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REPORT 5: FINAL REPORT

2.4.2 Accelerating Food Transformation

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Partner Foreword

Australia has a significant opportunity to build a globally competitive upcycled food sector that delivers environmental, economic and food system benefits. With millions of tonnes of food surplus generated each year, upcycling offers a practical pathway to retain food within the human supply chain while creating new value for growers, manufacturers and consumers. International experience demonstrates that where clear definitions, supportive policy settings, trusted certification and coordinated market development exist, upcycled food sectors can scale rapidly. In Australia, realising this potential requires coordinated action across regulation, research, industry capability and consumer engagement to move beyond isolated innovation and towards a scalable, investable sector.

This research responds directly to that need by examining the regulatory, socio-technical and consumer dimensions shaping the emergence of upcycled food in Australia. It highlights the importance of understanding and navigating existing regulatory frameworks including food safety, labelling and the food–medicine interface, while demonstrating that regulation itself is not a primary barrier. Critically, the research builds the evidence base required to understand consumer acceptance and demand, which is essential to developing a viable new market category and supporting credible claims, investment and scale. Key learnings from the project include that:

- regulatory clarity and shared definitions are essential enablers of sector growth
- consumer awareness of upcycled food remains low, but purchase intent is positive
- perceived quality, not environmental benefit alone, drives willingness to pay
- transparent labelling and trusted third-party validation are critical to building trust
- collaborative supply chains and enabling infrastructure underpin commercial viability

From End Food Waste Australia's perspective, this project is important because it provides practical insight that allows businesses, policymakers and researchers to move forward with confidence rather than navigating complexity in isolation. By bringing together regulatory analysis, industry experience and consumer evidence, the study offers a shared foundation to support coordinated action, reduce risk and accelerate learning. The findings are relevant not only nationally, but also internationally, contributing to the growing body of knowledge on how upcycled food sectors can be responsibly developed, scaled and embedded as a core strategy for reducing food waste and strengthening food system resilience.

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Executive Summary

Australia faces a significant challenge in managing food waste, with approximately 2.96 million tonnes of food wasted annually in primary production and manufacturing (FIAL, 2021). In response, the concept of upcycled food – transforming surplus or waste food into new, value-added products – has emerged as a promising solution.

This final report synthesises findings from a multi-phase research project aimed at accelerating food transformation through upcycling, offering insights into the regulatory, socio-technical, and consumer landscapes that shape, or may shape, the sector. Overall, the project had three key aims:

1. Advance understanding of the regulatory and socio-technical environment for upcycled food in Queensland.
2. Develop regulatory and market pathways to facilitate the upcycled food sector.
3. Provide advice to industry and government on consumer perspectives and strategies to improve acceptance of upcycled food.

To achieve these aims, the project was structured into four phases: Phase 1 - literature review and stakeholder interviews, Phase 2 - regulatory analysis, Phase 3 - case studies, and Phase 4 - consumer study. Each of these phases is briefly summarised below.

Phase 1: Literature review and stakeholder interviews

The literature review revealed that while technical research on upcycled food is growing, there is limited social science analysis, particularly in the Australian context. A key issue noted in the literature has been the lack of a universally accepted definition of upcycled food, which complicates regulation, certification, and consumer understanding, though efforts have been made in recent years to reduce this conceptual ambiguity.

Stakeholder interviews with 15 participants—including entrepreneurs, growers, and government representatives—highlighted several barriers, including (1) regulatory ambiguity, especially around therapeutic goods versus food classification; (2) manufacturing limitations, with few facilities suitable for small-scale or experimental production; (3) low consumer awareness, coupled with misconceptions about safety and quality; and (4) supply chain precarity, where surplus food availability fluctuates and may become economically valuable, undermining affordability.

This phase identified several opportunities, including government funding, third-party facilitators to connect supply chain actors, mobile manufacturing solutions, and values-driven motivations among founders.

Phase 2: Regulatory analysis

Australia currently lacks specific legislation for upcycled food, including an official/legal definition of upcycled food. However, existing food safety, labelling, and therapeutic goods regulations (may) apply, depending on the product type. Key findings from this phase of the project include:

- Food safety standards do not disproportionately burden upcycled food but require careful compliance.
- Labelling requirements necessitate transparency.
- Novel food regulation is generally not a barrier, as most upcycled products use familiar ingredients.
- Therapeutic goods regulation presents complexity for products with health claims, requiring clarity on classification.

Internationally, the United States Upcycled Food Certification scheme and proposed legislation (NO TIME TO Waste Act) offer models for Australia to consider, particularly in defining and verifying upcycled food claims.

Phase 3: Case Studies

Five Australian businesses engaged in upcycling were profiled for this Phase of the research, revealing diverse approaches and challenges. Overall, key themes that emerged via the case studies include: (1) low-tech processing can be strategically used for scalability and cost-effectiveness; (2) participants had pre-existing food manufacturing expertise, facilitating their ability to engage in upcycling; (3) collaborative supply chains are needed, which can be facilitated by third party actors; (4) marketing challenges exist, such as consumer understanding, positioning, and price; (5) values-driven motivations were noted as a reason for engaging in upcycling; and (6) funding/grants help support commercialisation and infrastructure.

Phase 4: Consumer Study

A nationally representative survey (n=2,557) and focus groups (n=45) explored consumer awareness, perceptions, and purchase intentions related to upcycled food. Findings from this phase revealed that only 31.7% of Australians were aware of the term "upcycled food," with many misunderstanding its meaning, however, consumers preferred the term "upcycled food" over alternatives like "rescued food". Plant-based products (e.g., breakfast foods, baked goods, snacks) were preferred by consumers relative to animal-based ones. Consumers showed positive purchase intentions, especially for products made from surplus food, however, price sensitivity was high; consumers expected upcycled food to be cheaper than conventional alternatives. Environmental benefits were found to support purchase intention but not willingness to pay, rather, perceived quality was the strongest predictor of willingness to pay. Consumers were wary of greenwashing and preferred information from trusted sources like government and research institutions.

Overall, the project identified key insights across its phases, which can be briefly summarised as follows:

1. Definitional clarity is essential.
2. Lifecycle assessments should be used to validate environmental claims.
3. No specific legal barriers exist, but regulatory complexity remains.
4. Low-tech methods offer scalable solutions but require infrastructure support.
5. Supply chain precarity challenges consistent production and pricing of upcycled foods.
6. Government funding is crucial but often inaccessible to early-stage ventures.
7. Consider existing market preferences (e.g., plant-based upcycled food) to support market development.
8. Consumer awareness and knowledge is low; education should focus on safety and ingredient transparency.
9. Marketing strategies should emphasise quality over environmental messaging to reduce consumer price sensitivity.
10. Third-party facilitators play a vital role in connecting supply chain actors.
11. Economic viability must be demonstrated to attract investment and scale.

Drawing on these findings, key recommendations for government include developing a legal definition of upcycled food, integrating upcycled food into waste policy, funding infrastructure and education, and supporting certification. For industry, recommendations include focusing on manufacturing upcycled foods from plant-based products, ensuring transparent labelling, and building strategic partnerships.

Overall, this project suggests that upcycled food presents a viable and scalable opportunity to reduce food waste, support sustainability, and create economic value in Australia. However, strategic support across regulation, infrastructure, funding, and consumer engagement is essential.

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1. Introduction

This report is the final report of a total of five reports that were written for Project 2.4.2 'Accelerating Food Transformation'. This report can be read as a standalone report, in that it summarises key information from the previous reports. However, Reports 1-4 provide significantly more depth.

By way of context to this project, in recent years, a new category of food products has emerged as a solution to organic food waste. This new category is often referred to as "upcycled food" or "food waste valorisation" and involves the transformation of food surplus and waste into new, value-added products. Examples of upcycled food products include biscuits containing bananas and pineapples that would have gone to waste, pasta made from spent grain produced during brewing, crackers that contain pulp from plant-based milk production and baking mixes or beer made using surplus bread. With an estimated ~2.96M T p.a. of food wasted in primary production and manufacturing (FIAL, 2021), there are significant opportunities to convert food surplus and waste into upcycled food.

An 'upcycling' approach to waste can be highly scalable and sustainable. Upcycling has been named an emerging food trend, including on Whole Food Markets Top 10 food trends for 2023 (Whole Foods Market, 2022), with a global market size valued at 38.95 billion (USD) in 2024 and a predicted market potential of 68.56 billion (USD) by 2032 (Fortune Business Insights 2025). However, as with any new market—but especially new foods—various regulatory, social, and technical factors can act as barriers, whilst changes to these factors can create new opportunities to expand the market, create jobs, and transform food waste.

Although the anticipated opportunity is significant, a number of challenges face the upcycled food industry in Australia. First, there is no primary data available about the overall opportunities and barriers to upcycled food, and related food transformation pathways. Second, there are no regulatory analyses examining how regulations impact food upcycling and in turn, what kinds of regulatory reform would facilitate alternative markets and industries for food surplus and waste transformation. Third, while there is emerging research that focuses on consumers' uptake, relatively little is known about Australian consumers' response to upcycled food. Collectively, these challenges significantly reduce the capacity of Australian industries to develop alternative markets using food surplus and waste.

This project sought to address the challenges, drawing an innovative mix of empirical and regulatory methods to understand the full range of opportunities and barriers to upcycled foods, and closely related food transformation pathways, across regulatory, social, and technical domains. Specifically, the three key aims of this project were:

1. **Advance understanding about the regulatory and socio-technical environment for, and barriers to, upcycling food in Queensland:** Using mixed social science methods, and in collaboration with industry, consumers and government, this project reviewed and evaluated the multiple factors that influence food surplus and waste transformation in Queensland.
2. **Develop regulatory and market pathways to facilitate the upcycled food sector:** This project determined what kinds of regulatory reforms and related initiatives are required to scale-up alternative markets for food surplus and waste drawing on findings from empirical and regulatory research and on examples from domestic and international jurisdictions.
3. **Provide advice to industry and to government about consumer perspectives on upcycled food products including how best to develop consumer acceptance and adoption:** The regulations that currently influence food surplus and waste transformation are, in part, designed to facilitate consumer acceptance by building trust and safety. Understanding consumer perceptions of the issues with food products created from food surplus and waste transformation and understanding how best to communicate the benefits of these food products are essential aspects of supporting market growth and ensuring regulatory success.

To realise these aims, this project involved four stages:

1. **Phase 1:** The purpose of this phase was to comprehensively understand and evaluate barriers to upcycling food, and to related notions of food surplus and waste transformation. In doing this, this phase sought to identify opportunities and strategies to overcome these barriers. This involved: (a) a review of literature on upcycled food opportunities and barriers; and (b) semi-structure interviews with stakeholders.
2. **Phase 2:** The purpose of this phase was to understand how, and in what circumstances, law and policy could be improved or developed to enable upcycled food at both the state (Queensland) and Federal levels.
3. **Phase 3:** The purpose of this stage was to conduct case studies which capture the natural context and complexities faced by Australian businesses engaging in food surplus and waste transformation.
4. **Phase 4:** The purpose of this stage was to understand and evaluate consumer acceptance of upcycled food, facilitating recommendations for developing strategies to support consumer adoption of products created from food surplus or waste. To do this: (a) focus groups with Australian consumers were conducted to explore the factors impacting their acceptance of products created from food surplus or waste, followed by (b) a quantitative survey to test the generalisability of the findings from the focus groups with a larger sample of Australian consumers.

This report presents findings and key insights across all four phases of the project and is structured as follows.

First, information pertaining to Phase 1 is outlined. This includes a summary of the literature review, highlighting that state of current knowledge regarding upcycled food and key gaps in the literature. The method for the stakeholder interviews is then outlined, and the thematic findings from the interviews are presented. Key findings and recommendations based on this phase are also outlined.

Second, details relating to Phase 2 are summarised. This includes an overview of the legal and regulatory frameworks in Australia relevant to upcycled food, and areas of these laws which may have implications for the transformation of food surplus and waste. International frameworks, including upcycled food certification, are discussed, and key recommendations relating to this phase are noted.

Third, a summary of Phase 3 and its key findings is provided. Here, a brief overview of this phase is included, followed by the methodology utilised for this phase and the key themes noted across the five case studies. Again, this section offers a summary of the relevant conclusions and recommendations noted via this phase.

Fourth, insights related to Phase 4 are outlined. This includes an overview of the research methodology related to both the focus groups and online survey conducted as part of this phase, and the key findings resulting from this data. Drawing on these findings, insights and strategies that could be used to increase consumer acceptance of upcycled food are provided.

Fifth, the overarching findings from across the projects are summarised, followed by summary of the overall recommendations and areas for future research.

2. Phase 1: Literature review and semi-structured interviews

This section summarises findings from Phase 1 of the project; the literature review and stakeholder interviews.

2.1 Literature review

Most of the literature relating to food upcycling, food revalorisation, and food surplus and waste transformation originates from the natural sciences. As a result, the research to date has largely focused on technical avenues to developing new products from surplus and waste. In comparison, there is relatively limited academic literature on upcycled food from a social science perspective, and particularly, research which explores the regulatory and socio-technical environment for upcycling food. Given the purpose of the project, the literature review conducted as part of Phase 1 focused on what is known in the current social science-based literature regarding upcycled food. This section summarises key insights from the existing literature, however, more detail is provided in Report 1.

2.1.1 Defining upcycled food

Various terms have been used, often interchangeably, to describe this new category of food derived from food excess or waste often using novel approaches or technologies. These terms include 'upcycled food', 'food valorisation', 'food transformation', 'value-added surplus products', and 'waste-to-value'. Sometimes these terms refer to what can be understood as upcycled foods, and other times they refer to a different product or process (such as fuel creation). The 'upcycled food' terminology has gained traction in recent years, largely in part due to the work of the Upcycled Food Association in the United States, and is the term used in this report. As interest in upcycled food continues to grow, calls have been made to ensure upcycled food is clearly defined by academia, industry, and government (see, for example, Aschemann-Witzel et al., 2023; Bhatt et al., 2020; Moshtaghian et al., 2021; Thorsen et al., 2024). As Aschemann-Witzel et al. (2023) suggest, definitional clarity is needed so that boundaries of what is considered upcycled food can be delineated from other ways of using food waste (see also Thorsen et al., 2024).

The literature found that there is not one widely agreed upon definition of upcycled foods. However, what it did reveal is that any official definition of upcycled food should emphasise environmental and social value, given the role of upcycled foods in improving food systems outcomes including reducing waste and the potential environmental and social values consumers would ascribe to a food labelled as "upcycled". (see Aschemann-Witzel et al., 2023; Moshtaghian et al., 2021) While recognising the key themes from the various definitions of upcycled food – including waste, value, human consumption/use, and transparency – the project defines upcycled food as to foods or food by-products that would have otherwise been wasted that have been transformed so as to create a new ingredient or product that is intended for human consumption or use (see, also, Spratt et al., 2021). This may include, as per the Upcycled Certified® Program, food, a menu item, beverage, dietary supplement, companion pet food, cosmetic, personal care, and/or household cleaning product (Where Food Comes From, 2024).

2.1.2 Challenges or barriers to upcycling

While the academic literature on upcycling food is relatively nascent, it does already acknowledge a number of challenges associated with upcycled food, within the key themes of (1) definitional clarity, (2) consumer/public acceptance, and (3) business capability.

In relation to definitional clarity, a number of scholars have called for greater clarity regarding what is considered an 'upcycled food' and have argued that this is necessary to ensure that there is clear delineation of what is or is not an upcycled food (see Aschemann-Witzel et al., 2023; Bhatt et al., 2020; Moshtaghian et al., 2021; Thorsen et al., 2024). While significant progress has been made on this front in recent years, several areas of contention remain including the type of value that should be provided by upcycled food and whether upcycled food must result in a food product for human consumption. Another area of contention,

identified by Moshtaghian et al. (2021), is that upcycled food or ingredients can originate from food surplus, food waste, or food loss. Arguably, the distinction here is important, as this may impact whether or not upcycled food is seen to contribute to national and/or state food loss and waste targets, as well as the United Nations Sustainable Development Goal 12.3. In a similar vein, it is also unclear whether upcycled food is a key strategy for reducing waste and what role upcycled food must play to be considered a food waste reduction strategy. This lack of clarity has played out in discussions about where (if anywhere) upcycled food sits in the food waste hierarchy (see Aschemann-Witzel et al., 2023; Moshtaghian et al., 2021). The lack of clarity about what upcycled food is and under what circumstances it can be considered a food waste reduction strategy could undermine support for the sector. It may weaken the potential to build understanding among prospective investors and consumers, and could limit the kinds of public sector support that can be harnessed.

Public and/or consumer acceptance is the most commonly noted challenge to the upcycled food sector to date. This includes, but is not limited to, (1) a lack of understanding and awareness of upcycled food (Aschemann-Witzel et al., 2023; Perito et al., 2020; Thorsen, Nyhof, et al., 2022); (2) [negative] perceptions around safety and hygiene (Bhatt et al., 2020; Miroso, 2022); (3) [negative] perceptions around quality (e.g., taste) (Moshtaghian et al., 2021); and (4) the price of upcycled food (e.g. Moshtaghian et al., 2021), particularly when the upcycled food is considered more expensive than 'conventional' food.

Business capability – as a broad theme – emerged as another potential barrier or challenge to upcycled food. This theme includes concerns that there is a general lack of innovative businesses (Miroso, 2022). Further to this, it is also observed that start-ups are commonly involved in developing upcycled foods, and these organisations tend to lack experience dealing with vendors/retailers (Thorsen et al., 2021), as well as the capital and ability to scale up to produce economies of scale (Miroso, 2022). This latter point creates an intertwined problem: the lack of ability to scale up is often linked to higher prices (because economics of scale cannot be achieved), which in turn impacts consumers' willingness to purchase a product (and relatedly, retailers' willingness to stock the product (see Thorsen et al., 2021, 2022)). Beyond the individual business, a lack of collaboration between supply chains has also been noted as a barrier to upcycled food (see Do Canto et al., 2021; Rao et al., 2023). This lack of collaboration arguably impacts the sharing of information and ideas, which may in turn, limit opportunities to develop upcycled foods.

2.1.3 Opportunities and enablers of upcycled foods.

Much of the emerging literature to date related to the opportunities and enablers of upcycled food focuses on how to position upcycled food specifically (as opposed to other food categories) to consumers (e.g. Aschemann-Witzel et al., 2022; Aschemann-Witzel & Stangherlin, 2021; Bhatt et al., 2020; Hellali & Korai, 2023; McCarthy et al., 2020; Perito et al., 2020; Sharma & Deutsch, 2023; Taufik et al., 2023; Zhang et al., 2021). Certification was also an emerging area of note, with several scholars suggesting that it can play an important role in supporting and promoting the industry (see Miroso, 2022; Thorsen et al., 2022; Zhang et al., 2021). Finally, while it was noted that "collaboration and partnerships between upcycled food manufacturers, farmers, and other organizations throughout the food sector will be required to provide the necessary resources, facilities, and finance" (Thorsen et al., 2024, p. 7), and that regional and government support is needed, limited information is available about how this can be done effectively.

2.2 Semi-structured interviews

Given the limited research in this domain to date, and the fact that upcycled food is only just emerging in Australia, qualitative semi-structured interviews were conducted as part of Phase 1 to provide an in-depth exploration of the challenges/barriers and opportunities/enablers to upcycled food within the Australian context (ethical approval was obtained from QUT's University Human Research Ethics Committee (#6940)). In total, 15 participants agreed to be interviewed for the project. Participants included those who sold produce that was upcycled and entrepreneurs who manufacture upcycled food products (n= 12), as well as government

and non-government actors (n = 3). Of the 15, 13 participants were from Australia and the remaining 2 were from New Zealand. For more details about the recruitment and interview process, please see Report 1.

The following summarises the key findings from the interviews, focusing on themes relating to how participants understood or conceptualised 'upcycled' food and what they perceived to be the main barriers and opportunities impacting the upcycled food industry in Australia. While participants were not explicitly queried about unintended consequences and certification, these themes did emerge during the interviews, however, more information about these two themes can be found in Report 1.

2.2.1 Conceptualising upcycled food

Participants had varying views about what is – or is not – upcycling and/or an upcycled ingredient or food. Overall, the responses indicated a lack of clarity around what is considered an 'upcycled food'. While none of the participants described upcycling or upcycled food in exactly the same way, a common theme was that upcycled food was broadly about taking food and turning it into something else. Another common theme was the view that upcycling was connected to ensuring food was not wasted. The analysis also revealed some conjecture about what could – or should – be classified as 'upcycled', including whether or not (1) the term upcycling food could be used when the end product was not a food, (2) the 'end product' had to be 'food', and (3) if upcycled food is an ingredient or product. Some participants did express caution around using the term 'upcycled food' because it was a bit "gimmicky" (#6), because people "don't understand it" (#11, see also #13, #14), or that some companies were just jumping on the "bandwagon" by using the term when what they are doing is just "smart processing" (#14).

2.2.2 Barriers and challenges

The data revealed nuanced barriers and challenges related to upcycling food in Australia. These were categorised as relating to (1) food standards/regulation; (2) manufacturing capacity and capability; (3) lack of industry knowledge; (4) consumer awareness; (5) economic access to surplus food; (6) the 'value' of food; and (7) relationships and access to markets. Each are briefly discussed in the following paragraphs.

Participants identified food standards and related facility requirements as the most relevant regulations to upcycled foods; however, these were not commonly perceived as being a barrier or a challenge. Most participants identified food law and regulation as a necessary, beneficial, and conventional, albeit costly, part of running a food business, and did not identify any particular aspect as unnecessary or especially burdensome for upcycled foods. Some participants raised the topic of intellectual property, noting that this could lead to difficulties where manufacturers being contracted to produce an upcycled food lack capacity to ensure confidentiality and are unfamiliar with contractual terms regarding IP. Participants – especially those producing functional food that claims to have health benefits – also noted therapeutic goods regulation, highlighting a preference to align their products with the definition of food to fall within Australia's food regulation and thus avoid the application of therapeutic goods regulation. This preference was typically due to a lack of knowledge about the regime, or the costs, time, and complexity of therapeutic goods regulation compared to food.

Manufacturing capacity and capabilities were identified as a key barrier to upcycling food in Australia. In general, participants highlighted that potential manufacturers were either too large to assist with proof-of-concept or experimentation, while the few laboratories, namely CSIRO facilities, which would be suitable were difficult to secure owing to high demand and cost. Participants also noted difficulties with sourcing the right equipment needed to upcycle their various products in Australia.

Lack of industry knowledge was recognised as another potential barrier, with participants indicating that the knowledge and infrastructure requirements for upcycling food meant that it was not necessarily a natural transition from grower to upcycled food manufacturer. Indeed, most of the interviewed representatives of upcycled food companies did not have a background in

horticulture, but rather had a background in food manufacturing, and for many growers, the incentives to expand their business to upcycled food were not strong.

Consumer awareness, perceptions and education – or rather, the lack thereof – were, not surprisingly, also revealed to be a major barrier highlighted by the participants. Some participants expressed concerns that consumers would perceive upcycled food as being cheap, when in reality, the costs involved in manufacturing upcycled food, particularly for start-ups, meant this is generally not the case. Other participants highlighted the need for more consumer education around upcycled food, with some seeing a role for government in this space.

Other participants noted that upcycled food companies have issues obtaining economical access to surplus food. Findings revealed the type of access issue denoted by participants depends on whether they are using waste generated from manufacturing or whether they are seeking access to surplus fruit and vegetables. In the case of the former, for instance, the issues can centre around businesses wanting to keep the types and level of waste they are generating private. With regard to the latter, there is a cost in harvesting surplus fruit and vegetable, as well as existing contracts from growers to provide surplus as animal feed.

While not explicitly highlighted as a barrier or challenge, participants did identify some complexities around the value of surplus food or food that would be wasted in usual manufacturing which could be viewed as a potential challenge. This centred around how food surplus and food waste moves from having no value, and being more an economic burden, to having value once it has upcycling potential. For some upcycled food companies using food waste from other kinds of food manufacturing, this can be a challenge, particularly if the input, which was previously waste (and a likely cost), moves to being seen as valuable (because of its potential to be upcycled) by a manufacturer. This, in turn, may result in a price increase for that product, or the manufacturer may decide to upcycle it themselves. These types of situations highlight the somewhat precarious nature of the upcycled food supply chain and presents considerable risk to the upcycled food manufacturer in the event the upcycled ingredient becomes too costly to continue production. Other companies using surplus fruit and vegetable pay for the product from the start. While this is more of a fixed cost, the risk still exists that the grower will increase the price to a point that it is no longer economical to use it as an upcycled ingredient. Added to this, this type of supply chain – where the upcycled food comes from surplus – can also be precarious, in the sense that the upcycled food manufacturer has no guarantee of the quantities that will be available, or even supply.

Finally, while it was typically not mentioned explicitly as a barrier (or enabler, depending on how it is perceived) by participants, the need to establish relationships and/or collaborations with actors in the supply chain (i.e., growers who have the produce that can be 'upcycled' to retailers to stock the end product), as well as those specifically involved in upcycling, was recognised as being important. Some participants explicitly raised challenges associated with access to markets owing to the role and power of supermarkets, and noted that without the supermarkets stocking their product, they had limited access to consumer markets.

2.2.3 Opportunities and enablers

Participants identified a number of potential opportunities and/or enablers when asked what could support the upcycled food industry in Australia, though these were often linked to overcoming a perceived barrier. Specifically, the importance of funding, third-party enablers, the support of supermarkets, the potential for government procurement, the potential for mobile manufacturing, and the social and environmental motivations of upcycled food companies were highlighted by participants. These themes are briefly discussed in the following paragraphs.

Overwhelmingly, participants identified government grants for upcycled food start-ups as a key way to enable and support the upcycled food industry in Australia, however, participants generally also highlighted the difficulties they faced in accessing funding. This included having limited time and resources to put together the applications, and/or that they did not meet the criteria, such as

being ready to go to market. Some participants also suggested government procurement policies could play a role in supporting upcycled food and creating demand.

Third party enablers and the support of supermarkets was also noted by participants. Third party enablers included relationships with funders or seed programs who aim to connect those interested in upcycling (and have a viable idea) to those who have capacity to support, as well as networks or a facilitator who can help connect various actors within the supply chain to enable upcycling. Participants also noted that supermarkets, given their resources and access to market, would be well positioned to support upcycled food products and companies and help expand the industry.

Mobile manufacturing was suggested as a way to overcome some of the challenges associated with manufacturing upcycled food, particularly to process freshly harvested crops on farm and/or produce that would not typically leave the farm. However, others did not perceive this to be a viable solution, noting the potential cost, and/or lack of resources, including time, for primary producers to utilise this equipment.

Finally, the data suggested that sustainability-related motivations may be a key driver for upcycled food manufacturers. While this could motivate participation in food upcycling, participants did suggest that unless they can demonstrate the economic value of their activities, they may not be able to obtain the necessary funding to carry out their business. This points to a need to demonstrate the economic viability of upcycling.

2.3 Summary

The findings from the interviews echo many of the observations noted via the literature review. More specifically, both the literature review and the interviews with participants in the upcycled food sector highlighted definitional clarity, consumer acceptance and business capability as being potential barriers; whilst increased consumer awareness, funding, and certification were noted as potential enablers in both the literature review and/or interview data.

However, the interviews also pointed to a number of additional insights, nuances, and points of consideration in regard to potential barriers and enablers for the upcycled food industry in Australia, as outlined in more detail below.

In regard to potential barriers and challenges, it was noted that regulation is not seen as a current barrier for the upcycled food industry in Australia, particularly when the end product can be classified as food. However, some upcycled food can be described as functional food, in that it offers purported health benefits beyond conventional food (Temple, 2022). These foods exist somewhere between food and therapeutic good and thus fall into a grey area when it comes to regulation referred to as the food-medicine interface. If a food is a therapeutic good (a medicine), then it will be regulated by the *Therapeutic Goods Act 1989* (Cth), whereas food is regulated by the Food Standards Australia New Zealand, via [Australia New Zealand Food Standards Code](#) (the Code). Whether an upcycled product is regulated as a 'food' or as a 'medicine' depends on its individual qualities and factors such as whether it is likely to be taken for a therapeutic use (such as to reduce disease risk or influence a physiological process) and whether it has traditionally been consumed as a food in its current form (Therapeutic Goods Administration, 2022). Given the complexities of navigating therapeutic goods regulation, upcycled food producers will likely find it much easier to position the product according to the regulatory definition of food. However, if the product is more akin to medicine, then it should be regulated appropriately (Curl et al., 2016). A nuance to this finding, however, is implications relating to the lack of knowledge about therapeutic goods regulation, and particularly, the added costs and time needed to navigate this complex regulatory landscape. As a fairly nascent industry in Australia with predominately start-up organisations engaging in upcycled food, it is feasible to suggest that many would lack the knowledge and funds to navigate therapeutic goods regulation. On this point, however, it is worth acknowledging that the literature points to "food first, feed second, cosmetics last" approach" in relation to upcycled food and

ingredients (Altintzoglou & Aschemann-Witzel, 2024, p. 4), which highlights the position that where possible, upcycling should be used to produce food first, rather than goods that would fall under therapeutic goods regulation.

Manufacturing capabilities and capacity were noted as a key barrier for the upcycled food industry in Australia and will likely remain a significant challenge until there is more investment in manufacturing capabilities and capacity. Of particular note is that many existing facilities are too large to assist with proof-of-concept or experimentation, while the few laboratories, namely CSIRO facilities, which would be suitable are difficult to engage owing to demand and cost. Added to this, the desire of many upcycled food companies to protect their IP becomes more challenging when they are having to use shared manufacturing sites. On the point of manufacturing, assistance from a third-party who could connect upcycled food manufacturers with appropriate manufacturing facilities (and even help with access to/knowledge around surpluses available) was noted as being a potential enabler.

It was clear from the interviews that participants viewed 'upcycling' in different ways and to refer to different things. Whilst attempts have been made by the Upcycled Food Association in the United States to define upcycled food, there is a lack of guidance in Australia at present as to what constitutes 'upcycled food', including whether or not (a) the end product has to be for 'food' and (b) it is intended for human consumption. According to the Upcycled Food Association, an official definition is important for several reasons including to assist consumers, manufacturers and food companies to understand what upcycled food is and how to practice 'conscious consumerism', how to market products, and encourage companies to engage in these food transformation pathways. A clear definition may also assist in determining certification for upcycling and play a role in informing other regulatory instruments.

The need for government funding was seen as a key enabler to develop the upcycled food industry in Australia, but it was also viewed as a potential challenge paradoxically. For many participants, they did not have the time or resources to apply for government grants, or they were not able to apply for the grant because they did not meet requisite criteria (for example, related to being ready to go to market). This latter point, in particular, means upcycled food manufacturers need to invest considerable sums of their own money – or find private investors willing to take a risk on an un-tested product – to generate a proof-of-concept, which is likely to be a significant deterrent. While there are difficulties with creating schemes to support companies without a proof-of-concept or commercial-ready product, the "Beyond Cups" program in Queensland is an example of how government schemes can be designed to target small-scale start-ups without a proof-of-concept product yet, but with proven feasibility and potential (Queensland Government, 2024). This program involves extensive training, support, and feedback to start-ups before allocating funds to certain companies so that they can pursue proof-of-concept. This approach would be especially useful for upcycled food companies, as participants observed the importance of not only funding, but also business capacity-building support provided by their networks.

Some upcycled food products rely on a somewhat precarious supply chain, in the sense that the food surplus or waste required fluctuates (this is often referred to as the 'surprise chain' in that the types and/or quantity is not predetermined and/or guaranteed). This issue is inherent to the nature of upcycled food, but likely creates challenges in obtaining funding from investors or banks. Whilst food relief charities – many of which, depending on the definition, engage in upcycling food – have learnt to work with the 'surprise chain', such a supply chain is unlikely to be sustainable for a for-profit organisation. Further to this, as noted in the literature, if an upcycled food company were to move away from the 'surprise chain' to one that ensures a consistent supply, this may mean food is being produced just so it can be 'upcycled' (see Thorsen et al., 2024). When this occurs, as Aschemann-Witzel and co-authors (2023) suggest, the resulting product should no longer be labelled as upcycled.

Whilst it was noted above that the precarity of the supply chain may have an impact on an upcycled food manufacturer's business model, there were a number of other findings that emerged through the interviews that may also be relevant to the notion of business models. Economical access to surplus food, for example, is a key feature of some upcycled food businesses, that is, they

need economical access to surplus food from farms or manufacturing facilities to keep costs low and ensure their price remains attractive enough for consumers (and also at a price-point retailers are willing to stock). As the literature has highlighted though (see Altintzoglou & Aschemann-Witzel 2024) and as reflected by interview participants, there is a risk that upcycled food makes surplus food more economically valuable, and in turn over time, upcycling economically unviable.

Many of the participants interviewed for this study turned to upcycling because of altruistic reasons, not necessarily because there was a clear business case for upcycling, that is, a clear economic rationale for developing and manufacturing upcycled food. While not explicitly expressed by participants, there may be a need to highlight the business case for upcycling so that it has broader appeal to those who do not possess such an altruistic motivation.

Finally, while research has been done in international contexts to explore consumers' attitudes to upcycled food, this research does point to the need for further consumer studies in Australia to understand consumer's perceptions of upcycled food. This includes, but is not limited to, consumers': (a) awareness and understanding of upcycled food; (b) views on the key benefits and drawbacks of upcycled food relative to other food types; and (c) responses to, and likelihood of, the purchase of upcycled food.

In light of the findings from Phase 1 of the project, eight recommendations were suggested (more detail about each of these recommendations can be found in Report 1):

1. There is a need to develop a clear and shared definition of upcycled food by academic, industry, and consumers.
2. There is a pressing need for consumer studies relating to upcycled food in Australia.
3. Lifecycle assessment should be carried out to determine if a specific upcycled food is in fact 'sustainable'.
4. There is a need for improved manufacturing capabilities in Australia.
5. Government support/funding is crucial to help upcycled food manufacturers.
6. Consumer education will be needed to raise awareness about upcycled food.
7. Third-party facilitators play an important role in connecting actors interested in, and willing to engage in, upcycled food.
8. There is a need to establish a business case for upcycled food to help demonstrate economic viability.

3. Phase 2: Regulatory analysis

This phase of the project involved a legal and regulatory analysis of relevant regulation for upcycled foods with a view to understanding how law and policy could enable upcycled foods at state and federal levels. Here, it is important to note that in Australian law, there is currently no mention of upcycled food. This means that upcycled food has not attracted a specific set of laws, policies or other types of regulations that distinctly deal with this new food category. As a result, there are no specific legal barriers that directly target upcycled foods in Australia.

Regardless, several legal regimes regulate an upcycled product depending on the type of product. This includes: (1) food safety standards, (2) labelling, (3) novel foods, (4) therapeutic goods approval, and (5) food waste policies. The analysis conducted as part of this phase focused on whether these regulations pose a particular barrier to upcycled food products. Further to this, the research also incorporated an investigation into how upcycled foods have been regulated in other jurisdictions.

3.1 Analysis of the legal and regulatory landscape for upcycled foods in Australia

The following summarises the key findings from the regulatory analysis. More detail can be found in Report 2.

3.1.1 Food safety standards

With respect to food standards, findings from Phase 2 highlighted that relevant food standards for upcycled food include those specific to particular food products (e.g., required storage temperatures or ingredients for a specific type of food), types of packaging required (i.e., food-grade plastic), and labelling requirements (e.g., allergen labelling). Following a review of these standards, it appears that there are no specific food safety standards that would disproportionately burden upcycled food products. As such, existing food standards related to food safety do not seem to generally or directly hinder upcycling practices in Australia.

Nevertheless, it is important for upcycled food companies to identify the relevant standards and at what point in the food transformation process they need to be met. An illustrative example of this is bakery goods, and in particular, bread. Bread can be made using by-products from other food processes, such as beer brewing, and it can also be a key ingredient in upcycled food, such as using unsold bread to make breadcrumbs. There are specific food safety standards and labelling standards that apply to bread as a food product (See the Code, Standards 2.1.1 and 1.2.10). These standards relate to the environment within which the product was created, and the packaging and/or labelling associated with the product.

Further to this, as per the Code, Standards 3.1.1 (Interpretation and Application), 3.2.2 (Food Safety Practices and General Requirements) and 3.2.3 (Food Premises and Equipment) apply to all Australian food businesses regardless of whether they are commercial or home-based businesses. As such, the core standards for food safety do not vary regardless of the scale of the business. This is important for upcycling practices, as many upcycling start-ups initially operate on a small scale. The safety standards would apply to them the same as they apply to all other commercial and home-based food businesses. However, home-based businesses may be exempt from some requirements, including Standard 3.2.2 clause 17, and Standard 3.2.3 clauses 4, 10 and 14 (Food Standards Australia and New Zealand, 2016, pp. 204–210). These exceptions include: hygiene for food handlers—duties of food businesses, water supply, floors, and hand washing facilities. Any exceptions must be approved in writing by the appropriate enforcement agency.

In addition to this, most upcycled food companies will also need to obtain a local food business license. In Queensland, there are a few exceptions to the requirement for a food business license with the most relevant exceptions for upcycled food companies being the preparation of unpackaged snack food (such as, cakes and biscuits without cream or custard, confectionary, potato chips, nuts) and the sale of food by a non-profit organisation that meets the exemption criteria.

3.1.2 Labelling

There are two regulatory frameworks relevant to labelling—the Code and Australian Consumer Law.

Chapter 1 of the Code outlines the general labelling and information requirements relevant to all foods. Many of these requirements vary depending on the setting in which the products are manufactured, and no specific requirements exist for labelling upcycled food products. Chapter 2 of the Code outlines specific labelling and information requirements that apply to certain food products. Whether these labelling standards apply to upcycled food products will depend on the type of product and the setting in which it is being made available.

In accordance with Standard 1.2.4, upcycled food manufacturers would have to label all the ingredients in their product in descending order of weight, as well as allergens, and this would include the component that was upcycled. Any compound ingredients, that is ‘an ingredient of a food which is itself made from two or more ingredients’ (the Code 1.2.4-1(1)), must be listed on the product and either a full list of its specific ingredients provided in brackets within the ingredient list or all ingredients provided in the main ingredient list (*Competition and Consumer Act 2010* (Cth) sch 2 ss 18, 29, 33). For instance, breadcrumbs made from surplus bread would need to list all the ingredients contained in the bread as well as any additional ingredients added into the breadcrumb mix.

The length of an ingredient list when upcycling manufactured foods, such as bread and bakery items, may be problematic when limited packaging space is available. As the upcycled food industry grows, clarification of best practice when constructing the ingredient list for upcycled foods may be required. We consider labelling further in Part Two when certification is examined.

Further to this, any claims on a label, or related marketing material, are subject to the prohibitions on false, misleading or deceptive representations under Australian Consumer Law (Australian Competition and Consumer Commission, 2024). Upcycled food companies may claim that their product is ‘upcycled’ as well as other environmental claims such as ‘helps reduce food waste’ or ‘better for the environment’. The Australian Competition and Consumer Commission (‘ACCC’) has identified misleading or false environmental claims as an enforcement priority (ACCC, 2023). The ACCC has developed guidelines for businesses ‘Making environmental claims’ to avoid breaching the prohibitions on false, misleading or deceptive conduct (ACCC, 2023). Upcycled food companies making claims on products should follow these guidelines to avoid potential breaches of consumer law.

3.1.3 Novel food regulation

A novel food has two main elements: (1) a non-traditional food (2) that requires an assessment of the public health and safety considerations (the Code 1.5.1-1). Food upcycling is an emerging area within the food manufacturing and waste management hierarchy. Whilst it is new, it does not necessarily mean that an upcycled food product will satisfy the definition of novel and in doing so require pre-market approval. A non-traditional food is any food or substance that does not have a history of human consumption in Australia or New Zealand (the Code 1.5.1-1). A food can be non-traditional but not raise public health and safety concerns, and so not be “novel” under the regime. Given upcycled food products commonly use surplus from farms or by-products from food and drink manufacturing, and as such do not generally meet the definition of “non-traditional”. Thus, novel food regulation is not viewed as a barrier in the current market.

3.1.4 Therapeutic Goods Regulations

Unlike food which, as discussed, does not often require pre-market approval unless it is novel, medical and biological products require pre-market approval through the *Therapeutic Goods Act 1989* (Cth) administered by the Therapeutic Goods Administration (TGA) (*Therapeutic Goods Act 1989* (Cth) s 19). Generally, the standards required to be met for therapeutic goods compared to food are also more complex and costly. Most upcycled food products would not require TGA approval by virtue of being food

products (as opposed to being therapeutic goods), however, there may be instances where a food product is more analogous to a therapeutic good and in which case should be regulated by the TGA.

The analysis revealed that the distinction between food and therapeutic goods is blurred where a product designed to be eaten significantly focuses on its health benefits such as preventing a disease, influencing conception, or changing physiological processes (as per the definition of “therapeutic good” and “therapeutic use” in s 3 of the *Therapeutic Goods Act 1989* (Cth)). Moreover, there is potential for an upcycled food company, especially one using surplus fruit and vegetables, to extend into supplements, which may be regulated by the TGA. As such, if an upcycled food product is a therapeutic good then manufacturers will have to meet the standards for therapeutic goods, including obtaining a TGA license for their facility and meeting requirements around packaging and advertising (*Therapeutic Goods Act 1989* (Cth) Part 3-3 Manufacturing of therapeutic goods).

To aid in determining when product is a food versus therapeutic good, the TGA has developed the Food-Medicine Interface Guidance Tool (FMIGT) (2022). It is recommended that upcycled food manufacturers utilise this tool to ensure their product has the correct regulatory oversight and that they are not in violation of the *Therapeutic Goods Act 1989* (Cth).

3.1.5 Competition law

While there are no major aspects of competition law that would be problematic for upcycled food manufacturers, the analysis suggested that exclusive dealing practices should be considered, in that any contracting practices must ensure that they do not ‘have the purpose, or has or is likely to have the effect, of substantially lessening competition’ (*Competition and Consumer Act 2010* (Cth) ss 47(1), (10)(a)). For instance, upcycled food companies may be prohibited from entering contracts that require the company providing the by-product only sell it to them if such conduct is aiming to, has, or is likely to, substantially lessen competition (*Competition and Consumer Act 2010* (Cth), s 47(4)(b)). The reverse is also applicable: companies providing a by-product to an upcycled food company cannot legally require that the upcycled food company only obtain by-products from them or from a select group of companies where such requirements may substantially lessen competition (*Competition and Consumer Act 2010* (Cth), s 47(2)(d)).

3.1.6 Food waste policies

Analysis of food waste policies (see Report 2, Appendix C for more detail) revealed that there is an opportunity for future food waste policies to highlight the role of upcycled foods, as to date, upcycled food is not commonly mentioned or prioritised as a food waste strategy.

3.2 International upcycled food regulation

The analysis for Phase 2 did not identify any specific law dealing directly with upcycled foods in comparable jurisdictions to Australia or highlighted in legal literature, nor did it find any potential barriers associated with public international standards (e.g., Codex Alimentarius Commission) or regulation in other jurisdictions. Report 2 did, however, highlight the Proposed (at the time of writing) US Law, NO TIME TO Waste Act, noting that while such a law would not necessarily be needed in Australia, the proposed Act does create a legal definition of upcycled food, which could be useful. More specifically, a consistent definition of upcycled food is especially important in light of the need to ensure upcycled food claims relating to waste diversion and environmental impacts are accurate and appropriately communicated to consumers. Creating a legal definition may also foster consumer understanding and trust, which was identified as a challenge in Phase 1. However, there are many food categories that do not have a legal definition, for instance, meat and dairy alternatives or functional foods. As such, creating a legal definition of upcycled food would be a significant development in food law.

Further to this, it was noted that the current Upcycled Food Certification scheme, which is trademarked in the US and Canada, may be a model for Australia. Such a certification scheme may help with respect to verifying waste diversion claims and related environmental claims, and therefore ensure they do not run afoul of requirements under Australian Consumer Law around labelling.

3.3 Summary

Based on this analysis, key findings from Phase 2 are as follows:

1. No regulations in Australia appear to unduly burden upcycled foods. This aligns with findings from semi-structured interviews from Phase 1.
2. “Upcycled food” lacks a legal definition, which may hinder consumer trust and potentially creates a challenge for compliance with Australian Consumer Law.
3. The verification and accurate account of upcycled food claims, including claims related to waste diversion, is an increasingly important issue for the upcycled food sector.
4. There is some ambiguity about whether certain upcycled food products, especially those that are supplements and extracts, are a food or a medicine, which may create risk and confusion with respect to TGA requirements.
5. While there appears to be no laws specific to upcycled food in comparable jurisdictions, the US has a third-party certification scheme and a proposed law focused on public awareness regarding food waste that encompasses upcycled foods. The ongoing monitoring of laws related to upcycled foods in comparable jurisdictions is recommended.

4. Phase 3: Case studies

This phase of the project involved a case study analysis of five (5) Australian businesses engaged in food surplus and waste transformation. The purpose of Phase 3 was to capture the natural context and complexities faced by upcycled food businesses, profile examples of upcycled food businesses and gain insights into the quantity of waste that could be redirected towards upcycling. It sought to answer questions regarding how alternative markets for food waste and surplus transformation have emerged, what factors facilitated and enabled their emergence, and how regulators and other businesses can identify and facilitate future opportunities for food surplus and waste transformation.

Case studies were selected based on their involvement in upcycling with a specific focus on Queensland-based businesses or businesses upcycling foods produced in Queensland (ethical approval was obtained from QUT's University Human Research Ethics Committee (#8476)). They were also selected to ensure diversity among the sample with respect to: (a) the role taken in regard to upcycling (i.e., directly upcycling or facilitating upcycling); (b) purpose (profit and not-for-profit); and (c) size (small to large enterprises). Data included semi-structured interviews with staff in leadership roles within the selected organisations, site visits (where feasible), and publicly available information and any additional information provided by the organisation. Table 1 provides a brief snapshot of the case organisations as well as the unique features of the case. Further details about the organisations who participated in the case studies, data collection, and data analysis can be found in Report 3.

Table 1. Snapshot of organisations and their unique features

Case Study	Unique Features
Zest Element	Small-scale startup focused on fruit powders; strong emphasis on health benefits and local sourcing.
Second Squeeze	Acts as a facilitator for other businesses; combines sourcing, processing, and distribution; strong business acumen and infrastructure.
FareShare	Not-for-profit focused on food relief; large-scale meal production from donated surplus; unique logistical and funding challenges.
Montague Farms	Large grower with retail and export operations; piloted upcycled products (e.g., Rescue Pops); faced barriers in commercialisation and marketing.
Banana Feeds Australia	Animal supplement business using surplus bananas; export-oriented; exploring transition to human-grade supplements.

4.1 Key themes across the case studies

Report 3 presents each case as a standalone case study, and as such, the relevant information and/or themes presented does vary across the cases. For the purposes of this report, however, key themes that emerged across the case studies have been summarised.

4.1.1 Low-tech processing as a strategic advantage

The majority of the case study organisations predominately relied on relatively simple, low-tech food processing methods, as summarised in Table 2. This, in turn, helped to reduce start up and operational costs, facilitated scalability, and where required, enabled flexibility in sourcing and processing diverse inputs. Montague Farms, however, did face challenges in terms of upcycling plums, in that they needed to be de-seeded prior to being pureed. Given the volume of plums being pureed, this was outsourced to a facility that had the equipment to do this, however, this added additional costs which, in turn, contributed to a higher price point for the resulting product.

Table 2. Processing methods

Case Study	Unique Features
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Zest Element	Used standard food dehydrators and blenders to produce fruit powders and slices.
Second Squeeze	Relied on basic equipment like cold press juicers and filters for some products.
FareShare	Used conventional kitchen equipment to prepare meals from surplus food, though some specialised equipment was needed (e.g., freeze-drying, retort).
Montague Farms	Faced challenges with high-tech processing for Rescue Pops, which required transporting fruit to distant facilities for de-seeding and pureeing—highlighting the cost and complexity of more advanced methods.
Banana Feeds Australia	Used commercial-grade dryers, mills, and slicers, modified from overseas models to suit their needs.

4.1.2 Pre-existing expertise in food manufacturing

Each entity was founded or led by individuals who had prior experience in food manufacturing and processing (see Table 3) which, in turn, aided in the identification of upcycling opportunities, facilitated product development and operational setup, and assisted in gaining access to relevant networks and infrastructure.

Table 3. Previous experience

Case Study	Unique Features
Zest Element	Founder had experience in raw vegan food production and dehydrating fruit in the UK.
Second Squeeze	Team had over 20 years in fruit processing and distilling, allowing them to identify and act on upcycling opportunities.
FareShare	Founders came from catering, using leftover meals to create pastries for food relief.
Montague Farms	Leveraged its large-scale fruit production and on-site retail store to pilot upcycled products like apple paste and Rescue Pops.
Banana Feeds Australia	Founders combined farming and food processing expertise, enabling them to create a unique animal supplement.

4.1.3 Collaborative supply chain relationships

Upcycling efforts required coordination across the supply chain and/or strong relationships with multiple actors, as was evident, but nuanced, across all five cases. This is illustrated in Table 4. Overall, however, these relationships included sourcing surplus or waste inputs from farms, manufacturers, or retailers; partnering with other businesses for processing, distribution, and/or product development; and/or engaging with third-party facilitators and government bodies for support.

Table 4. Supply chain relationships

Case Study	Unique Features
Zest Element	Sourced cosmetically imperfect fruit from local farms via Facebook Marketplace and personal networks.
Second Squeeze	Acted as a facilitator, matching surplus ingredients (e.g., green banana flour, raspberry syrup) with manufacturers and buyers.
FareShare	Partnered with food rescue organisations and supermarkets to receive surplus food, but faced logistical challenges with farm donations.
Montague Farms	Collaborated with RMIT, Peters Ice Cream, and Woolworths to develop and distribute Rescue Pops.
Banana Feeds Australia	Provided bins to growers and paid for pickup, ensuring mutual benefit and stable supply.

4.1.4 Marketing challenges

Marketing emerged as a consistent challenge, with insights from the case studies suggesting that consumers often lacked understanding of upcycled products. Across the cases, questions also emerged about whether to promote environmental (benefits (versus health benefits) of upcycled products. There was also consensus that branding and product positioning were critical to commercial success. Table 5 summarises the nuances across the cases.

Table 5. Marketing challenges

Case Study	Unique Features
Zest Element	Shifted from promoting sustainability to focusing on health benefits after advice that “most people don’t care” about environmental claims.
Second Squeeze	Helped other companies develop marketing strategies but noted that branding and product positioning were critical.
FareShare	Did not market to consumers, but have faced challenges around competition for surplus food.
Montague Farms	Rescue Pops failed commercially, which the organisation felt was partly due to marketing that emphasised “rescue” rather than taste, nutrition, or dairy-free benefits.
Banana Feeds Australia	Focused on health benefits for animals rather than upcycling.

4.1.5 Values-driven motivation

While cognisant of the financial benefits, founders were often motivated by environmental sustainability, reducing food waste, and supporting agriculture and circular economy principles. This echoes findings from the interviews (Phase 1). Nuances from each case are summarised in Table 6.

Table 6. Motivation

Case Study	Unique Features
Zest Element	Founder was motivated by reducing waste and improving nutrition.
Second Squeeze	Emphasised financial sustainability across the supply chain.
FareShare	Operated from a rights-based perspective:
Montague Farms	Sought to reduce stone fruit waste and explored upcycling as a way to improve sustainability and product value.
Banana Feeds Australia	Aimed to support farmers and reduce waste.

4.1.6 Funding and support

Across the case studies, participants highlighted that access to grants and institutional support was crucial to enable research and development and support scaling and market entry. Participants did, however, note the need for more targeted funding, especially to support commercialisation.

4.2 Summary

In summary, all case studies underscored the importance of collaborations across supply chains, as opposed to one entity deciding to create an upcycled product and creating its own supply chain. Rather, the approach to engaging in upcycling is more about information gathering across the supply chain regarding the kinds of surplus, waste, and product ideas that may exist. While one entity might draw this together to form a product or outcome, there still needs to be a lot of support and engagement across the supply chain and situations where two or more entities work together to create a product are a useful model. This does underscore the role of third-party facilitators in ‘connecting the dots’, which was also a finding in Report 1 (see also Section 2.2.3 of this report).

Another commonality across the case studies, and which differed from Report 1, was the emphasis on low-tech manufacturing methods as opposed to food manufacturing techniques that required highly specialised equipment and knowledge. This kept costs low and improved the potential to increase scale. Potentially, then, a useful strategy is to focus on enabling upcycled foods that come about using low-tech methods. This may also carry the additional benefit of appealing to consumers seeking products that are less processed, as is also consistent with public health nutrition advice, though this would be dependent on consumer analyses (Thorsen, Skeaff, et al., 2022).

The case studies also illustrate the ways in which upcycled food businesses, and other entities engaged in upcycling, tend to emerge from actors with pre-existing food manufacturing knowledge and experience as opposed to, for instance, those actors focused more on production or retail. Perhaps this stems from the importance of relationships across production through to retail to develop an upcycled food product as well as the specialised knowledge required to manufacture a product.

Entities engaged in upcycling tend to share common values regarding resourcefulness (using resources that exist effectively) and sustainability (in the sense of mitigating environmental impact). Upcycling, or value-adding to foods that are surplus or going to be wasted, was often not conceived of as only a strategy to reduce waste but as something that needed to be developed in ways that ensured resource use across the lifecycle of the product was minimised. This suggests a broader conception of upcycling is developing. For entities looking to enable upcycling, it suggests that the criteria used to evaluate potential products should be broader and more complex in terms of the environmental impacts considered.

Finally, the marketing of upcycled food products emerged as a key area across most of the case studies with various strategies and insights being developed.

5. Phase 4: Consumer study

Consumer acceptance of upcycled food is a widely recognised barrier to the potential of upcycled food to reduce food waste. While there is emerging research that focuses on understanding the factors that support consumers' uptake of upcycled food, relatively little is known about Australian consumers' response to upcycled food. To address this gap, this phase involved six focus groups with 45 Australian consumers to explore factors that may influence their acceptance of upcycled food. Following this, an approximately nationally representative—on the parameters of age, gender (non-binary, female and male), and place of residence—online survey was conducted with 2,557 Australians to generalise the findings from the focus groups (See Report 4 for more details about the methodology). (Ethical approval was obtained from QUT's University Human Research Ethics Committee (#8538)).

In both the focus groups and survey, three different types of upcycled food were considered:

1. Upcycled food that comes from excess or surplus food. For example, a vegetable powder that is made from excess vegetables that farmers can't sell to supermarkets because they don't look perfect although they are edible.
2. Upcycled food that comes from food that is safe to eat but nearing its date label. For example, bread nearing/passing its date label reprocessed into breadcrumbs.
3. Upcycled food which uses food components or by-products that were previously thought to be inedible. For example, a snack bar made from coffee fruit, which is the cherry covering the coffee bean that is often discarded during processing.

The key findings from this phase of the project are summarised below, however, substantially more detail is provided in Report 4. The implications of the findings are also briefly summarised.

5.1 Key findings

This section focuses on the key findings from Phase 4, including consumers' awareness of and knowledge about upcycled food, consumer expectations of upcycled food, consumer perceptions of and intentions to purchase upcycled food, strategies to improve consumer acceptance of upcycled food and consumer education on upcycled food.

5.1.1 Awareness/Knowledge of Upcycled Food

The findings reveal that consumer awareness and knowledge of upcycled food are generally low, with only 31.7% of Australian consumers aware of the term 'upcycled food'. Awareness of upcycled food was higher in younger age groups, for males, and for those living in New South Wales and Victoria. Awareness levels in Queensland are approximately 28%.

Familiarity with the concept of upcycled food, even if participants were not aware of the term 'upcycled food', was also low. Of note, a significant proportion (50.9%) of participants that reported being familiar with the concept of upcycled food, misunderstood the meaning of the term. Many consumers thought that upcycled food referred only to surplus food donated to charities for distribution to those in need.

Nonetheless, once the concept was clarified in the survey, the term 'upcycled food' was preferred by 45.7% of consumers, indicating a general acceptance of the terminology. 'Rescued food', selected by 16.5% of participants, was the next most preferred term. However, the focus group data highlight that some consumers questioned whether upcycled foods needed to be labelled as such, for example:

I'm a bit conflicted. On one hand, I agree that consumers knowing more would be better. But on the other hand, I feel like ignorance might be bliss. Hearing the word 'upcycled', it doesn't bring the best initial impression image to my

mind. It sounds like a bit of a dirty word. Like, I'm eating food that—just offcuts, kind of thing. Then with that, that means I'd expect lower price, lower quality—all that kind of thing. If you really want to sell it, just sell it as a normal thing. Like we've mentioned, Vegemite, breadcrumbs, all those kinds of things, we don't think about them as upcycled products, but we just eat them. P7-M-18-24

5.1.2 Consumer Expectations of Upcycled Food

Consumers expressed a preference for upcycled food to contain over 50% upcycled ingredients to be labelled 'upcycled food'.

Over two-thirds of participants supported the upcycling of plant-based ingredients, while animal-based categories received the least support.

Participants were asked to select the food categories they consider suited to containing upcycled ingredients, with the option to select multiple categories. More than half of the consumers surveyed view breakfast foods, baked foods, snack foods, pastas, sauces, and soups as products they perceived to be suitable to contain upcycled ingredients (see Table 7).

Table 7. Food categories selected by participants as suitable for the reintroduction of upcycled ingredients

Food category	% of sample that selected food category
Breakfast foods (e.g., cereals, granola, porridge)	55.7%
Baked foods (e.g., biscuits, muffins, breads)	55.6%
Snack foods (e.g., sweet and savoury snacks such as cereal bars, crisps, crackers, sweets)	54.8%
Pastas (e.g., dry pasta, noodles)	54.6%
Sauces (e.g., jams, chutneys, pasta sauces)	54.0%
Soups (e.g., including broths and stocks)	50.3%
Drinks (e.g., smoothies, juices, soft drinks, alcoholic drinks)	36.5%
Dairy products (e.g., yogurts, cheeses, ice-creams)	29.5%
Meat products (e.g., chicken nuggets, meatballs, deli meats)	26.5%
Fish products (e.g., fish balls, canned fish)	22.6%
None of the above – I do not like the concept of upcycled food	13.5%

This is consistent with the focus group findings where participants reported varying levels of comfort with upcycled food determined in part by the type of upcycled product:

It would depend on what the product was. There are some products that I would eat upcycled and some that I probably wouldn't. P2-F-65+

5.1.3 Consumer Intentions to Purchase Upcycled Food

Purchase intentions were measured through three questions measuring the probability, likelihood, and willingness to buy upcycled food from 'extremely low' to 'extremely high' on a 7-point scale. Overall, on average, consumers demonstrated a slightly positive intention to purchase upcycled food generally (Mean=4.64, Standard Deviation=1.54). The research also found that younger (see Figure 1), female, and higher-educated consumers are more likely to purchase upcycled food.

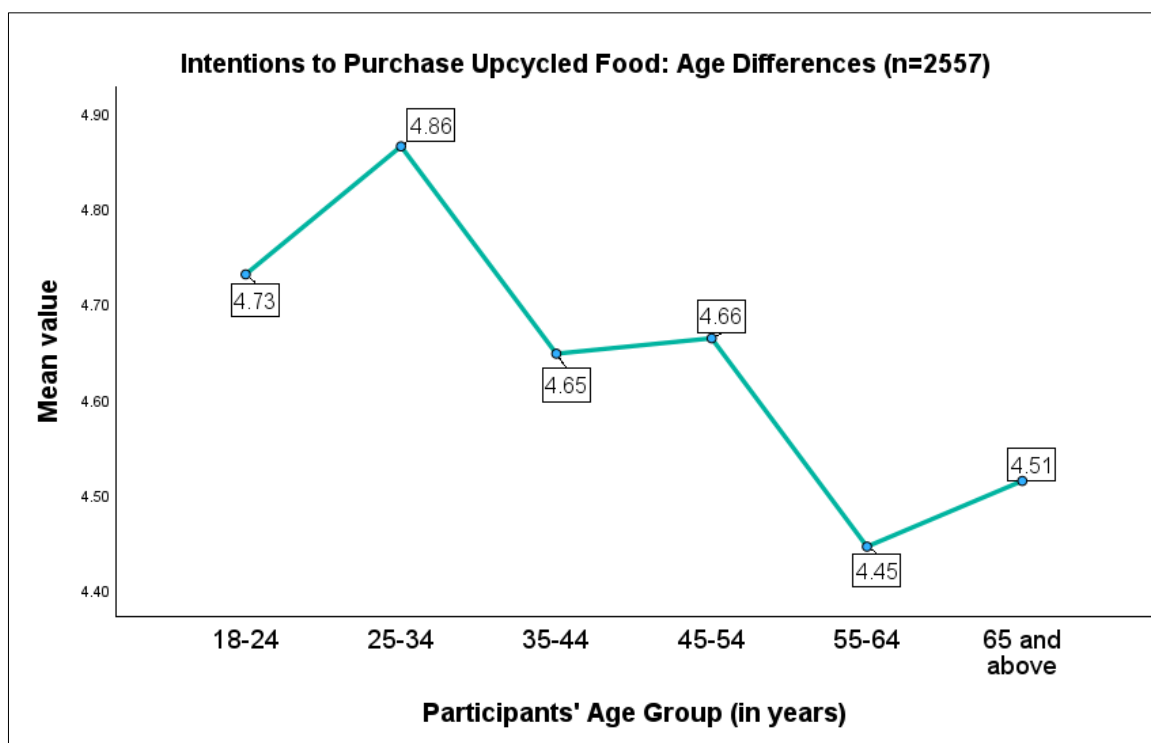


Figure 1. Intentions to purchase upcycled food: Age differences

Consumers intentions to purchase upcycled food made from surplus products (Mean=5.14, Standard Deviation=1.60) were higher compared to upcycled food made from ingredients nearing their date label (Mean=4.91, Standard Deviation=1.61) or food previously thought to be inedible (Mean=4.61, Standard Deviation=1.61).

5.1.4 Consumer Perceptions of Upcycled Food

Participants were asked to indicate their level of agreement that upcycled food provides environmental benefit and health benefit, and are high quality, taste good, lower cost compared to conventional food, and safe. These attributes were identified as potentially important to the consumer acceptance of upcycled food in the focus group findings and then measured using scales from extant literature (i.e., Moshtaghian et al. (2023) and Hellali & Korai (2023)). Their responses were measured on a 7-point scale ranging from 'completely disagree' to 'completely agree'.

Consumers generally thought upcycled food would offer environmental benefit over and be less costly than conventional food alternatives, while being safe to consume (see Figure 2).

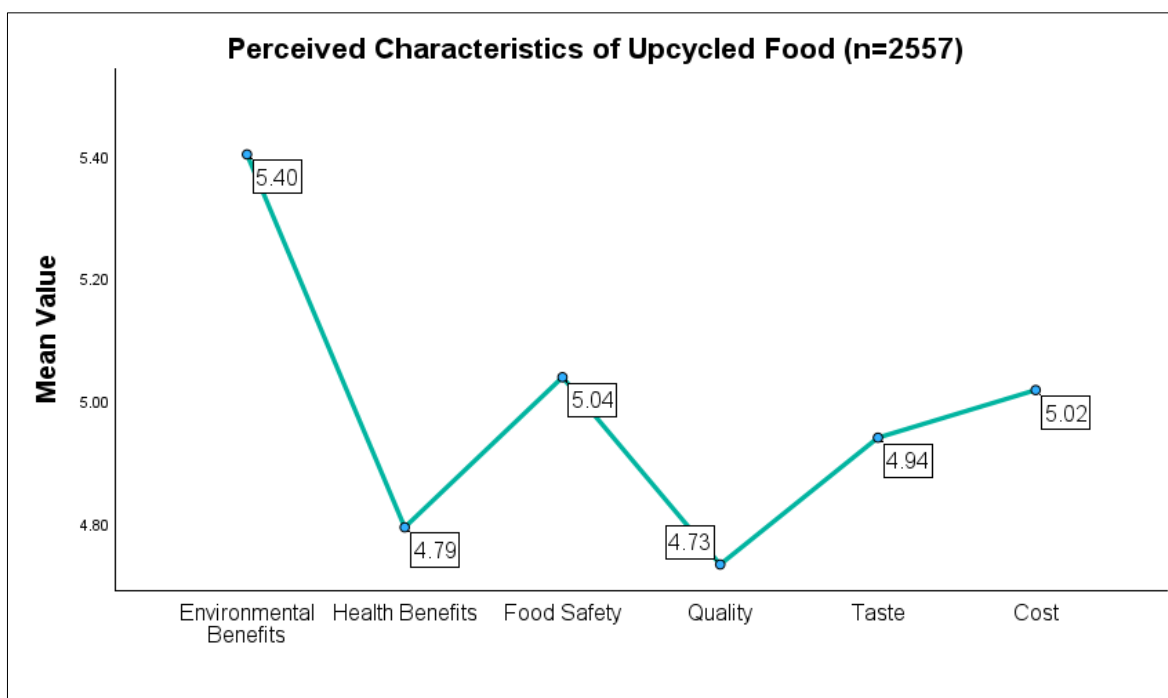


Figure 2. Mean comparison between different characteristics of upcycled food

The analysis of the focus group data revealed that some participants carefully considered the likely impact of upcycled food on waste reduction and more broadly the environment. One participant from the focus groups, as an illustrative example, discussed the need to understand the “whole-of-product-life” environmental impact of upcycled food—including the impact of reprocessing upcycled ingredients—in comparison with alternative uses of the waste:

I also think that with the benefits—you’re obviously talking about the reduction of waste. Then you might also be building on that and saying, lower carbon footprint. But then I think it’s also important to include transporting the by-products to waste facilities and maybe the water that’s involved. Then also the energy that’s involved, so the carbon footprint of that. How potentially it might even be better using this for something different, whether it be fertiliser or—I don’t know. That whole-of-life environmental impact assessment, I think would really come into use there as well. P2-F-18-24

However, while environmental benefit was found to support consumers’ intention to purchase upcycled food, it was not a strong determinant of consumers’ willingness to pay the same price for upcycled food as their conventional food counterparts.

Overall, there is a high level of price sensitivity among consumers, with many expecting upcycled food to be cheaper than conventional alternatives. To manage price sensitivity, the results suggest that enhancing the perceived quality of upcycled food supports consumers’ willingness to pay the same price as they would for conventional food:

I think the sacrifice is that people want the perfect thing, and they’re choosing to not have the perfect thing [upcycled food product] because there’s that social responsibility involved in it. So if they’re going to be having the thing [upcycled food product] and the thing is saving people from spending more money to make that thing, then we

deserve to not spend as much money on that thing, or at least the quality of that thing should be very good as well.

P1-F-35-44

5.1.5 Improving Consumers' Acceptance of Upcycled Food

Consumers identified several strategies they thought would increase their intention to purchase upcycled food including price discounting, clear labelling of upcycled ingredients in upcycled food products, an upcycled food certification program, a clearer definition of upcycled food, public education/advertising campaigns, and the availability of upcycled food in local supermarkets. Participants, on average, thought that all six approaches could improve their acceptance of upcycled food to some degree. In particular, consumers thought that price discounting and clear labelling of the upcycled ingredients in upcycled food would be most effective. Interestingly, the analysis of the focus group data also provides additional insight into what participants may have understood clear labelling of upcycled ingredients to constitute, highlighting the focus on the inclusion of ingredients rather than labelling the food itself as upcycled:

I guess how far away it goes from what's normal in that food item. So if you use the muesli bar example and you've gotten breadcrumbs and you've put it in there, that seems quite a normal thing to do, but if you've gotten, I don't know, crushed prawn shells put in there... fish scales, that's a bit of a further leap, so that labelling I guess should define how far from 'normal' it is. P2-M-35-44

The report highlights several considerations for the implementation of the aforementioned strategies to increase consumer acceptance of upcycled food. Certification programs, for example, need to consider consumer expectations that upcycled food should contain over 50% upcycled ingredients. In terms of public education/advertising campaigns, trusted sources of information for consumers that were identified include family, friends, research organisations, and government institutions.

Focus group findings highlighted that some consumers did not believe that advertising campaigns were necessary, suggesting a focus on education about food safety standards around upcycled food instead.

I'd like to see it on the policy end where it's just something that happens and we know it's regulated and it's safe. Personally, I don't think people will need to know [that they are purchasing upcycled food], necessarily... But it's not something that needs to be made a big flap about. It just happens and it's done, and it's regulated and it's safe, like many other things. P1-F-35-44

This finding could be related to consumers' expectation that they would encounter greenwashing about upcycled food. Greenwashing was explained to participants as: (1) making misleading environmental claims, (2) presenting pro-environmental information in a selected or distorted way, or (3) engaging in pro-environmental actions to cover up poor environmental performance. Participants were asked: 'How likely do you believe it is that you will encounter 'greenwashing' in relation to upcycled food?' Their response was measured on a 7-point scale from 'highly unlikely' to 'highly likely'.

When participants were asked about their perceptions of greenwashing in relation to upcycled food, their responses indicated a belief that encountering greenwashing is somewhat likely (Mean=4.94, Standard Deviation=1.39). This finding is consistent with insights from the focus groups.

It sounds like a bit of like a greenwashing word [upcycled food] I feel like. I don't know. It sounds like it's trying to guilt you into making a more socially conscious decision or something...like it's not always clear-cut that upcycled equals good. Unless I'm specifically aware of what in particular about that upcycled product—what are the benefits of it—

then I think just slapping on the label upcycled, it's not going to—it's probably going to make me annoyed at the product. P7-M-18-24

5.1.6 Education on Upcycled Food

Consumers on average were at least slightly willing to seek more information about upcycled food. Most of them wanted further information about upcycled food provided on the packaging of upcycled food (60.7%), on government websites (43.9%), on TV programs such as documentaries or investigative series (41.5%), and on retail signage (e.g., signage within a food retailer) (35.8%). Most consumers wanted to know more about food safety standards in relation to upcycled food (78.1%) and the type of ingredients used in upcycling (74.3%) with less interest in further information about the environmental benefits of upcycled food (57.9%) or the definition of upcycling (57.3%).

Participants were asked to rank 10 options in terms of who they would trust most to provide information about upcycled food (Figure 3). The results were relatively fragmented. In terms of the source of information selected most commonly as a first choice among participants, the largest proportion of participants selected 'family and friends' (17.8%), followed by 'research organisations' (15.6%), and 'government institutions' (12.8%).

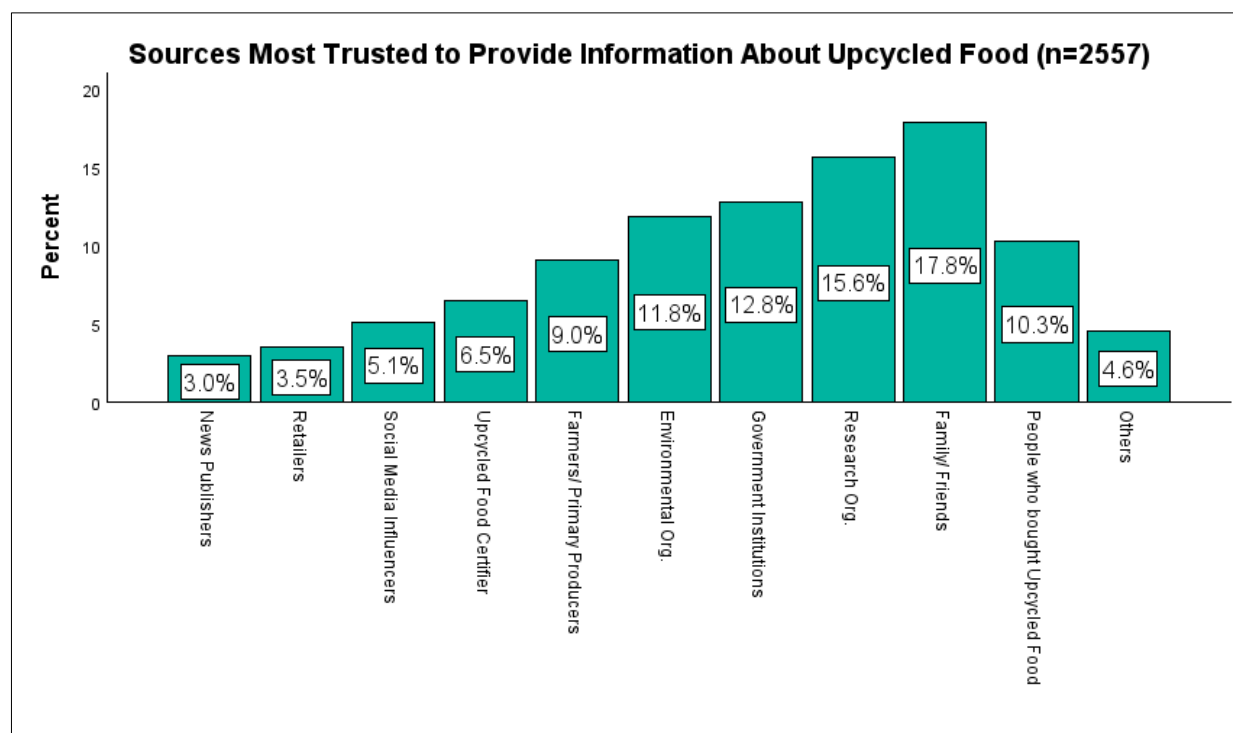


Figure 3. Sources most trusted to provide information about upcycled food

5.2 Summary

Overall, this phase of the project provided valuable insights for industry and government to develop strategies that enhance consumer acceptance and adoption of upcycled food products. It is important to note, however, that the insights provided are drawn solely from the findings of the research conducted and as such, the operational environment and other relevant circumstances should be taken into account when considering any of the recommendations provided.

Figure 4 provides a visual snapshot of the key findings from this phase of the project.



Figure 4. Visual summary of consumer study

Overall, the findings from this phase of the project revealed there is scope to improve consumer awareness and understanding of upcycled food in Australia. There was no strong evidence for using different terminology to describe the concept of upcycled food, with the largest proportion of consumers surveyed preferring this term. Consumers reported a positive intention to purchase upcycled food in Australia, particularly for 'upcycled food made from excess or surplus products, such as vegetable powder'. As such, there may be greater market demand for upcycled food products in this category. There may also be greater market opportunity in Australia for upcycled food made from plant-based ingredients from the following food categories: breakfast foods, baked foods, snack foods, pastas, sauces, and soups.

Considering the findings of the research together, one approach to promote the uptake of upcycled food may be to avoid explicitly labelling upcycled food as such, but to identify the upcycled ingredients in the list of ingredients on packaging instead. This approach could be supported by providing education around the concept of upcycling so that if consumers see the upcycled ingredients, they already understand and have access to information explaining that these products comply with food safety standards. This approach would leverage consumers trust in food safety standards (see Food Standards Australia New Zealand, 2024) to support consumer acceptance of upcycled food. Public education campaigns could focus on food safety, upcycled food

ingredients, and the process of upcycling in line with consumers' preference for this type of information. A key advantage of this approach could be that consumers would not expect a price discount because the food would not be labelled as upcycled.

Another approach is to emphasise the environmental benefits of upcycled food, as this was identified as a key driver of consumers' intention to purchase upcycled food. The disadvantage of this approach is that the perceived environmental benefit of upcycled food does not strongly support consumers' willingness to pay the same price for upcycled food as conventional food, which is problematic given that consumers generally expect to pay less for upcycled food. Any communication about the environmental benefits of upcycled food would also need to consider consumers' sensitivity to greenwashing and their sophisticated understanding of 'whole-of-product-life' environmental impact. However, consumers' pricing expectations could be managed in this approach either through subsidies or by emphasising the quality of upcycled food, which was found to support consumers' willingness to pay.

Government and research organisations were identified as trusted sources of information about upcycled food and consumers preferred that information to be provided on the packaging of upcycled food, government websites, TV programs such as documentaries or investigative series, and on retail signage (e.g., signage within a food retailer).

6. Overall findings

This section draws on the findings across Phases 1-4 to provide an overall summary of the key insights generated.

There is a need for the government to develop or endorse an official definition of upcycled food to establish consensus.

This finding emerged from Phase 1 and was supported across Phases 2 and 4 of the project. As noted in Phase 1, definitional clarity can provide clarification on what does – or does not – count as upcycled food, and in turn, the role it plays in the food waste reduction hierarchy. This is consistent with the findings from Phase 2 of the project, which acknowledges that policy integration is needed to include upcycled food in food waste strategies. Further, Phase 2 noted there is a proposed law in the US that seeks to legally define upcycled food, as well as the Upcycled Food Certification scheme that provides clarity around what can be considered an upcycled food and/or ingredient. Having a clear definition would be useful in terms of providing greater clarity from a regulatory perspective, particularly in terms of labelling – specifically to avoid potentially misleading consumers – and could potentially aid in determining whether an upcycled food/ingredient can be classified as food, novel food, and/or needs to be regulated via the Therapeutic Goods Administration as a medicine. It was suggested that a certification scheme, like the Upcycled Food Certification scheme in the US and Canada may be useful for Australia, however, such a scheme would need to be aware of consumer expectations (e.g., >50% upcycled content) in Australia as per the findings of Phase 4.

Lifecycle assessment should be carried out to determine if a specific upcycled food is in fact ‘sustainable’.

A finding from Phase 1 was that lifecycle assessment should be carried out to determine whether upcycling a food that would otherwise be wasted was in fact a more sustainable option, noting that the additional processing and ‘food miles’ may make the resulting product less environmentally friendly over other food waste reduction measures. This will become important if, in light of findings from Phase 2, environmental claims are made on the packaging of upcycled food. Any such claims would require verification to ensure compliance with Australian Consumer Law. In Phase 3, it was observed that the entities involved in upcycling often had a broader view of what makes a product sustainable that extended beyond upcycling. Support for this approach is also underscored via the findings from Phase 4, which noted that while Australian consumers generally perceived upcycled foods as environmentally beneficial, they are wary of greenwashing. Phase 4 also highlighted that some consumers themselves are aware of the need for a lifecycle approach to determining whether upcycled food is sustainable.

There are no specific legal barriers to upcycled food in Australia, however, the interplay between the laws that regulate food and those that regulate therapeutic goods adds complexity.

The fact that relevant laws were not generally or unduly burdening upcycled foods in Australia was a key finding of Phase 2 of the project and also echoed by participants in Phase 1. That being said, the regulatory and legal analysis did highlight that upcycled food manufacturers do navigate a complex legal landscape, which could partly explain why upcycled food businesses are often founded by individuals with prior experience in food manufacturing (as illustrated in Phase 1 and 3). Upcycled food manufacturers creating products designed to have particular health impacts face the additional difficulty of determining whether their product will be regulated as a therapeutic good or as a food. There is currently a grey area in relation to supplements, for instance, in that they can sometimes be labelled as a food and therefore do not have to go through the process of therapeutic good regulations. Participants in Phase 1 noted that therapeutic goods regulation was comparatively more time-intensive and costly. Any changes or clarifications to this area of law may have implications for upcycled food manufacturers who produce supplement-like products or products otherwise designed to have specific health benefits.

Current upcycling in Australia seems to rely predominately on low-tech methods that are scalable and cost-effective.

This was a finding noted in Phase 1 and 3 of the project. The benefit of these low-tech methods is that they are relatively scalable and cost-effective, but they may limit the types – and volumes – of products/ingredients that can be upscaled at commercial levels. In general, regulatory compliance is also less burdensome when low-tech methods are used. Participants in Phase 1 noted that the shortage of manufacturing facilities in Australia, both for proof of concept and capacity to upcycle food at scale, and the prohibitive cost of existing facilities, particularly for start-ups, are challenging. Hence, a key recommendation from Phase 1 was that there is a need for improved manufacturing capabilities in Australia.

Consistent access to surplus food may hinder the growth of the upcycled food industry.

This finding emerged from Phase 1 and was echoed by participants involved in Phase 3 of the project. Specifically, findings from Phase 1 noted challenges arising once a food or ingredient typically seen as a waste product starts to have economic value, and in turn, may become cost prohibitive. This is particularly important given findings from Phase 4, which found that Australian consumers are price-sensitive and expect upcycled food to be cheaper than conventional food. Phase 1 and 3 findings also highlighted potential challenges with securing ongoing and consistent access to surplus food required for a particular upcycled food/ingredient. The fluctuating levels of inputs make it challenging to have a consistent end product – in terms of flavour, taste, and supply – which in turn makes it harder to market and secure retail access. A solution to this, developed by various upcycling food companies, was to extend the shelf life of the ingredient via dehydration and other methods, though this required access to the equipment to do this at scale and appropriate storage facilities. Another way upcycled food businesses can address this difficulty is by having multiple products with some product lines relying on upcycled food ingredients with a relatively stable supply (e.g., yeast or bread) and other product lines amendable to seasonal fluctuations. Finally, upcycled food businesses with the capacity to transport and store food, as well as process it, may be able to adjust to fluctuations more easily than those who focus solely on processing.

Government support/funding is crucial to help upcycled food manufacturers.

Findings in Phase 1 and 3 underscored the importance of government funding to enable upcycled food. However, it was also noted that such funding is often inaccessible to small businesses for a variety of reasons, including limited resources and time to apply for the grants, and/or inability to meet grant criteria. Participants highlighted that fundings for early stages of upcycling, including proof of concept, would be beneficial. Government procurement practices could also be a way to facilitate the growth of upcycled food.

Consumer awareness of and knowledge about upcycled food is low and can be supported through consumer education.

Phase 1 of the project, through both the literature review and participants, indicated that consumer awareness about upcycled food in Australia is likely to be low. Phase 4 of the project quantitatively validated this proposition through a nationally representative survey (n=2,557) that found that only 31.7% of Australians are aware of the term “upcycled food” and that generally, knowledge about upcycled food was also low. Phase 4 also suggested that although there was some willingness by consumers to proactively seek out information about upcycled food, a structured and coordinated approach to disseminating information is likely required to improve awareness and knowledge levels. The findings demonstrated that most consumers wanted to know more about food safety standards in relation to upcycled food and the type of ingredients used in upcycling with less interest in further information about the environmental benefits of upcycled food (possibly related to concerns regarding greenwashing) or the definition of upcycling. The study also revealed that Australian consumers prefer information about upcycling to come from trusted sources of information, including research institutions and government, and that informal communication networks (i.e., family and friends) will likely play an important role in information dissemination.

Consumers’ price sensitivity is a key challenge for the economic viability of upcycled food, but it is possible to address through appropriate marketing strategy.

Phase 4 shows that although Australian consumers generally perceive upcycled food to be environmentally beneficial and safe, they are price-sensitive and expect upcycled food to be cheaper than their conventional food counterparts. As an illustrative example, a consumer would typically expect a baking mix marketed as containing upcycled bread to have a lower price point than a regular baking mix. This is consistent with the findings from the literature review in Phase 1. Phase 4 suggests that this expectation is related to consumer expectations that it would cost less to produce upcycled food and that the upcycled ingredients would be of lower quality. Consumers also indicated that they thought price discounting would be the most effective strategy to encourage their purchase of upcycled food. However, Phase 1 and Phase 3 highlight that the economic viability of producing upcycled food may not be as straight-forward as what consumers may believe and that upcycled food can be of comparable quality than their conventional food counterparts. One approach to addressing these market beliefs would be to educate consumers regarding the quality and cost of producing upcycled food. This type of approach aligns with the Phase 4 finding that the perceived quality of upcycled food (not its associated environmental benefit) was the strongest predictor of consumers' willingness to pay the same price for upcycled food as conventional food. Phase 4 also presents initial evidence suggesting that some consumers question the need to label upcycled food as such, which would by-pass the need to manage consumers' price sensitivity; however, further research is recommended to investigate any potential unintended consequences of this approach.

Consumer preferences for product types need to be considered in investments to grow the upcycled food sector.

Phase 4 suggests that there may be more inherent market demand for particular types of upcycled products. Consumers' intentions to purchase upcycled food made from surplus products were higher compared to upcycled food made from ingredients nearing their date label or food previously thought to be inedible. Over two-thirds of participants supported the upcycling of plant-based ingredients, while animal-based categories received the least support. More than half of the consumers surveyed view breakfast foods, baked foods, snack foods, pastas, sauces, and soups as products they perceived to be suitable to contain upcycled ingredients. Consumer preferences are important to consider for both government support/funding and individual upcycled food manufacturers – in addition to other factors highlighted in Phase 1 and Phase 3 such as the consistent availability of ingredients for upcycling and how easily those ingredients can be processed – because upcycled products in these categories may require less marketing investment to support consumer demand.

Third-party facilitators play an important role in connecting actors interested in, and willing to engage in, upcycled food.

This finding was noted in Phase 1 and also observed in Phase 3. Specifically, Phase 3 of the study highlighted that upcycled food businesses often relied on prior experience in food manufacturing and, as a result, existing relationships and networks. Correspondingly, Phase 1 found the lack of these prior relationships, experience, and knowledge as a key barrier. It found that getting started with upcycling is challenging for actors who are unable to connect the dots with other actors needed across their specific supply chains (e.g., access to surplus food that can be used for upcycled, manufacturers with the right equipment and/or technical expertise, access to the market). Thus, participants noted that third party facilitators – such as the work being done by Phase 3 case study organisation, Second Squeeze (see Report 3/Section 4) – are crucial for those wanting to explore opportunities for upcycling, particularly primary producers who have surplus food. Relatedly, this research found that growers are in a strategic position in the supply chain to use surplus foods, but may struggle to engage in upcycling as it requires a different set of skills, knowledge, connections, and technologies. In this instance, specific mechanisms, including third party facilitators, would benefit growers looking to exploit economic opportunities in their surplus produce.

There is a need to establish a business case for upcycled food to help demonstrate economic viability.

A theme noted across Phases 1 and 3 was that those currently involved in the upcycled food industry tend to upcycle surplus food predominately due to altruistic motivations. To grow the industry, and attract investment and funding, the economic viability of upcycled food products does need to be more firmly established. Lessons can also be learnt from the experiences of the case

study organisations involved in Phase 3. However, given the upcycled food industry is fairly nascent in Australia, the opportunity exists to showcase successful examples as the industry grows. It is recognised, however, that organisations (as was noted in this study) are reticent or unable to share their financial and waste diversion data, which may impede the ability to develop such business cases.

7. Recommendations

Based on the overall findings of this project, several recommendations are suggested, targeting industry and government/policy makers, as outlined below.

Key recommendations for government and policy makers

1. Develop a legal definition of upcycled food to establish a nationally accepted definition to guide regulation, potential certification, and marketing.
2. Provide guidance on navigating food versus therapeutic goods regulation.
3. Integrate upcycled food into food waste policy, to ensure upcycled food is recognised as a formal strategy in national and state food waste reduction plans.
4. Support and fund infrastructure and innovation, including shared manufacturing hubs for experimentation and small-batch production.
5. Provide funding support, including grants tailored to early-stage upcycled food ventures and pilots, as well as those targeting mentoring and business development programs. Consider existing market preferences when allocating funding (e.g., plant-based upcycled food).
6. Consider launching or supporting a national educational campaign to build consumer awareness and knowledge of upcycled food, which could focus on food safety, ingredient sourcing, and to an extent, environmental impact (keeping in mind consumers' concern regarding greenwashing). Consumers prefer information about upcycled food from sources such as research organisations and government.
7. Consider supporting a certification program, taking into account consumer expectations (e.g., >50% upcycled content), to help build trust in the industry.

Key recommendations for industry/industry associations

1. Be mindful of consumer expectations about upcycled food/ingredients (e.g., >50% upcycled content) in product positioning.
2. Focus on plant-based upcycled foods (e.g., breakfast, baked goods, snacks), which were considered more acceptable to consumers than animal-based ones. This may reduce marketing investment required to encourage consumer uptake.
3. Support consumer education by focusing on food safety and ingredient transparency, rather than abstract environmental messaging. If environmental messaging is used, consider the needs for lifecycle assessment to validate claims.
4. Avoid overemphasis on "upcycled" branding; instead, highlight quality of the upcycled product/ingredient to manage consumers' high level of price sensitivity.
5. Be mindful of therapeutic goods regulation, particularly for those products that emphasise a health benefit.
6. Invest in low-tech, scalable processing facilities, particularly those that can extend the shelf-life of surplus products and aid in a consistent supply source.
7. Opportunities exist for business to act as third party facilitators to connect actors and streamline logistics.

8. Identify partnerships across growers, processors, retailers and research institutions to support the development and innovation of the industry.
9. Share success stories and case studies to inspire adoption.

8. Conclusion and future research

Overall, the findings from this project suggest that upcycled food is a viable industry in Australia – including as a means to address food waste – but that it needs strategic support across regulation, infrastructure, funding, and consumer engagement.

Whilst this research sought to provide the first socio-legal investigation into upcycled food in Australia, there are several avenues for future research to further support the development of the upcycled food sector. This includes:

- Developing case studies of organisations who are successfully engaged in upcycling, though may not label it as such.
- Exploring the possibility of export to other, more developed markets for upcycled food.
- Exploring additional barriers that were not uncovered via the primary data collected for this study, such as waste and/or planning laws.
- Exploring what legal protections are needed for intellectual property in collaborative upcycling ventures.
- Exploring lessons that Australia can learn from jurisdictions with established certification schemes.
- Identifying what support mechanisms would enable growers (who are not currently involved in upcycling) to more easily participate in the upcycled food supply chain.
- Investigating levels of consumer acceptance of different types of upcycled food.
- Profiling potential target audiences for different types of upcycled food.
- Message/information testing of the information provided to consumers.
- Testing consumer price sensitivity for different types of upcycled food.
- Investigating what types of brands (e.g., startups vs. established) are most trusted to deliver upcycled products.

9. Impact and Ongoing Monitoring

While the nature of this project means the impact is not as easily measured nor direct, the findings of this project are likely to have positive impacts for the upcycled food industry. Specifically, the findings of this project provide a roadmap for regulatory reform, infrastructure investment, and consumer engagement, all of which can be used to help grow the industry and ensure a market for upcycled food products. For growers and manufacturers in particular, the findings highlight that valorising surplus food into waste does not necessarily have to come with significant capital expenditure; rather it is possible to use low-tech – and low cost – processing methods to valorise surplus food into upcycled products. Of particular note for growers and manufacturers is the findings from the consumer study. These insights should be used to inform marketing strategies to ensure consumer acceptance and uptake of upcycled food products.

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