycledfood.org/impact)

38 Where Food Comes From. Where food comes from, Inc. acquires upcycled certified® program as reducing food waste through upcycling becomes fastest growing consumer trend [Internet]. Where Food Comes From; 2023 [cited 2024 Jan 15]. Available from: https://www.globenewswire.com/news-release/2023/12/27/2801338/0/en/Where-Food-Comes-From-Inc-Acquires-Upcycled-Certified-Program-as-Reducing-Food-Waste-Through-Upcycling-Becomes-Fastest-Growing-Consumer-Trend.html

39 In December 2023, The Upcycled Certified® Program was acquired by Where Food Comes From

There are three designations under the certification:

- Upcycled ingredients (UI)
- Products containing upcycled ingredients (PUI)
- Products containing <10% upcycled content (Less than PUI)

All items certified are either UI eligible or not.

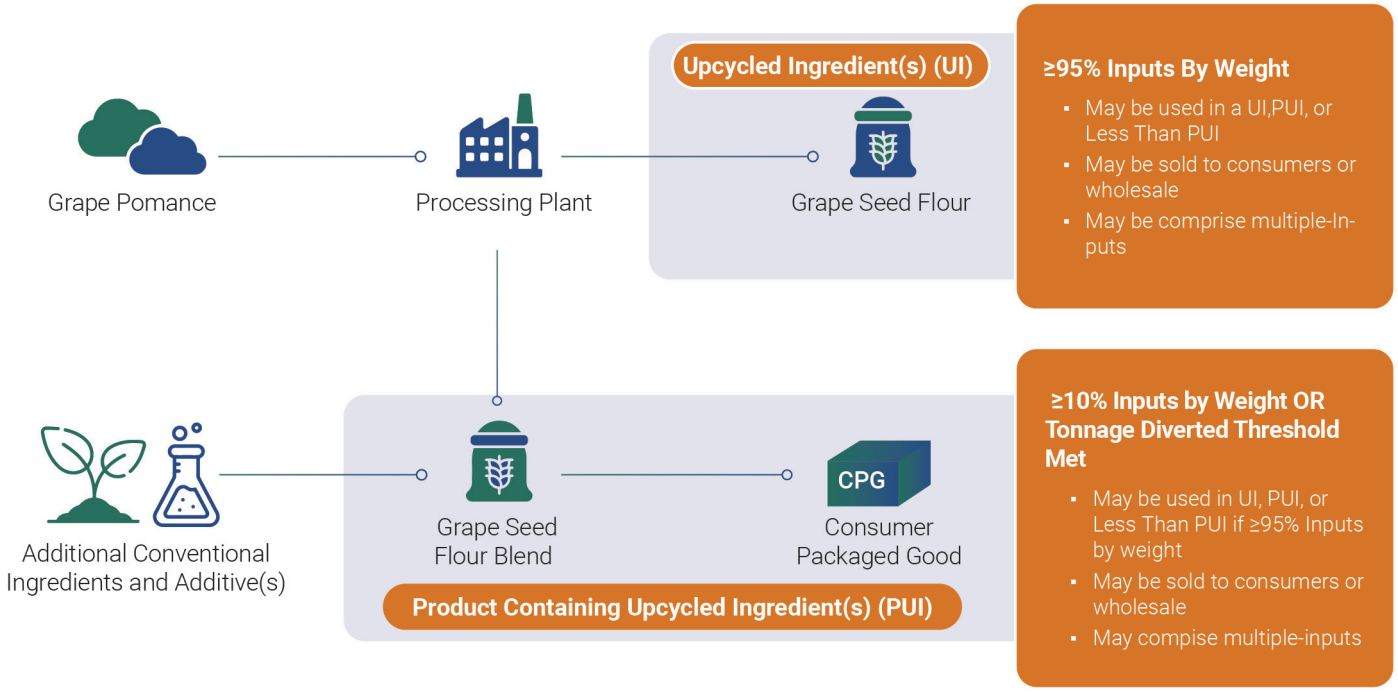


Figure 2 – Differentiating upcycled ingredients from products containing upcycled ingredients (Sourced directly from the Upcycled Food Association[40])

40 Upcycled Food Association [Internet]. 2022 [cited 2023 Oct 14]. Available from: https://static1.squarespace.com/static/606ce580b6b9b6777f470253/t/630f5c59408cbc03108c5f76/1661951066332/Upcycled+Certified+Standard_V2.pdf

There are minimum thresholds for upcycled content in UIs and PUIs to obtain the various tiers of certification.

Table 5 – Thresholds for certification of upcycled ingredients (UI) and products (PUI) (Sourced directly from the Upcycled Food Association [41])

ANNUAL GROSS PRODUCT SALES	UPCYCLED INGREDIENT (UI)	PRODUCT CONTAINING UPCYCLED INGREDIENTS (PUI)[4]		
Tier 1 Product <$2 million annual gross product sales	≥95% of the content by weight shall be formulated from Inputs[1,2]	≥10% of the content by weight shall be formulated from Inputs[2,3]	Or	Annual PUI production results in ≥5 tons/ year of Inputs[2,4]
Tier 2 Product $2-$5 million annual gross product sales	≥95% of the content by weight shall be formulated from Inputs[1,2]	≥10% of the content by weight shall be formulated from Inputs[2,3]	Or	Annual PUI production results in ≥10 tons/ year of Inputs[2,4]
Tier 3 Product $5-$25 million annual gross product sales	≥95% of the content by weight shall be formulated from Inputs[1,2]	≥10% of the content by weight shall be formulated from Inputs[2,3]	Or	Annual PUI production results in ≥25 tons/ year of Inputs[2,4]
Tier 4 Product $25-$50 million annual gross product sales	≥95% of the content by weight shall be formulated from Inputs[1,2]	≥10% of the content by weight shall be formulated from Inputs[2,3]	Or	Annual PUI production results in ≥100 tons/ year of Inputs[2,4]
Tier 5 Product >$50 million annual gross product sales	≥95% of the content by weight shall be formulated from Inputs[1,2]	≥10% of the content by weight shall be formulated from Inputs[2,3]	Or	Annual PUI production results in ≥200 tons/ year of Inputs[2,4]

1 Meets requirements within Sections 4.3.1, 4.3.2, 4.3.4, and 4.3.5.

2 Input(s): Any food material, product or byproduct of food production, or portion within, diverted from but not limited to an agricultural, aquaculture, or food production setting, that would typically be destined for a food loss or waste destination,7 that instead is used in the production of an ingredient or retail Consumer Good.

3 May include UI(s) or PUI(s) and meets requirements within Sections 4.3.1, 4.3.3, 4.3.4, 4.3.5, and Note 2, Section 4.3.1.

4 Meets requirements within Sections 4.3.1, 4.3.4, and 4.3.6. Note: If available, annual gross sales product shall be the preceding 12 months of product-specific sales upon date of certification application/renewal. As noted within Section 4.3.1, market forecasts, sales projections, or extrapolated data may be used in the absence of production and sales data from the past 12 months.

5 A product that does not meet or exceed the minimum ≥10% Input(s) content by weight or tonnage diverted as a result of yearly production thresholds may qualify for a Minimal Content PUI designation.

41 Upcycled Food Association [Internet]. 2022 [cited 2023 Oct 14]. Available from: https://static1.squarespace.com/static/606ce580b6b9b6777f470253/t/630f5c59408cbc03108c5f76/1661951066332/Upcycled+Certified+Standard_V2.pdf

The simplified Certification Process is as follows:

01 **Input:**
What is the upcycled input(s) and evidence of diversion

02 **Product:**
What product is the input being used in and measuring compliance against minimum content thresholds

03 **Facilities**:
Evidence to ensure food safety systems and other compliance elements are in place to demonstrate product integrity.

The Standard is already on its second revision and future revisions will likely consider environmental impact reporting including greenhouse gas emissions.

3.2.2. Learnings from implementing the Standard in the USA and Canada

– informed by discussions with the certifying body WFCF

Speaking with the certifying body, WFCF, was highly informative in terms of understanding the implications of administering the certification and learnings from seeing this in practice.

Table 6 – Learnings from implementing Certified Upcycled® in the USA and Canada

	LEARNINGS
Implementation process	Asking questions in the right way to obtain the necessary information has been an iterative process and could only be done through implementing the Standard in the real world.
Terminology	Finding universal language that can be aggregated across all the applications of the standard has been challenging as the way people refer to upcycling components and measure this varies.
Data	The data is highly variable. Some upcycled producers rely on their suppliers to provide accurate information and there can be a lack of transparency between the supplier and the company.
Supplier relationships	It is crucial to develop a good relationship with input material suppliers, co-packers and co-manufacturers to obtain the necessary data for certification. If companies are concerned about supplying data, non-disclosure agreements can be established.
Certification not awarded	Sometimes certification is not possible, as the input material was already going to a human market and is therefore not being 'upcycled' or only a small tonnage of input material can be attributed as 'upcycled'. The certifying body will work with companies to find solutions such as other suppliers for their ingredient who meet the criteria (i.e., some producers are valorising whey, others aren't, so identifying those who don't have a human food use option and are currently wasting is viable).

	LEARNINGS
Measuring impact	Reporting the total tonnage of food waste diverted into certified upcycled ingredients and products is the key impact metric for Certified Upcycled®. Some challenges for measurement include: • Varied methods for calculating diversion by companies • Fluctuations in tonnage across the year, and measurement reporting being annual • Companies can submit projections or actual figures for tonnage diverted • Projections were often higher than actuals and overall tonnage would go down when companies switched from projections to actuals • A change was made to count zero tonnage for projections and only use this to assess eligibility. Actuals are added to aggregated tonnage figures when they are available making tonnage numbers more accurate. • An outstanding challenge is dealing with products that either remove certification or are no longer eligible for certification. One solution could be adjusting figures for the time certification was achieved for. • Looking at the tonnage diverted at the point of diversion from waste doesn't measure what is wasted during the manufacturing process to create the upcycled food.
Aggregated story	Individualised product data tells the product story, i.e., label on-pack influencing consumers at the point of sale. Aggregated data on the certification program as a whole speaks to different stakeholders i.e., investors, policy makers, retailers, governments. Storytelling is important for individuals to know that they are part of a larger mission.
Marketing	It is useful to have champions at a brand level before certification. Verification only looks at the labelling requirements and management of marketing materials is no longer required for approval. This provides more opportunity for brands to tell their own upcycling story and provides space for authenticity. There is a lag time between getting verification and the certification mark appearing on the pack, therefore being able to tell the story is an important lever for companies to bridge this timing gap.

3.2.3. International expansion of the Certification

The international expansion of the Standard presents many opportunities and very few barriers. A seamless transition could be facilitated due to the remote auditing process, this is already in practice with the Non-GMO Standard. There are no regulatory or legislative implications of implementation as the Standard is predicated on participants adhering to local regulations and legislation. There is also a strong precedent for standards to operate without geographical boundaries. For example, due to trade partnerships the USDA Organic Standard allows for international use of the mark noting adherence to export and import market requirements[42]. International expansion represents a large opportunity for multinational companies to certify their products in multiple markets. It will be important to have local support services available to provide tailored guidance to companies. One challenge this presents is around language and translations, but this can be developed over time. Protections for the mark should be put in place for example trademarks in various countries and calibration across technical administrators verifying the Standard is essential.

The Upcycled Food Association and WFCF have voiced their interest in the international expansion of the pioneering Upcycled Certified certification.

42 Organic 101 – organic trade basics [Internet]. USDA [access on 2024 Feb 25]. Available from: https://www.usda.gov/media/blog/2013/12/20/organic-101-organic-trade-basics

Expanding the geographical reach of the certification will likely involve the following considerations:

Environmental Readiness

- Data showing consumer awareness, readiness, and demand
- Regulatory environment including any regulatory barriers
- Areas of support expected from retailers, government, social media influencers, press, nonprofit funding, etc.

Organisational Strength

- Partner organisation description, areas of expertise, operational advantages, and service area
- Description of vision for business development, marketing, and administration of Upcycled Certified
- Experience demonstrating the success of program similar to Upcycled Certified program

Scope of Opportunity

- Territory market size, including the projected number of companies likely to certify ingredients and products in the first year through to three years of program administration
- Number and category (food, beverage, cosmetic, etc...) of ingredients and products likely to be certified in the first year through to three years of program administration
- Marquee brands interested in Upcycled Certified within the territory

Funding Model

- Model to fund Upcycled Certified® start-up costs in the new territory including partner organisation education regarding the Upcycled Certified program, legal counsel to support drafting agreements, trademark registration, licensing surveillance, and others
- Funding model opportunities for ongoing maintenance and management

Note: *International roll-out has not occurred at the time of drafting.*

Upcycled Certified® Label

RECOMMENDATION:
Consider models for expanding Upcycled Certified® internationally

A potential pathway for expansion – delivery through regional partners

There is potential to establish regional partners who understand how the certification works and have knowledge of the local regulations, market, and close links to other businesses in the upcycled food sector. Taking Australia and New Zealand for example, there is a shared Food Standards Code between the two countries which makes it simple for one local partner to deliver support across the two regions. Also, for companies who are not ready for certification, there is a role in providing guidance toward achieving requirements for certification and exploring local grants, partnerships, and support services. A licensing or royalty-based model could be used to underpin the international expansion of Upcycled Certified®.

Companies already in the USA or Canadian market who have a presence in other markets may be suitable pilot companies. If expansion were to occur, regional partners should develop training materials in collaboration with Where Food Comes From to enable local ambassadors to advocate and advise on the certification. For example, plugging into food waste voluntary commitment programs (i.e., The Australian Food Pact) to access and support their networks and leverage existing engagement.

It will be important to achieve consistency across jurisdictions. The following should be considered:

- Alignment of verification process internationally.
- Implementation may differ across regions.
- Protocols, auditing, and calibration should be consistent.
- Consideration must be given for the translation of the Standard into other languages.

3.2.4. A content analysis of on-pack labelling and claims

Education is a key element in growing the upcycled food sector. On-pack labelling can be an effective educational tool for consumers, in fact, recent research shows that consumers want to see information about the upcycled nature of products online and on-pack to assist their purchasing decisions[43].

I conducted a content analysis of the claims and messaging on-pack for 15 upcycled food products purchased from supermarkets in the USA. The criteria are designed to understand language use, messaging angles, and certification presence.

43 Goodman-Smith F, Bhatt S, Grasso S, Deutsch J, Mirosa M. Consumer acceptance of upcycled craft beer: A new zealand case study. Frontiers in Nutrition. 2023;10. doi:10.3389/fnut.2023.1235137

Table 7 – Content analysis of food on-pack claims and messaging for upcycled food products

	Food waste messaging	Environmental messaging	Mentions upcycling	Other descriptors instead of 'upcycled'	Denotes which ingredients are upcycled	Has Upcycled Certified® certification
BEVERAGES						
Waju fruit water	Zero waste	Better for the planet		Abandoned	Carbonated water sourced from fruit	
Balthouse Farms juice	By purchasing this product you're helping to prevent food waste			Carrot juice is made from perfectly imperfect carrots	Contains juice from both whole carrots and upcycled carrots	Back of pack
Blue stripes cacao water	The chocolate industry wastes 70% of the cacao pod	Sustainability mission	Bluestripes upcycles the whole cacao (shell, fruit and beans)			Back of pack
Hope and sesame – sesame milk		Planet friendly	Upcycled – after the seeds are pressed for oil, we make sesame milk with the reset of the sesame.			
BREAKFAST FOODS						
Chia Smash					Upcycled raspberries	Back of pack
Seven Sundays Oat Protein Cereal		Your bowl is fighting climate change.	Upcycled oats (front of pack). Upcycled oaty character explaining upcycled process.	Overlooked	Upcycled oat protein, upcycled non-gmo corn.	Front and back of pack

	Food waste messaging	Environmental messaging	Mentions upcycling	Other descriptors instead of 'upcycled'	Denotes which ingredients are upcycled	Has Upcycled Certified® certification
BAKING AND CONFECTIONARY						
Renewal mill dark chocolate brownie in a mug		Fight climate change from your kitchen. By choosing upcycled you're reducing global food waste, a leading driver of climate change.	Upcycled		Denotes upcycled ingredients with (+)	Front of pack
Renewal mill upcycled seed and sumac cracker mix		Fights climate change. Reducing global food waste. Eat upcycled and take a stand against climate change.	Upcycled		Upcycled cornflour front of pack and denotes with (+)	Front of pack
Regrained carrot cake mix	Food waste is water waste.	Help fight climate change at home. This upcycled mix saves 83 gallons of water.	Upcycled food lab		Denotes upcycled ingredients with (+)	Front of pack
Blue stripes dried cacao fruit		Sustainability mission Good for the planet				Front of pack
Blue stripes dark chocolate bar				Made with entire cacao pod		Back of pack
CRISPS						
Uglies kettle crisps	Reducing food waste and helping fight hunger.	26% of produce in the US gets discarded for cosmetic reasons		Naturally imperfect . Potatoes that might otherwise be discarded.		

	Food waste messaging	Environmental messaging	Mentions upcycling	Other descriptors instead of 'upcycled'	Denotes which ingredients are upcycled	Has Upcycled Certified® certification
Pipcorn twists		Sustainable	Upcycled heirloom cornflour		Upcycled heirloom cornflour (front of pack). Denotes upcycled ingredients with (+)	
Kazoo tortilla chips		Sustainable future. Low water footprint. 16 gallons of water saved by this bag. Better for the planet.	Upcycle corn germ		Upcycled corn germ.	Front of pack
Barnana plantain chips		Protect the planet.	We use upcycled bananas			

Note *that the above examples are from the USA and not the EU. The EU Green Washing laws are currently under review including the possible introduction of a new law and amendments to existing laws[44]. These changes, if passed would change the nature of allowable claims related to upcycled foods including specifics relating to the percentage of upcycled ingredients in the products. Environmental claims would be required to be third-party verified.*

3.2.5. Opportunities for promoting upcycled foods

Consumer demand is the biggest lever to drive demand for upcycled foods. A climate aisle in the retail environment could help customers identify climate-friendly products.

It must be clear to the consumer that what they buy makes a positive impact on the environment and many upcycled food companies are including environmental messaging on-pack. The environmental benefits of upcycled foods have been named as the biggest benefit consumers associate with upcycled foods[45]. We need to harness this and help consumers understand that what they eat is one of the biggest levers on climate, "every consumer is a change maker" – Anna Hammond.

44 Green Claims [Internet].European Commission [accessed on 2024 Mar 16]. Available from: Green claims - European Commission (europa.eu)

45 Goodman-Smith F, Bhatt S, Grasso S, Deutsch J, Mirosa M. Consumer acceptance of upcycled craft beer: A new zealand case study. Frontiers in Nutrition. 2023;10. doi:10.3389/fnut.2023.1235137

RECOMMENDATION:
Upcycled food companies include environmental messaging on-pack in alignment with regulations

In addition to consumer acceptance, retailer acceptance is paramount. Research conducted in 2021[46] showed that environmental benefits alone are not enough of a differentiator to convince retailers to stock upcycled products, companies need to also focus on pricing, promotional strategies, demonstrating consumer demand, and filling gaps in the market.

Education is essential to demonstrate the wide range of benefits of upcycled foods to retailers in conjunction with continued consumer education to build demand for upcycled products. The behaviour change that is required to convince businesses to adopt new ingredients and products is challenging and often requires the creation of incentives (operationally, systemically, corporately) and alignment with company targets to hasten adoption of these more sustainable alternatives.

Upcycled food shelf in Sprouts supermarket, USA

46 Thorsen M, Nyhof F, Goodman-Smith F, Deutsch J, Mirosa M. Accessing supermarket shelves: Retail Category Managers Advice to upcycled food manufacturers. Journal of Food Products Marketing. 2022;28(4):179–92. doi:10.1080/10454446.2022.2072695

3.3. The role of research, development, and innovation

Upcycled foods utilise ingredients that might not otherwise end up in the human food supply chain. Due to this companies often require assistance with product development to understand how to use these novel inputs or formulate ingredients for the food industry. Research is also required on cross-cutting topics to advance and impact the whole sector (i.e., food safety, consumer acceptance, policy interventions, and technology development).

A key objective of this Fellowship was to ***visit R&D facilities where significant upcycled food research and product development occurs.***

There are various options for companies to access research and development (R&D) support. This section documents visits with four key groups involved in research and innovation:

- University research providers
- Private R&D companies
- Innovative technology companies
- Not-for-profit organisations

Case studies are presented to illustrate the different ways companies can access research and innovation support. Australian companies have access to a similar ecosystem of R&D support. We are in fact in a leading position as End Food Waste CRC is the largest research organisation dedicated to food waste globally. There are also learnings we can take about the specific ways that support is delivered on upcycling to advance the research approaches we take in Australia.

3.3.1. University research providers

DREXEL UNIVERSITY, USA

Drexel University is home to Drexel Food Lab for food product development and culinary arts. They work with companies to understand the feasibility, nutrition, and capabilities of products and ingredients, this includes helping manufacturers understand the opportunities for upcycled foods. They also place huge emphasis on taste and creating desirable products for consumers given their unique culinary expertise.

Rachel Sherman and Zae'Onah Howell, Drexel University

Often companies will have an ingredient they are interested in utilising yet do not understand the full potential of the ingredient including:

- What proportions it can be used in (i.e., inclusion rates)
- What applications it performs best in
- Flavour attributes – not only acceptable but also desirable

Drexel works with clients over a 12–16-week period on bench scale applications. They then support the manufacturer in understanding the commercialisation options.

Development areas clients ask for assistance on:

- Packaging format (i.e. jar or squeeze bottle)
- Sensory and consumer testing
- Shelf-life assessment
- Optimisation to achieve longer shelf-life - pH, water activity

Some of the key challenges are:

- Safety/ contamination
- Supply chain consistency

Nutrition research is also important. For example, Drexel worked with a company that were exploring human food applications for an eggshell powder and required guidance on the nutritional composition to understand the use ratios and potential applications.

Drexel also helps to take an upcycled ingredient and demonstrate this in a finished food i.e., Agricycle breadfruit flour incorporated into pasta or crackers. The manufacturer could then share ideas with clients to enable the uptake of the product.

This support enables companies who are exploring upcycled ingredients to refine, optimise, trial and receive advice on the development of new products.

3.3.2. Private R&D companies

MATTSON, USA

Mattson is a food and beverage insights, strategy, innovation, and development firm based in San Francisco. They work with start-ups to some of America's largest food and beverage companies to design, formulate, and improve products. In recent times, Mattson has worked on several upcycled food projects to support businesses to explore the opportunities that food surplus and byproducts present as food ingredients.

The general process followed by the team at Mattson includes the following steps:

1. A visit to the manufacturing site to understand where the waste is occurring and how to capture it in a food-safe and consistent way (i.e., greening citrus – walk the plant to understand how to capture the green citrus and how to process it into juice or pulp quickly so it doesn't spoil before it can be used).
2. Understand preparation, transportation, and storage requirements for the surplus stream.
3. Highlight any additional processing steps required and costs associated with this.
4. Brainstorming new product ideas and testing these ideas with consumers (i.e., a new beverage made from green citrus).
5. Formulation of products and commercialising them at the production facility.

Mattson product development labs

3.3.3. Innovative technology companies

GREEN SPOT TECHNOLOGIES, FRANCE

Green Spot Technologies, based in France, uses fermentation to transform surplus and byproducts into food ingredients with a zero-waste approach.

The solid-state fermentation process is:

- Easy to adapt to different byproduct streams
- Cost-effective
- Doesn't require water
- Has low energy requirements

The company founder studied in New Zealand and moved to France in 2018 due to the availability of investment for a demonstration facility. The fermentation demonstration plant (current capacity of 100T/year with plans to reach 600T/year at industrial scale) is located in the South of France near Avignon. The plant location was determined by some key criteria:

- A 2000 m^2 block
- An area that enables food compliance
- In a location close to partners and supply (to keep supply chains short) – all input material is currently sourced from France.

The plant design is easy to replicate and could be rolled out in other locations. Green Spot has a workforce of 22 people and has conducted R&D on 100 different side streams and launched three key products: fermented tomato; apple; and spent grain. The ingredients are mostly functional (i.e., texture, colour, water retention) and the largest uptake has been for meat analogues, bakery, and snack products. Companies are either looking to substitute an ingredient or conduct innovation to develop a new product, co-design is very important here. This provides companies access to technology and processing capabilities. They then work with companies to incorporate the ingredient into products.

NETZRO, SBC USA

NETZRO is a food upcycling technology platform founded by UFA Board member Sue Marshall. Sue came across an infrared technology to separate hay from manure and wondered whether this could be applied to separate food waste components for valorisation. Two key trial materials were egg shells (separating the shell from the membrane) and spent grain. The technology can efficiently convert food side streams into new upcycled ingredients at a price point of less than 25 cents per pound for large companies to use and make a margin. Making the technology cost-effective is essential, "Players who stay relevant have to sell to big companies" – Sue Marshall. NETZRO also works with fruit producers, juice companies, brewers, distillers, egg producers, and food manufacturers to adopt the technology. Sometimes ingredients companies come to them for a processing solution for a raw material of interest, other times food companies come to them seeking guidance on what to do with their byproducts or surplus.

Sue Marshall, NETZRO SBC

3.3.4. Not-for-profit Organisations

FOOD VALLEY, NETHERLANDS

Food Valley is an Independent Foundation in the Netherlands formed in 2004 to mobilise food innovation. It started as a network organisation with a group of Agrifood companies. They were asked by Government departments to work on a circular transition for the food system. They now have over 600 collaborators, innovators, and science-based partners worldwide.

OVER
600
collaborators, innovators, and science-based partners worldwide.

They work on innovation, entrepreneurship, and creating access to shared facilities to pilot and test solutions, this includes the hiring of pilot equipment to be shared between companies. They are home to a platform called Food Leap which is a repository for shared facilities.

Food Valley began an Upcycling Community in 2022 which includes 35+ companies globally to enhance knowledge sharing and partnership formation.

The upcycling community has three key work programs:

01 **Working with consumers**

02 **Data exchange in the value chain**

03 **Product development.**

Food Valley is currently drafting a position paper on upcycling with partners in the upcycling community. This involves input from the Upcycled Food Association in the USA, researchers, industry and market research institutes. The purpose of the paper is to provide recommendations on future priorities for the sector and the role of government. This provides support to the whole sector.

Caroline Duivenvoorden, Pablo Juliano, Jolijn Zwart-van Kessel and Ned Spang at Food Valley

WASTE AND RESOURCES ACTION PROGRAM, UK

The Waste and Resources Action Program (WRAP) is a not-for-profit organisation that originated in the UK and now operates across six continents. They facilitate research, industry collaboration, funding, public engagement, and policy advice on a range of environmental issues including food waste.

WRAP has a food waste reduction roadmap to provide guidance for different sectors (retail, manufacturing, hospitality/food service) on food waste reduction activities. WRAP find that the further a business is along the food waste journey the more upcycling opportunities come up. Upcycling could be worked into the checklists and supported through tools and case studies that WRAP develops.

Kate Groves, Tom Quested, Harriet Lamb, Sue Riley, WRAP UK

The commercial team at WRAP administers a grant on food waste valorisation/upcycling. The grant focuses on difficult waste streams to process. It was launched in 2020 and two projects were awarded funding.

Example project: Whey waste - Activitech (Nottingham)

Globally 180-190mt/year of whey are produced every year[47]. Whey can be used in place of lactose to make galacto-oligosaccharides (GOS), prebiotics for gut health for cosmetic and health food markets. Activitech is currently undergoing a patent application and has plans to deploy reactors at the dairy company, Soptio's, sites. They have developed a process of transforming the whey into GOS and reusing the enzyme on a continuous rolling basis.

Provision of tools, case studies and funding enable companies to inform decisions.

Companies can access research and innovation support from universities, private R&D companies, technology companies and not-for-profit organisations. Upcycled food companies should maximise access to support services to bridge gaps that the industry needs to overcome to be successful.

RECOMMENDATION: Industry should utilise research support services

3.4. Policy recommendations for the upcycled food sector

Policy settings influence where governments focus regulations, taxes, investments, education, and incentives. Enabling policy settings can shift the trajectory of a sector.

A key objective of this Fellowship was to ***discuss how upcycled foods can more overtly be included in global targets and standards (i.e. UN SDG 12.3).***

47 Buchanan D, Matindale W, Romeih E, Hebishy E. Recent advances in whey processing and valorisation: Technological and environmental perspectives. Dairy Technology. 2023, 76 (2) 291-312: https://doi.org/10.1111/1471-0307.12935

This section addresses five key topics:

- The terminology used to describe upcycling
- Guidance around destinations that count toward achieving SDG 12.3
- Incorporation of upcycling into the food waste hierarchy
- Identifying food safety and regulatory parameters
- Allocating emissions to upcycling activity

3.4.1. Terminology to describe upcycling

It is important to have clear terminology to allow for communication, momentum building, and policy making. The concept of utilising food waste to create new products is described differently across different regions.

Table 8 – Terminology used to describe the concept of upcycling

USA
The term 'upcycled' is well established in the USA given the presence of the trade association UFA and the work undertaken on a consolidated definition. UFA's work to raise awareness on behalf of companies for the concept of 'upcycling' and the launch of Certified Upcycled has established this terminology in both business and consumer vocabulary.
EUROPE
Typically, in Europe the terms co-product valorisation and side stream valorisation are used instead of upcycled. However, some companies commented that the terms co-product and side-stream lack meaning for the consumer. In France, the term upcycled is difficult due to the lack of French translation. There are also connotations with 'upcycled' being more expensive, niche and not scaled. Language around circularity could be useful and telling a story alongside the terminology. It is also worth noting that, byproducts[48] and animal byproducts[49], by definition in Europe are not intended to be eaten directly by humans and are therefore not classified as food waste. As a consequence current definitions prevent the use of these byproducts from counting toward SDG12.3. This could be reconsidered if byproducts enter the food supply chain.
UK
In the UK the term 'Upcycled' has been adopted widely to talk about furniture or clothing. However, it is not used to describe value-adding to food as commonly. There is also some confusion with redistribution and rescue. Valorisation tends to be more normalised in the UK to describe creating new products from byproducts. If upcycling were to become normalised significant education would need to take place.

RECOMMENDATION:
Regions should define and agree on appropriate terminology for their geography to build momentum for the concept.

48 Supporting policy with scientific evidence [Internet]. [cited 2023 Nov 15]. Available from: https://knowledge4policy.ec.europa.eu/glossary-item/product_en#:~:text=Bioeconomy,can%20have%20negative%20ecological%20consequences.

49 Animal by-products [Internet]. [cited 2023 Nov 15]. Available from: https://food.ec.europa.eu/safety/animal-products_en

3.4.2. Adapting guidance around destinations that count toward achieving SDG 12.3 to include upcycling

The United Nations set the Sustainable Development Goal Target 12.3 to *'halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses'* by 2030. Various efforts have been made to unpack this target most specifically by a group of international leaders tasked with Food Loss and Waste targets known as Champions 12.3[50]. This group provided guidance on interpreting the target and delineating between activities that count toward reducing food loss and waste vs activities that divert food waste from landfill but do not count towards the target. Currently, as the guidance stands upcycled foods are not mentioned explicitly. This guidance is designed to support governments working towards SDG 12.3 to determine where to deploy policy interventions and funding.

Only three food waste destinations currently contribute towards SDG12.3:

01 **Prevention and redistribution to people**

02 **Animal feed**

03 **Biomaterial/ processing**

> **Note,** *that the European version of the food waste hierarchy includes prevention and food for people*[51] *at the top of the hierarchy, this also does not specify upcycling explicitly. Therefore, with more explicit guidance concerning upcycling more targeted policy decisions can be enabled.*

50 About champions 12.3 [Internet]. Champions 12.3 [cited 2024 February 20]. Available from: https://champions123.org/about-champions-123

51 Food waste measurement [Internet]. [cited 2023 Nov 15]. Available from: https://food.ec.europa.eu/safety/food-waste/eu-actions-against-food-waste/food-waste-measurement_en

RECOMMENDATION:
Add upcycling into the prevention and redistribution designation of Champions 12.3 guidance on interpreting SDG 12.3 (depicted below).

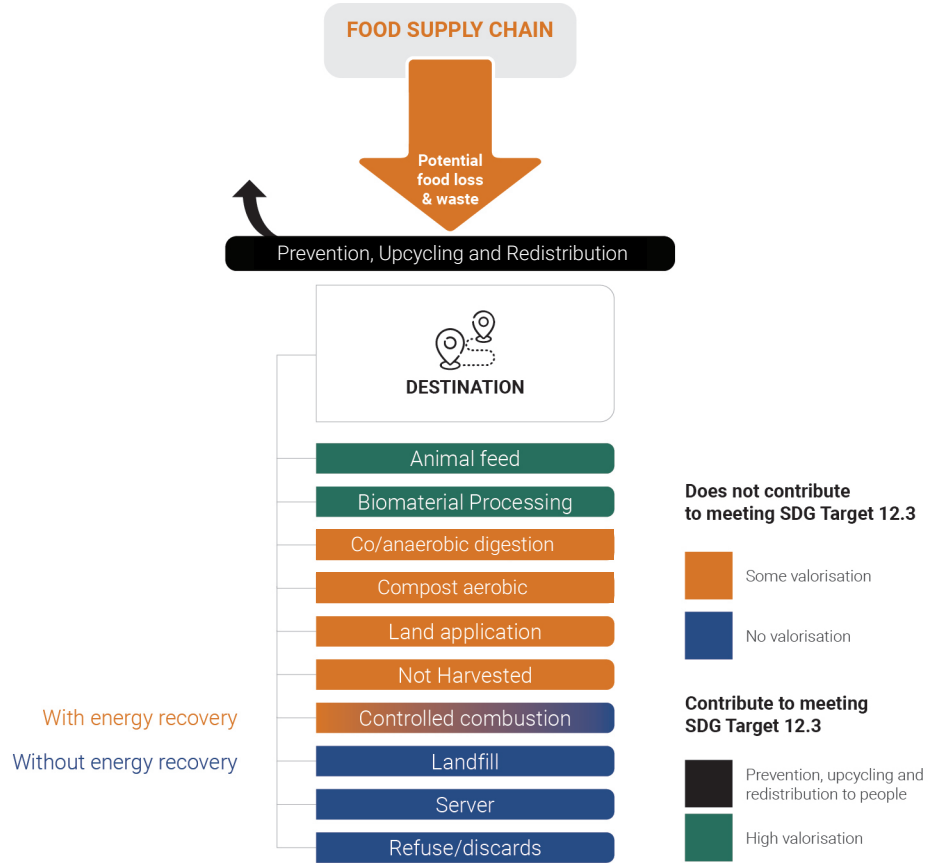


Figure 3 – Updated guidance on interpreting Sustainable Development Goal 12.3 to include upcycling (Adapted figure[52])

3.4.3. Incorporation of upcycling into the food waste hierarchy

There have been previous attempts made to identify where upcycling should sit within the food waste hierarchy and therefore whether it counts towards SDG 12.3. The consensus is that upcycling is a food waste avoidance destination and should count towards the target. Discussions with Clementine O'Connor from the UN Environment Programme and Liz Goodwin from World Resources Institute (WRI) informed that upcycling is an activity that should sit alongside the food waste "prevention" level of the hierarchy as the action of upcycling prevents the food from being wasted to human food supply.

Clementine O'Connor, UNEP

52 The 2023-2028 Investment Framework Update [Internet]. [cited 2024 Jan 15]. Available from: https://wpstaq-ap-southeast-2-media.s3.amazonaws.com/endfwa/wp-content/uploads/media/2023/11/Investment-Framework-Update-2023-final.pdf

Additionally, on 19 October 2023, the United States Environmental Protection Agency launched the new Wasted Food Scale[53] which incorporates upcycled food. This places upcycling below prevention activities and alongside redistribution.

Figure 4 – Wasted Food Scale (Sourced directly from the USA Environmental Protection Agency[54])

Although it is promising to see upcycling incorporated into this guidance, a ladder or hierarchy is perhaps a clearer way to present prioritisation of food waste reduction initiatives.

Therefore, I have modified a version of the food waste hierarchy used in Australia. The following figure (5) has been prepared as a result of discussions and recent publications and provides more explicit guidance on the prioritisation of upcycling as a food waste reduction initiative. I have proposed below distinguishing 'prevention' activities from 'retention' activities. Prevention includes activities that reduce the total volume of food going to waste or requiring additional processing. Retention activities include additional steps taken (i.e., redistribution or upcycling) to ensure that the food that remains is consumed by humans.

53 Wasted Food Scale. [Internet]. 2023 [cited 2023 Nov 15]. Available from: https://www.epa.gov/sustainable-management-food/wasted-food-scale

54 Wasted Food Scale. [Internet]. 2023 [cited 2023 Nov 15]. Available from: https://www.epa.gov/sustainable-management-food/wasted-food-scale

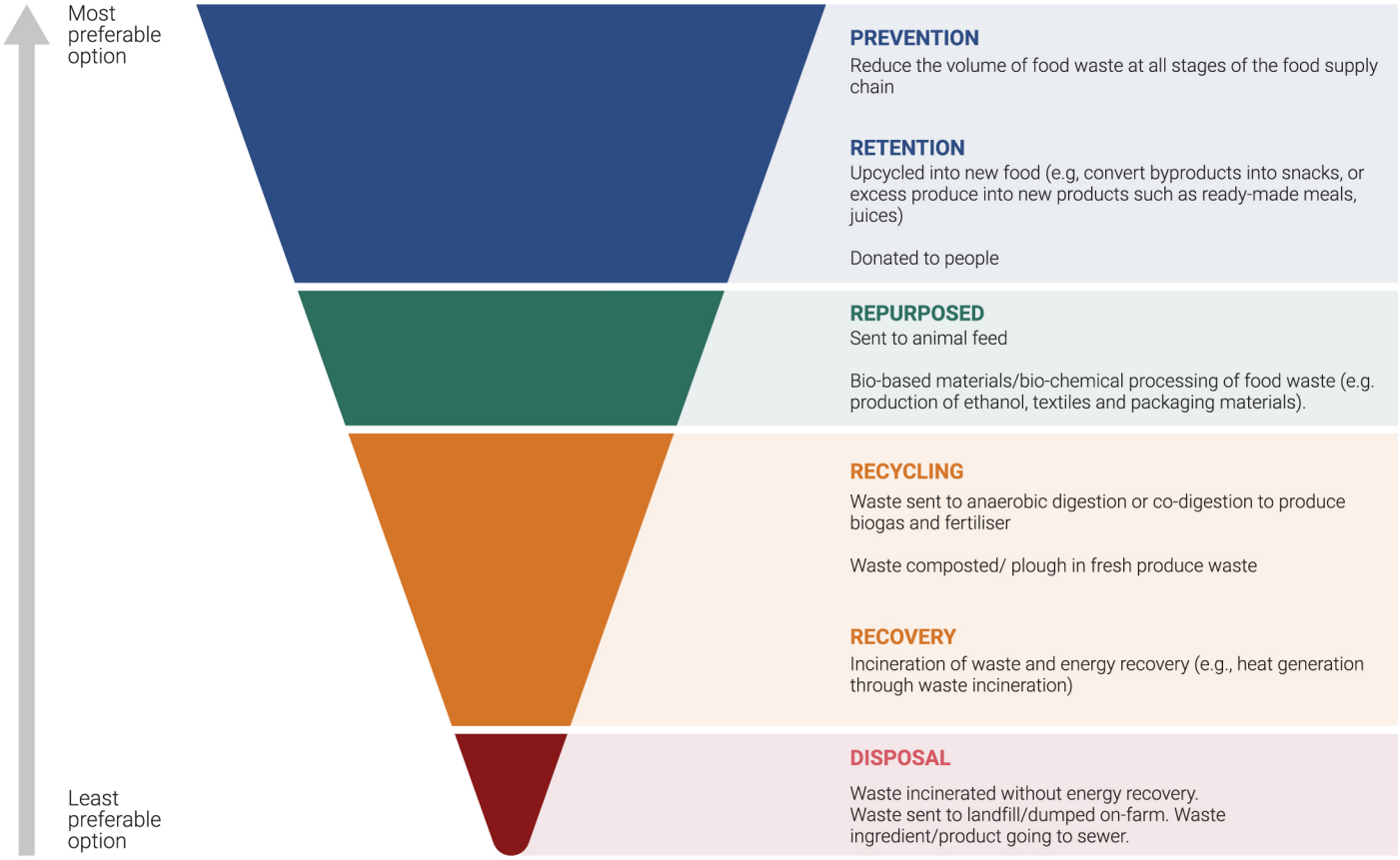


Figure 5 – Updated food waste hierarchy to include upcycling (Adapted figure[55])

RECOMMENDATION:

- Addition of a new category to the food waste hierarchy called "Retention" which refers to products retained within the human food supply chain through redistribution and upcycling.
- Quantify the amount of food available in the supply chain that could enter back into the food system to understand the full opportunity.

A further area to explore when classifying and prioritising food waste reduction solutions, including upcycling, is developing mechanisms to account for the extra material being retained in the food system through increased yields and utilising byproducts.

55 Sector action plan summary - bread and bakery [Internet]. [cited 2023 Dec 15]. Available from: https://www.lovefoodhatewaste.nsw.gov.au/

3.4.4. Allocating emissions to upcycling activity

A topic raised in discussions across the USA, UK, and Europe was a lack of clarity around calculating and attributing the emissions associated with producing upcycled foods. Organisations want to understand the net environmental impact of upcycling. I had discussions with Professor Ned Spang from the University of California, Davis (UC Davis) Food Loss and Waste Collaborative on this topic.

Where there is one input material with multiple products coming from it, how do we allocate the impacts over all the different products being made?

Options:

- Economic value - allocate across multiple streams (price fluctuation is a challenge)
- Mass - allocate across multiple streams based on their relative mass flows.
- Combination of mass and economics.
- Systems expansion - track in detail what is displaced in the system.[56]

Simple method

1. Credit (avoided waste - emissions factor offset)
2. Debit (scope 1,2,3 emissions from additional processing – note displacement, instead of transporting to landfill, transport for processing)
3. Credit (emissions avoided from what is being displaced)
4. Net = emissions attributed to upcycling (could be a positive or negative figure)

When accounting for Greenhouse gas emission (GHGE) impact it is not always clear where the product was going before, and which products are being displaced as a result. Understanding what has changed is essential and focussing on this rather than quantifying the entire system could increase the feasibility of undertaking these assessments.

It is going to become increasingly important to quantify the benefits of upcycling to input into systems such as carbon credits. Ecoscore is also due to be launched in 2024, there is a push for lifecycle assessment (LCA) methodology to be used as the base[57]. Upcycling could be considered as an aspect of an overall Ecoscore.

Carbon and GHGEs can also start to cloud the story of using more of the food that is available in the food system and there is a lack of reporting and measurement of true food use. This is a missed opportunity in the food industry. Speaking with Toine Timmermans at Food Waste Free United, we need to shift focus from food to feed and fuel towards food to food. It is challenging to achieve carbon neutrality without compensation as energy is being added to the biomass, this then becomes a policy equation, not purely a LCA equation. Timmermans suggested there could be merit in forming an international working group on the topic.

Parallel model in the animal feed sector

The Global Metrics for Sustainable Feed database[58] is a publicly available global database of lifecycle assessment data for animal feed ingredients.

56 Kendall A, Marvinney E, Brodt S, Zhu W. Life cycle–based assessment of energy use and greenhouse gas emissions in Almond production, part I: Analytical framework and baseline results. Journal of Industrial Ecology. 2015;19(6):1008–18. doi:10.1111/jiec.12332

57 Presentation [Internet]. Eco-score [accessed 2024 Feb 5]. Available from: https://docs.score-environnemental.com/v/en/

58 GFLI database [Internet]. Global metrics for sustainable feed [accessed 2024 Feb 25]. Available form: https://globalfeedlca.org/gfli-database/

The recommended methodology for emissions associated with feed is the 'product environmental footprint category rule' (PEFCR) methodology which attributes emissions in association with economic value, mass, or energy across the fractions of feed ingredient.

- Economic value (preferred method in feed)
- Mass
- Energy

This methodology could be used in the upcycled food sector. Take brewers spent grain for example. I have prioritised mass as the data is most readily available.

Table 9 – Simple emissions attribution calculation for brewer's spent grain using PEFCR mass-based method

	BEER	BREWERS SPENT GRAIN	OTHER BY-PRODUCTS
Mass	100kg	20kg[59]	3kg
% of emissions	81.3%	16.3%	2.4%

When using the economic value model you can theoretically claim co-products with zero economic value as zero emissions using the agreed PEFCR methodology. Emissions associated with BSG are ~1% (based on economic value).

RECOMMENDATION:

Form an international working group on emissions calculations for upcycled food.

3.4.5. Identifying food safety and regulatory parameters

Analysing specific food safety regulations and legislation was outside the scope of this research. All regulations and legislation need to be managed within the legal context of each jurisdiction. However common themes emerged through discussions with stakeholders.

Common themes arising from discussions were:

- The regulatory burden fell around food safety and labelling
- Traceability is important
- Novel foods require pre-market approval, foods generally recognised as safe do not[60].
- Participants perceived the EU's novel food pre-market approval process as a barrier. In the US, pre-market approval is generally not required provided upcycled food companies establish that their product is generally recognised as safe (GRAS)[61].

59 S.I. Mussatto, G. Dragone, I.C. Roberto, Brewers' spent grain: generation, characteristics and potential applications, Journal of Cereal Science. 2006, 43(1) 1-14,https://doi.org/10.1016/j.jcs.2005.06.001.

60 Navigating regulations (EU novel foods, US GRAS) to deliver food innovation

61 Novel food regulation: EFSA vs FDA [Internet]. Safe food 360 [accessed 2024 Feb 25]. Available from: https://safefood360.com/blog/novel-food-regulation-efsa-versus-fda/

Potential regulatory challenges

- Lack of traceability
- Cold chain integrity, lack of monitoring
- Food fraud i.e., meat unfit for human consumption going back into the food supply chain
- Laws that restrict the use of side streams i.e., in France, wine byproducts cannot be directly valorised, they must first be sent to distillation[62].
- Labelling requirements for upcycled ingredients (including allergens and consideration for loss of record of 'age' of ingredients)

Upcycled food manufacturers can take steps to reduce regulatory barriers:

- Implement a relevant food safety standard for their jurisdiction
- Exercising due diligence to reduce food safety risks
- Design-in food safety by making products that are lower risk and inherently safer
- Keep the supply chain as contained as possible
- Maintain documentation for traceability, point of origin, compliance
- Ensure input material suppliers are maintaining compliance

The main challenge concerning regulations and legislation is that upcycled ingredients are not specifically addressed.

RECOMMENDATIONS:

1. Policymakers assess how to enable upcycled foods within their jurisdiction (i.e., procurement, grants etc.)
2. Regulators develop a legal definition of upcycled foods to create more certainty around how these foods will be governed.
3. Jurisdictions with pre-market approval processes for novel foods consider how to amend the regime to enable upcycled foods that illustrate a potential to divert food waste and lessen environmental impacts. For instance, it could be particular approval processes or a faster process.

3.5. Summaries from International Upcycling Events

A key objective of this Fellowship was to ***engage with leading upcycled food businesses and experts by attending various international events.***

Four key events were attended:

- ReFED food waste solutions summit, St Louis
- Association for the Study of Food and the Society (ASFS) Knowing Food Conference, Boston
- Food 2 Food upcycled food industry engagement event, Netherlands
- Food Waste Free United DocuScience Event, Netherlands

62 Commission delegated regulation (EU) 2019/934. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R0934

3.5.1. ReFED food waste solutions summit, St Louis

The ReFED Summit is one of the biggest global food waste events of the year. This year there was an upcycled food tour to Anheuser-Busch and Evergrain (see more detail in Section 3.1.1). I had the opportunity to meet with representatives from the World Wildlife Fund, Kroger, UP., Inc, Renewal Mill, Matriark, Spare Food Co, NETZRO SBC, the Upcycled Food Association, United Nations Environment Programme, The Food and Agriculture Organisation, and more. A highlight was the panel discussion on upcycled food (moderated by Angie Crone, CEO of UFA) which included the following key messages:

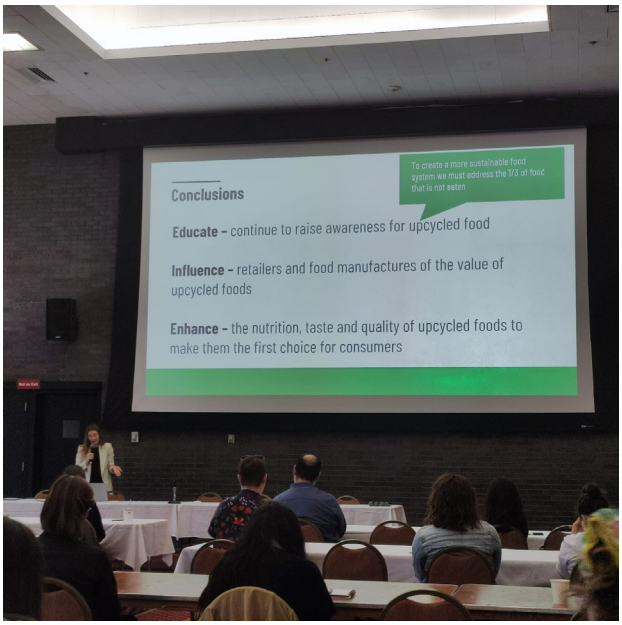
Food waste tour of AB In Bev with Dana Gunders, ReFED

- Collaborate with retailers and food service companies
- Change brand guidelines and specifications to design-out waste
- Don't necessarily need to collaborate within a sector or a supply chain. Work across the food system as other players in the food system can find the function
- The cost and the benefits are often not in the same place
- Food waste is an issue the food service sector can collaborate on non-competitively
- Collaboration can drive quality and sustainability at the same time
- There are lots of isolated solutions and currently, users have to stitch them together

Dana Gunders, ReFED Summit 2023

3.5.2. Association for the Study of Food and the Society Knowing Food Conference, Boston

The ASFS Conference was a multi-disciplinary research conference spanning the entire food system. Highlights included sessions on the contributions of chefs and restaurants to advancing sustainability and equity in food systems, a wine and cheese tasting creative writing workshop, a history of beer tour around Boston, and a 'Dine Around' dinner where local chefs brought a signature dish for sampling. I presented on the role of upcycled food in a sustainable food system. I presented three research papers that covered topics of consumer attitudes, retailer decision-making and enhancing nutrition of upcycled foods.



Speaking at Knowing Food Conference, Boston

3.5.3. Food 2 Food upcycled food industry engagement event, Netherlands

Food Waste Free United hosted an upcycled food industry event for food businesses and entrepreneurs. Five presentations were delivered by Toine Timmermans (Food Waste Free United), Pablo Juliano (CSIRO), Ned Spang (UC Davis), Karel van der Velden (Nijsen), and myself. I presented on:

- **Education** to raise awareness for upcycled food
- **Innovation** through R&D collaborations to advance product development
- **Influencing** retailers and food manufacturers of the value of upcycled foods
- **Partnerships** to advance scale
- **Enhancing** the nutrition, taste, and quality of upcycled foods to make them the first choice for consumers


Speaking at Food 2 Food event, Driebergen

3.5.4. Food Waste Free United DocuScience Event, Netherlands

This event, organised by Food Waste Free United, began with a zero food waste dinner with representatives from the Dutch hospitality and food service sector. The meal was followed by a screening of 'Abundance - The Farmlink Story', a documentary about university students in the USA who tackled a major food redistribution challenge during the COVID-19 pandemic. Finally, I was involved in a panel discussion focussed on the role of young people in the fight against food waste.

Panel discussion at Docuscience event, Wageningen University

04

Future Gazing

I had discussions with various sector leaders about where they believe the upcycled food sector is headed in the coming years.

4.1. Projected Changes for the upcycled sector in the United States

– informed by discussions with Ben Gray, Co-founder, Upcycled Food Association

Projected changes for the sector going forward:

- Private label is going to elevate the sector. This allows larger companies to get involved without having to put the R&D in and to see sales trends across different products.
- Communication of impact to the consumer will become more important with more significant market penetration.
- Consumer Packaged Goods (CPG) experience a lot of product churn, and this will continue.
- Demonstration of functional value will be important, if products are priced at a premium, product claims will be expected by retailers.

- More proliferation and adoption globally, companies want to add value to their product in different markets.
- The variety of companies, ideas, methods of upcycling, motives to engage with this solution, backgrounds, and heterogeneity will continue to grow.
- Markets are not in a place at the moment to invest significantly in R&D, might see consolidation and less risk appetite.
- Companies want to tell the story consistently across their product, even in different markets, having the ability to elevate a part of the story that third-party certified is appealing.
- Policy changes mandating food donation (i.e., a recent policy introduced in California[63]), need to consider the role of upcycling for products that are not suitable for donation.

4.2. Projected Changes for the upcycled sector in the UK and Europe

– informed by discussions with Toine Timmermans, Director, Food Waste Free United (Netherlands), and the Waste and Resources Action Program (UK)

Projected changes for the sector going forward:

- Retailers are asking for low-footprint products, driving manufacturers to look for new ingredients (i.e., upcycled).
- Ingredient companies and brand owners need to overcome issues such as inconsistent volume and fluctuations in price.
- Carbon messaging will be a key motivator for retailers (i.e., Dutch retailer, Albert Heijn mapped the carbon footprint of their private label products to inform reduction plans and targets[64]).
- Food waste to feed is growing. A change in the Netherlands over the last year allows processed animal proteins to be used in feed[65].
- Consideration should be made for minimum upcycled food content specifications as has been seen for plastics.

With Ned Spang and Pablo Juliano at Food Waste Free United

63 California food waste policy [Internet]. ReFED [accessed 2024 Feb 25]. Available from: https://policyfinder.refed.org/california/#:~:text=Code%20Regs.-,Tit.,agencies%20and%20recycle%20the%20remaining.

64 Albert Hein upgrades CO2 emission reduction target [Internet]. European supermarket magazine [accessed 2024 Feb 25]. Available from: https://www.esmmagazine.com/retail/albert-heijn-upgrades-co2-emission-reduction-target-227045

65 FAQs [Internet]. European animal by-product processing sector [accessed on 2024 Feb 25]. Available from: https://efpra.eu/faqs/

05

Conclusions and Recommendations

5.1. Conclusions

Upcycled food has significant potential to keep more resources in our food system and reduce the amount of food being wasted globally. During this Fellowship, I discovered some excellent examples of upcycling in practice across the USA, UK, and Europe. I was also reassured that Australia has the foundations to create a thriving sector at home. We could learn from the co-ordinated efforts in the USA driven by using a common language, certification scheme, and the presence of the Upcycled Food Association to build a community. To build consumer awareness we need clarity of message (i.e., common language), this clarity will amplify the message and lead to action. We can learn from research and development efforts specifically targeting upcycled foods and we can learn from the innovative models businesses have implemented in primary production (i.e., Food Fellows), in manufacturing (i.e., AB InBev), in distribution (i.e., Martiark working with distribution partner, Sysco), in retail (i.e., Renewal Mill and Up., Inc. partnering on private label with Kroger and Whole Foods) and in hospitality (i.e., Shuggies Trash Pies and Restaurant Sem). Explicitly naming upcycled food in international guidance documents (i.e., guidance on interpreting SDG 12.3 and the food waste hierarchy) would raise the profile of upcycling as a key intervention to reduce food waste and meet climate targets. Attention at this level can then enable upcycling to be embedded in national food waste strategies and policy and receive appropriate support and funding.

Lessons learned from leading upcycled food companies

Upcycled food companies and those partnering with them are driving change in our food system. These businesses, small and large, see the value of food differently and are converting that vision into viable businesses. These businesses operate at every level of the food supply chain and fill different needs and gaps in the market including creating markets for unsold surplus food (i.e., low-grade produce), markets for new food ingredients made from byproducts, and solutions for big food companies to amplify with scale. The hospitality sector plays an important role in demonstrating the potential of overlooked foods in our food system. Developing specific markets for upcycled food (e.g., hospitality and food service supply chains) will boost demand. Producers of upcycled ingredients and procurers of these ingredients play equally important roles in creating the necessary value chains to scale the industry. Some companies valorise their own byproducts and side streams (i.e., Food Fellows and AB InBev) other companies use food waste from external companies (Matriark, The Spare Food Co., UP, Inc., Renewal Mill). The success of these companies will depend on driving up consumer demand and awareness and creating cost-effective solutions.

Opportunities to expand the upcycled food certification to Australia

The introduction of Upcycled Certified® for upcycled products and ingredients in the USA and Canada, significantly raised the profile of the upcycled food sector both nationally and internationally. The certification provides a recognisable mark for consumers to identify upcycled products and third-party verification to create credibility for the sector. There is potential to roll the certification out in Australia and discussions are underway on mechanisms to enact this.

The role of research, development, and innovation

Companies can conduct their own in-house R&D or access research and innovation support from universities, private R&D companies, technology companies, and not-for-profit organisations. Australian companies have access to a similar ecosystem of R&D support. However, there are learnings we can take from research and innovation support targeted specifically at upcycling to advance the research approaches we take in Australia (i.e., upcycled food labs and upcycled food innovation communities). Upcycled food companies should maximise access to support services to bridge gaps that the industry needs to overcome to be successful.

Policy recommendations for the upcycled food sector

Enabling policy settings can help to reduce barriers and create opportunities for the upcycled food sector. Guidance is available in the form of the food waste hierarchy and guidance on interpreting the UN Sustainable Development Goal (SDG) 12.3 to help organisations to prioritise food waste reduction activities. Upcycling should be explicitly named in these guidance documents as a food waste 'retention' activity as food is retained within the human food supply chain and counts towards achieving the SDG. It will become increasingly important to calculate greenhouse gas emissions associated with upcycling and an international working group should be created to work on appropriate methodology. It is challenging for companies to navigate relevant regulations as upcycled foods and ingredients are not specified in regulations. It is recommended that policymakers assess how to enable upcycled foods within their jurisdiction (i.e., procurement, grants etc.) and that regulators develop a legal definition of upcycled foods to create more certainty around how these foods will be governed. Jurisdictions with pre-market approval processes for novel foods should consider how to amend the regime to enable upcycled foods that illustrate a potential to divert food waste and lessen environmental impacts and policies to encourage the adoption of upcycling practices as a solution to mitigate food waste and the impacts of climate change should be developed.

5.2. Summary of recommendations

Recommendations for industry:

- Raise consumer awareness and demand for upcycled foods.
- Create partnerships between innovative, agile companies and bigger companies with scale (i.e., private label opportunities with retailers).
- Pay for upcycled input materials to demonstrate the value of the material and enable necessary supply chains.
- Actors at every stage of the food supply chain should consider their opportunity to participate in the upcycled food sector.
- Harness innovation from the culinary sector to demonstrate the full potential of over-looked foods.
- Investigate opportunities for hospitality and food service businesses to procure upcycled ingredients.
- Include environmental messaging on-pack in alignment with regulations.
- Industry should utilise research support services.

Recommendations for researchers and food waste practitioners:

- Quantify the amount of food available in the supply chain that could enter back into the food system to understand the full opportunity for upcycling.
- Form an international working group on emissions calculations for upcycled food.
- Consider models for expanding Certified Upcycled internationally.

Recommendations for policymakers:

- Regions should define and agree on appropriate terminology for their geography to build momentum for the concept.
- Add upcycling into the prevention and redistribution designation of Champions 12.3 guidance on interpreting SDG 12.3.
- Addition of a new category to the food waste hierarchy called “Retention” which refers to products retained within the human food supply chain through redistribution and upcycling.
- Policymakers should assess how to enable upcycled foods within their jurisdiction (i.e., procurement, grants etc.)
- Regulators should develop a legal definition of upcycled foods to create more certainty around how these foods will be governed.
- Jurisdictions with pre-market approval processes for novel foods should consider how to amend the regime to enable upcycled foods that illustrate a potential to divert food waste and lessen environmental impacts.

5.3. Key recommendations for Australia

1. Adopt a food waste hierarchy including upcycling.
2. Form an upcycling community/network.
3. Adopt shared terminology for upcycling.
4. Identify opportunities for upcycling at every stage of the food supply chain.
5. Foster partnerships between large food companies and upcycled food companies.
6. Educate consumers about upcycling and the links to environment/ climate change.
7. Adopt an upcycled food certification.

06

Dissemination and Implementation

This report acts as a comprehensive overview of my Fellowship travels and I will be developing subsequent targeted materials for active and prospective upcycled food companies.

The international connections made on this Fellowship tour have already led to significant collaboration opportunities. Since returning I have:

- Presented to the United Nations Asia Pacific Food Waste Working Group about upcycling.
- Drafted an upcycled food case study for the upcoming UN Food Waste Index.
- Input into the Food Valley position paper on upcycled foods, providing Australian context and case studies.
- Had discussions with the Waste and Resources Action Program on developing a product library for upcycled ingredients.
- Presented about my Churchill Fellowship in presentations to Australian and International audiences.

Substantive pieces of work that arose from the Fellowship include:

- Working on a proposal with End Food Waste Australia colleagues with the aim to bring the Certified Upcycled® to Australia.
- Discussing with the World Resources Institute and United Nations Environment Programme opportunities to incorporate upcycling into the food waste hierarchy and guidance on delivering UN SDG 12.3.

These findings will influence my work at End Food Waste Australia, informing my guidance to industry, research and development proposals, and future food waste strategy development.

Appendix A – Trip Details

Supplementary Table 1 below provides a summary of the industry representatives from the upcycling sector visited.

Supplementary Table 1 – Summary of industry stakeholders

COMPANY	DESCRIPTION	LINK	LOCATION
EverGrain® by AB InBev	EverGrain® is Anheuser-Busch's upcycled food start up producing protein isolate from brewers spent grain, processing onsite.	https://evergrainingredients.com/	USA
Matriark	Create products from surplus horticulture (i.e. broths, sauces); have a product range for 3 channels: foodservice, retail, and emergency food.	https://www.matriarkfoods.com/	USA
NETZRO, SBC	Developed a technology to help process byproducts i.e. brewers spent grain, egg shells	https://netzro.us/	USA
Renewal Mill	Use Oakara (tofu byproduct) to make baking mixes and flour, partnered with retailers on private label opportunities	https://www.renewalmill.com/	USA
Regrained/ Upcycled foods inc	Use brewers spent grain to create upcycled ingredients that can be incorporated into a range of finished foods – partnered with multinational food ingredients companies and retailers	https://upcycledfoods.com/	USA
The Spare Food Co	Use whey and produce side streams to create an upcycled beverage, inspiration from culinary techniques	https://www.sparefood.com/tonic-collection	USA
Shuggies Trash Pies	Shuggie's recue a huge variety of ingredients that would otherwise go to waste — irregular or surplus produce, byproducts from food manufacturing, lower-on-the-food-chain seafood, and offcuts from the meat industry to showcase at their restaurant.	https://www.shuggiespizza.com/mission	USA

COMPANY	DESCRIPTION	LINK	LOCATION
Food waste factory/ Hutten	Large catering company who created the food waste factory to employ people struggling to get work and create products from waste to be used in the catering sector (i.e. soups, sauces)	https://deverspillingsfabriek.nl/	Netherlands
Rodenburg	Potato growers who developed a starch plant to create industrial products from food waste	https://biopolymers.nl/	Netherlands
Nijsen	Large scale transformation from food waste to animal feed, capturing manufacturing waste	https://nijsen.co/en/	Netherlands
Hubcycle	Create food ingredients from food waste that directly replace conventional ingredients (i.e. spices, flavours, functional ingredients)	https://www.hubcycled.com/en/	France
Green Spot Technologies	Create fermented, dried, powdered ingredients from byproducts and side streams from the food processing industry	https://Green Spot-tech.com/en/	France
SEM	Zero food waste restaurant	https://restaurantsem.com/mindset-1	Portugal

Supplementary Table 2 below provides a summary of the research and support services representatives from the upcycling sector visited.

Supplementary Table 2 – Summary of research and support services

COMPANY	DESCRIPTION	LINK	LOCATION
ReFED	US-based nonprofit dedicated to ending food loss and waste by advancing data-driven solutions	https://refed.org/	USA
Mattson	Food innovation and product development company	https://www.mattsonco.com/	USA
University of California, Davis (UC Davis) Food Loss and Waste Collaborative	An interdisciplinary research group focussed on food waste metrics and impact, food supply chain efficiency, consumer behaviour and food recovery, and circular solutions for food recovery and recycling	https://foodwastecollaborative.ucdavis.edu/about	USA
Drexel University	Food product design and culinary innovation lab supporting upcycled food product development	https://drexel.edu/cnhp/research/centers/Drexel-Food-Lab/	USA
Upcycled Food Association	Membership organisation to support the growth of the global upcycled food sector and owner of the Upcycled Certified standard	https://www.upcycledfood.org/	USA
Where Food Comes From, Inc.	A Certifying Body responsible for the third-party verification of various agricultural, food and environmental schemes, including Upcycled Certified®	https://www.wherefoodcomesfrom.com/	USA
Association for the Study of Food and Society	An association to promote the interdisciplinary study of food and society	https://www.food-culture.org/	Global
Waste and Resources Action Program	A Charitable Incorporated Organisation working with governments, industry and the voluntary sector on environmental initiatives.	https://wrap.org.uk/	UK
Food Waste Free United	A public private partnership to support the Netherlands to achieve UN SDG 12.3 (halve food waste by 2030)	https://samentegenvoedselverspilling.nl/	Netherlands
Food Valley	Independent association in The Netherlands, working internationally on the transition towards tasty, affordable, healthy and sustainable food, produced with respect for animals and the planet. The role of Foodvalley is to guide parties from thoughts and ambitions to collective action with frontrunners across sectors and countries, by providing access to the right insights, people, financial resources, shared facilities and best practices.	https://foodvalley.nl/en/	Netherlands
International Food Waste Coalition	Not-for-profit organisation coordinating action to reduce food loss and waste across Europe's hospitality and food service sector.	https://internationalfoodwastecoalition.org/	France

Supplementary Table 3 below provides a summary of the policy and regulatory representatives from the upcycling sector visited.

Supplementary Table 3 – Summary of policy and regulatory stakeholders

COMPANY	DESCRIPTION	LINK	LOCATION
World Resources Institute (WRI)	WRI's Food Program focuses on projects on Climate-Friendly Diets and Food Loss and Waste	https://www.wri.org/food	Global
United Nations Environment Program (UNEP)	Leading global authority on the environment.	https://www.unep.org/explore-topics/resource-efficiency/what-we-do/sustainable-lifestyles/food-and-food-waste	Global
Brand Reputation through Compliance (BRCGS)	BRCGS is a trade association for the UK food retail industry. BRCGS administers Global Standards for Food Safety, Packaging Materials, Storage and Distribution, Consumer Products, Agents and Brokers, Retail, Gluten Free, Plant-Based and Ethical Trading.	https://www.brcgs.com/	Global

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