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Phase 1 – Literature Review and Interviews

2.4.2 Accelerating Food Transformation

ENDFOODWASTE COOPERATIVE RESEARCH CENTRE

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Executive Summary

A new category of food products – "upcycled food" or "food waste valorisation" – has emerged in recent years as a solution to food waste. In essence, upcycled food involves the transformation of food surplus and waste into new, value-added products. Given the sheer volumes of food being wasted globally, upcycled food is being positioned as an important food waste prevention process (Thorsen et al., 2024). Upcycled food has recently been included in revised iterations of the food waste hierarchy (see, for example, Moshtaghian et al., 2021) and is being championed by the creation of the Upcycled Food Association in the United States and its subsequent Upcycled Certified® Program.

With an estimated ~2.96M T p.a. of food wasted in primary production and manufacturing (FIAL, 2021) in Australia each year, there are significant opportunities to convert food surplus and waste into upcycled food. However, there are a number of challenges currently facing the upcycled food industry in Australia. This includes no primary data about the overall opportunities and barriers to upcycled food; no understanding of the potential for regulation to hinder or support the industry; and limited information about consumers' responses to upcycled food within the Australian context. Collectively, these challenges significantly reduce the capacity of Australian industries to develop alternative markets using food surplus and waste. The overall aim of this project, Project 2.4.4 Accelerating Food Transformation, is to address these gaps.

This interim report focuses on the findings from Phase 1 of the project. Specifically, this phase involved a literature review and semi-structured interviews to explore the challenges/barriers and opportunities/enablers to upcycled food, with a particular focus on the Australian context. This research was conducted in accordance with ethics approval provided by QUT's Human Research Ethics Committee (approval number LR 2023-6940-16968).

As noted in the literature review within this report, the vast majority of 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 of developing new products from surplus and waste. The literature review presented in this report instead focuses on the emerging literature from the social sciences to gain a broader perspective about the challenges and barriers, as well as opportunities and enablers of upcycled food. The review notes that whilst work has been done by the Upcycled Foods Definition Task Force (2020) to define upcycled food, scholars are continuing to suggest that a harmonised and clear definition of upcycled food is required for academia, industry, and government (see, for example, Aschemann-Witzel et al., 2023; Bhatt et al., 2020; Moshtaghian et al., 2021; Thorsen et al, 2024). One reason definitional clarity is important is so boundaries of what is considered upcycled food can be delineated from other ways of using food waste (Thorsen et al., 2024; Aschemann-Witzel et al., 2023). The review also reveals a number of challenges that have been noted in the emerging upcycled food industry, including consumer/public acceptance and business capabilities. Much of the emerging literature focuses on how to position upcycled food to consumers, as well as the role certification and collaborations and partnerships can play. Importantly, the literature does highlight the potential for unintended consequences when it comes to upcycling food, with some scholars (e.g. Thorsen et al., 2024) cautioning against the assumption that upcycled food is the most sustainable option. Overall, a central argument within the existing literature is that upcycled food needs to be considered comprehensively (including social and environmental impacts) and on a case-by-case basis given the complexity of environmental and social impacts before conclusions can be reached about its positive contributions.

In addition to this literature review, this report highlights findings from 15 in-depth, semi-structured interviews conducted with upcycled food companies, government, and non-government actors. In a similar vein to the literature review, the purpose of these interviews was to explore participants' understanding of, and views regarding, the barriers and opportunities related to, upcycled food in Australia. A lack of clarity around how upcycled food can – or should be - conceptualised emerged as a key theme through the interviews. The unintended consequences of upcycling, as well as participants' views around certification, also emerged as

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themes. In regard to challenges and barriers specifically, participants highlighted manufacturing capacity and capabilities, lack of industry knowledge, consumer awareness, economical access to surplus food, the 'value' of food, and relationships and access to markets as key challenges or barriers. Importantly, food standards/regulation was not necessarily perceived as a barrier or challenge. However, participants highlighted that it is easier to navigate food regulation rather than therapeutic goods regulations, and thus it is easier to position an upcycled food product or ingredient as 'food', rather than a therapeutic good. In regard to opportunities and enablers, funding was a key enabler highlighted by participants, as well as assistance from third-party enablers, and having the support of supermarkets. The role of government procurement policies and mobile manufacturing were also suggested by some of the participants as potential opportunities. Interestingly, a number of the participants also highlighted an altruistic motivation for engaging in upcycling.

Building on the literature review and interviews with participants, the report highlights eight key recommendations to support and/or consider in relation to the upcycled food industry in Australia:

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.*

The next phases of this research will build on the preliminary findings of this research and will address some of the above recommendations by: (a) exploring the relevant regulation (and potential regularly barriers) (Phase 2); (b) creating case studies that showcase the business case for upcycled food (Phase 3); and (c) conducting focus groups and a national consumer survey to understand Australia consumers' perceptions of upcycled food (Phase 4).

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1. Introduction

A new category of food products has emerged as a solution to organic food waste in recent years. 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), and predicted by Forbes Magazine to have a market potential of US 46.7bn with a 5% compound annual growth rate (Shirvell, 2019).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 seeks 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 are:

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 will comprehensively review and evaluate 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 will determine 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 involves four stages:

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1. **Phase 1:** The purpose of this phase is to comprehensively understand and evaluate barriers to upcycling food, and to related food surplus and waste transformation, towards identifying opportunities and strategies to overcome these barriers. This will involve: (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 is 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 is 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 is to understand and evaluate consumer acceptance of upcycled food towards providing 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 will be 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 interim report presents findings from Phase 1. It details the findings from the literature review and stakeholder interviews. This report is structured as follows: First, the literature review is presented, highlighting that state of current knowledge regarding upcycled food and key gaps in the literature. Second, the method for the stakeholder interviews is outlined. Third, thematic findings from the interviews are presented. Fourth, a discussion is presented, bringing together key findings from the literature review and interviews. Fifth, conclusions and recommendations are outlined.

2. Literature Review

Food waste occurs at every stage of the food production and supply chain (Punia Bangar et al., 2024). Upcycled food, as a new food category, has emerged and gained traction in recent years (Aschemann-Witzel et al., 2023) – as exemplified by the creation of the Upcycled Food Association in the United States in 2019 and its subsequent Upcycled Certified® Program (Thorsen et al., 2024) –as one way to reduce food waste. Upcycling, in essence, involves repurposing or reusing food that would have otherwise been wasted (Altintzoglou & Aschemann-Witzel, 2024; Rao et al., 2021; Thorsen et al., 2024). Given the sheer volumes of food being wasted globally, upcycled food is being positioned as having positive sustainability impacts and recognised as an important food waste prevention process (Thorsen et al., 2024, p. 2), so much so that it has recently been included in revised iterations of the food waste hierarchy (see, for example, Moshtaghian et al., 2021, which is also illustrated in Section 2.2).

The vast majority of literature relating to food upcycling, food revalorisation, and food surplus and waste transformation, however, 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, and more specifically, Phase 1, the literature review outlined in this section highlights what is known in the current social science-based literature regarding upcycled food.

The starting point for the literature review was a basic key word search in both QUT's library database for academic literature, as well as in Google Scholar. Key words were identified based on the objectives of the project (specifically considering the terms "food transformation", "upcycled food" and "food waste") and included: 'upcycled', 'upcycled food', 'upcycling', 'food waste', 'food loss', 'food sustainability', 'food transformation', 'food supply chain', 'food valorisation', 'supply chain', 'valorisation', 'value-added surplus food'.

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This resulting literature review below includes overview of how upcycled food has been defined in academic literature; what is known about the challenges/barriers and opportunities/enablers to upcycled food; as well as the potential for unintended consequences to upcycled food. This section concludes by outlining directions for future research based on the current literature, and how this aligns with the various phases of this project.

2.1 Defining upcycling food

Besides '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 '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), when in fact, they may be referring to something else.

In regards to defining upcycled food, one of the most commonly used definitions is that proposed by the Upcycled Food Association (developed via a multi-stakeholder process by the Upcycled Foods Definition Task Force, 2020, p. 2 (hereafter 'Task Force')): "Upcycled foods use ingredients that otherwise would not have gone to human consumption, are procured and produced using verifiable supply chains, and have a positive impact on the environment". As outlined by the Task Force, there are five key elements of upcycled foods:

- **Element 1:** Upcycled foods are made from ingredients that would otherwise have ended up in any food waste destination.
- **Element 2:** Upcycled foods are value-added products.
- **Element 3:** Upcycled foods are for human consumption.
- **Element 4:** Upcycled foods have an auditable supply chain.
- **Element 5**: Upcycled foods indicate which ingredients are upcycled on their labels.

An important distinction here is that, as per Upcycled Food Association's definition, upcycled foods refer to the *end product*, and are made from *food products* or *ingredients* that go into *food products* for *human* consumption or use. This is perhaps best summarised by Aschemann-Witzel et al. (2023, p. 133), who, drawing on the Task Force's definition, highlight: "a food can be called upcycled food if it is: (1) a product consisting of or containing materials that otherwise would be *waste*, this material is (2) turned into a *food* product for human consumption, and this is done via (3) a process that involves an increase in *value*" [emphasis in the original]. Each of these italicised elements – waste, food, and value – will be discussed in more detail in the following paragraphs.

In regard to the element of *waste* in defining upcycled food, (see also Element 1 from the Task Force), Aschemann-Witzel et al. (2023, p. 133) outline three different origins for upcycled food, in that it can refer to: "foods made from surplus ingredients that would have been otherwise wasted" (Bhatt et al., 2018, p. 57) or "foods that are manufactured from ingredients that are by-products from producing another food product" (Bhatt et al., 2020, p. 3), or "foods that contain ingredients previously wasted in the supply chain" (Aschemann-Witzel & Peschel, 2019, p. 1)". This delineation lead Aschemann-Witzel et al. (2023) to suggest there are two types of upcycled food, which have "distinct roles in resource preservation" (Thorsen et al., 2024, p. 2): 'alternative use' and 'novel use'. 'Alternative use' is where edible food that would otherwise go to waste is transformed or upcycled into another food product,

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and therefore the resources that have gone into producing the food are preserved. Alternatively, 'novel use' is where parts of food not typically considered edible are transformed or upcycled into food products, and therefore the food resource base is broadened (Aschemann-Witzel et al., 2023; Thorsen et al., 2024). Of note here is that, as per the Task Force's view, a food or ingredient being diverted from waste into an upcycled food does not necessarily have to be initially intended for human consumption, but the upcycled food product itself does have to be for human consumption, as per the next point.

In regard to *food* as an element in defining upcycled food (see also Element 3 from the Task Force), the emphasis here is that upcycled food results in a food product or ingredient that is consumed by humans. Whilst there are legal definitions of food, food is defined broadly in the Upcycled Food Association's definition and is taken to mean anything that provides nutrition (Upcycled Food Definition Task Force, 2020). This also means any products that are upcycled for use in animal feed (and thus have exited the human supply chain) or result in non-food products that are for human consumption, such as cosmetics, are not, according to Upcycled Food Association, classified as 'upcycled food' (see Upcycled Foods Definitions Task Force, 2020). While upcycled food has been discussed under terms like "waste-to-value, value-added-surplus products, or side-stream valorization" (Aschemann-Witzel et al., 2023, p. 133; see also Bhatt et al., 2020; Moshtaghian et al., 2021), these terms also capture the upcycling, upscaling, transformation and/or valorisation of food into non-food products including animal feed, cosmetics, therapeutic goods, biofuels, and bioproducts (see, for example, Di Fraia et al., 2024). Therefore, the definition used by the Upcycled Food Association is much narrower because it focuses only on food products.

The *value* element to defining upcycled food is generally not interpreted as referring to purely economic value, though this notion of what is considered 'value' does range across the literature. For example, because upcycled foods move food (or ingredients) up the food waste hierarchy, its value, as per the Upcycled Food Association's definition, is dependent upon its environmental impact (see also Aschemann-Witzel et al., 2023). While noting the environmental value, Moshtaghian et al. (2021, pp. 1–2) also highlight the economic value of upcycled foods: "The production of upcycled foods is beneficial to the environment as it helps to repurpose food, that would otherwise be wasted, as a value-added food product. Value-added foods are foods that are produced, processed or altered in a manner that increases their economic value". More recently, Thorsen et al. (2024) acknowledge upcycled food has positive value (or negative, depending on the product and viewpoint) not only environmentally and economically, but also socially. Taking a slightly different perspective, Aschemann-Witzel et al. (2023) also note value may refer to nutritional value, in the sense that the resulting ingredient or food product creates a higher nutritional value. However, it is worth noting that Thorsen et al. (2022) has critically examined upcycled foods that are discretionary foods (e.g., biscuits, confectionary, chips) and suggests that these types of upcycled foods may actually be deficient in nutritional value. The Task Force has a narrower conception of value as simply economic value related to processing, explaining value as:

> *Diverted ingredients do not become upcycled foods until value is added to them in the sense of being processed or transformed into a new product. For example, whole produce that is retrieved from a field or diverted from a landfill where it would otherwise have gone to waste is a diverted ingredient, but until that ingredient is processed in some way or added to other inputs to create a new product, that ingredient is not an "upcycled food" for marketing and labelling [sic] purposes.*

While the previous paragraphs explain Elements 1-3 listed above, it is also important to elaborate on Elements 4 and 5, which highlight the need for upcycled food to come from auditable supply chains (Element 4) and clearly specify which ingredients or foods are upcycled on their labels (Element 5). Both points highlight the importance of transparency within the upcycled food domain, though may also be linked to food safety and ensuring the provision of accurate information to consumers. In regard to auditable supply chains, the Task Force (2020) stress it is important for upcycled food manufacturers to 'prove' that the diverted ingredient or food would have ended up in a food waste destination so as to capture the degree of waste reduction and any associated environmental impacts, and also so that it can be labelled as an 'upcycled food'. In a similar vein, the Task Force (2020)

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posits that disclosing how much of the ingredient or food is upcycled on labelling should be done in order to avoid or reduce confusion and misunderstanding for consumers.

A key point to note here is that is not clear in the current academic literature how much of an ingredient or product needs to be upcycled for the resulting product to be classified or defined as 'upcycled food'. However, according to the Upcycled Certified® Program (developed by the Upcycled Food Association), this depends on the 'type' of upcycled food or ingredient and the resulting classification: 'ingredient', 'product', or 'minimal content'. More specifically, as per the Program guidelines, an 'upcycled ingredient' must have greater or equal to 95% of upcycled inputs by weight; a 'product containing an upcycled food ingredient' must have greater or equal to 10% of upcycled input(s) or meet the threshold for total tonnage diverted; and 'products with minimal upcycled content' are those that have less than 10% upcycled input(s) by weight or contain content less than the threshold for total tonnage diverted (Where Food Comes From, 2024).

Interestingly, while the Upcycled Food Association's definition focuses specifically on food for human consumption and thus refers to upcycled food as the end product, the Upcycled Certified® Program adopts a much broader scope. It certifies *upcycled food ingredients and products* that have been "procured and produced with surplus food or food by-products from manufacturing, that use verifiable supply chains and have a positive impact on the environment" (Upcycled Food Association and Foundation, 2023, para. 1). Thus, the Upcycled Certified® Program shifts the definitional emphasis from the *end product* being classified as upcycled food (which is reflected in much of the current literature), to upcycled food referring to the food that is *transformed or upcycled in some way to create a value-added product*. Hence, the end product may not necessarily be food certified as 'upcycled'. This is further illustrated in how the 'product' type within the upcycled certification is explained, in that it "[i]ncludes, but is not limited to, a food, menu item, beverage, dietary supplement, companion pet food, cosmetic, personal care, or household cleaning product that includes Inputs and is intended for human use/ consumption" (Where Food Comes From, 2024, p. 13).

Finally, in contrast to the narrower and frequently cited definition adopted by the Upcycled Food Association, Spratt et al. (2021) used a Delphi method to develop a definition of upcycled food, drawing on a sample of 12 expert practitioners or manufacturers of upcycled food, all of whom were members of the US Upcycled Food Association. Via this study, the following definition of upcycled food was proposed: "Upcycled ingredients and food products elevate food that would otherwise be wasted to higher uses and have tangible benefits to the environment and society" (Spratt et al., 2021, p. 491). This definition proposed by Spratt and colleagues takes a broader view of upcycled food, in line with the Upcycled Certified® Program, as it conceives upcycled food not by the end output (i.e. whether it is converted into food) but as an input into a process (i.e. whether it is being used to make something else). Thus, the resulting product may not necessarily be a food, but also other products designed for human use, as per Upcycled Certified® Program's explanation of an upcycled 'product' (Where Food Comes From, 2024). However, Spratt and colleagues' definition also explicitly emphasises the need for upcycled food to provide non-economic value (i.e., social and environmental value) and does not place the same emphasis on verification and transparency, though this may be implied. Of note too, is that as part of the Delphi study "most, but not all, of the participants thought about upcycled food products as being meant for human consumption rather than animal consumption" (p. 490). However, by not including human consumption in the definition, this does result in alignment between Spratt and colleague's (2021) definition with the Upcycled Certified® Program, which explicitly references companion pet food as an upcycled product. Arguably though, the broad nature of Spratt et al.'s (2021) definition means that some may suggest that ingredients and products classified as upcycled may also result in animal feed, as this does result in elevating "food that would otherwise be wasted to higher uses" (p. 491). The revised food waste hierarchy by Moshtaghian et al. (2021) (see Figure 2 in Section 2.2) which explicitly includes upcycled food production may go some way in addressing this problem though, as it acknowledges that upcycling food sits above animal feed on the food waste hierarchy.

This review shows that there is no one widely agreed upon definition of upcycled foods. Regardless, any official definition of upcycled food should emphasise environmental and social value, given the role given to upcycled foods in improving food systems

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outcomes including waste and the potential environmental and social values consumers would ascribe to a food labelled as "upcycled". While recognising the elements noted in this section about waste, value, human consumption/use, and transparency, we adopt and draw on the broader definition of upcycled food proposed by Spratt et al. (2021) in this project, and particularly for the purposes of recruiting interview participants. In doing so, we posit that upcycled food refers 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. This may include, as per the Upcycled Certified® Program, food, a menu item, beverage, dietary supplement, companion pet food, cosmetic, personal care, and/or or household cleaning product (Where Food Comes From, 2024).

2.2 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, with the key themes of definitional clarity, consumer/public acceptance, and business capability emerging in the literature. These will be discussed briefly below.

2.2.1 Definitional clarity

As outlined in Section 2.1, a number of scholars have called for greater clarity of 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, the previous section illustrated several areas of contention 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 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). As a reflection of this, upcycled food is not included in Australia's National Food Waste Strategy (Australian Government, 2017), but it is included in the Stop Food Waste Australia (now End Food Waste Australia) Strategic Plan (2021), as illustrated in Figure 1. This placement by End Food Waste Australia differs to the recommendation from Moshtaghian and co-authors (2021), who propose that upcycled food should be positioned below redistribution (similar to repurpose in Stop Food Waste Australia's hierarchy), so as to recognise that upcycling typically required further inputs that come with additional economic, environmental, and/or nutritional costs (see also Thorsen et al., 2024) (see Figure 2). This area of contention is perhaps best summarised by Altintzoglou and Aschemann-Witzel (2024), who state: "One of the known challenges of upcycling is that food waste reduction and better utilisation of resources are perceived differently by the various stakeholders with relevant responsibilities in the food systems" (p. 2). To illustrate this point, for example, it is possible that some stakeholders do not see the additional economic and environmental costs that may be needed to upcycle a food as an acceptable trade off to reducing food loss or waste. Alternatively, others may see that the surplus food is better donated to people experiencing food insecurity, rather than being used to create an alternative product. Besides differing perspectives on food waste reduction, it is also the case that there is significant variety amongst upcycled food products in terms of types of waste and surplus used, level of processing and additional input requirements, and type of end products, which also makes it difficult to designate upcycled food a particular spot in the hierarchy.

The lack of clarity about what upcycled food is and under what circumstances it can be considered a food waste reduction strategy likely undermine support for the sector. It may weaken potential to build understanding among prospective investors and consumers, and limit the kinds of public sector support that can harnessed.

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Figure 1 (left hand side). Food and drink material hierarchy (source: Stop Food Waste Australia, 2021).

Figure 2 (right hand side). Food waste management hierarchy (source: Moshtaghian et al., 2021).

2.2.2 Consumer acceptance

Public and/or consumer acceptance is the most commonly noted challenge to upcycled food to date. While research suggests that consumers are open to purchasing upcycled foods (Goodman-Smith et al., 2021), barriers impacting consumer acceptance include:

- Consumers' lack understanding and awareness of upcycled food (Aschemann-Witzel et al., 2023; Perito et al., 2020; Thorsen, Nyhof, et al., 2022).
- Consumers can experience food neophobia (fear of unfamiliar food) and food technology neophobia (fear of unfamiliar food technologies) (Bhatt et al., 2020), which is linked to the previous point, as well as to the fact that most upcycled food manufacturers to date are typically small/entrepreneurial businesses, and thus are 'unknown' to consumers (see also Thorsen, Nyhof, et al., 2022).
- Consumers' [negative] perceptions around safety and hygiene (Bhatt et al., 2020; Mirosa, 2022).
- Consumers' perception that upcycled ingredients are of poorer quality (Bhatt et al., 2020; Thorsen et al., 2021; Thorsen, Nyhof, et al., 2022; Zhang et al., 2021), as well as perceptions around quality (e.g., taste) more broadly (Moshtaghian et al., 2021).
- The price of upcycled food (e.g. Moshtaghian et al., 2021), particularly when the upcycled food is considered more expensive than conventional food, given research suggests that consumers do not feel that upcycled foods should be more expensive (Peschel & Aschemann-Witzel, 2020). Price is closely linked consumers' perceptions regarding the perceived quality of upcycled food, however, it also has implications for upcycled food manufacturers grappling with economies of scale, which necessitates higher pricing models for profitability.
- Sociodemographic characteristics (such as gender, age, income, and education) that influence consumers' acceptance of upcycled food (Aschemann-Witzel et al., 2022; Moshtaghian et al., 2021).
- Consumers' beliefs related to upcycled food, including around food waste management, sustainability, environmental concern (Moshtaghian et al., 2021)

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- Concerns about the perceived usefulness of technology being used to generate upcycled food in terms of its positive impact on the environment (Hellali & Korai, 2023)

There is also emerging research examining retailers' perspectives and recommendations associated with upcycled food (see Mirosa, 2022 Thorsen et al., 2021, 2022). While this largely points to issues linked to consumer acceptance, it does acknowledge the gatekeeping role retail managers play in getting products on shelves (Mirosa, 2022 Thorsen et al., 2021, 2022) –a point that is particularly important in the Australian context given the supermarket duopoly.

2.2.3 Business capability

Business capability is also another area that has been considered an emerging issue for expanding upcycled food production and consumption. This refers to concern that there is a general lack of innovative businesses (Mirosa, 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 (Mirosa, 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.

Finally, it is worth explicitly highlighting the work of Rao and co-authors (2023) in regard to challenges or barriers of upcycled food, as their paper identifies a number of additional challenges/barriers – which may also be linked to opportunities for upcycled food – based on interviews with actors in the Netherlands food supply chain. As illustrated in Figure 3, interviews identified challenges (or opportunities, depending on how these are viewed) related to upcycled food. While this includes local embeddedness, food safety, and societal perceptions, which broadly align with the points noted above, of particular note here is consideration of ethics (and notably competition for surplus food – for example, where it is redirected from animal feed) and coping with uncertainty (particularly around governance and legal gaps). While Rao et al.'s (2023) suggests these challenges can be overcome, the opportunity exists to examine these issues and opportunities more deeply, and in an Australian context specifically.

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Figure 3. Challenges/opportunities for upcycled food in the Netherlands (source: Rao et al., 2023)

2.3 Opportunities and enablers of upcycled food

While the challenges above may also present opportunities for upcycled food manufacturers, 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). This literature will be explored more thoroughly in Phase 4 of the project, however, is it worth noting that, at present, there are a very limited number of studies in the Australian context.

Certification is also an emerging area of note, with a several scholars suggesting that it can play an important role in supporting and promoting the industry (see Mirosa, 2022; Thorsen et al., 2022; Zhang et al., 2021). As Thorsen et al. (2022) in particular note, certification was perceived by retailers as a useful mechanism for consumer education, quality assurance, and to assist in avoiding claims of greenwashing.

In response to challenges associated with the supply chain, Thorsen et al. (2024) suggest 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” (p. 7), but as yet, limited information is known about how this can be done in a practical sense. Further to this, Thorsen et al. (2024) also note that “[n]ational and regional government support via subsidies, investment in research and development, and public-private collaborations will also help to facilitate the transition to a circular economy”, but

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what these subsidies and collaborations look like in practice and how they can enable upcycled food production remain largely unexplored to date.

2.4 Unintended consequences

While upcycled food is largely promoted as a way to bring about positive environmental, social, and economic impacts, scholars have also pointed out the potential for negative and/or unintended consequences and have cautioned against the simple assumption that upcycling food is a sustainable option. Thorsen et al. (2024), for example, offer a useful visual summarising the potential positive and negative sustainability impacts of upcycled food (see Figure 4).

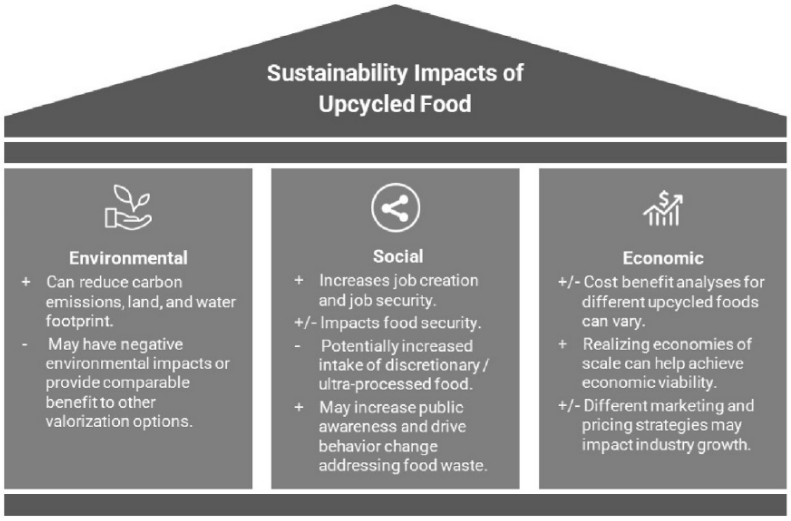

Figure 4. Positive and negative sustainability impacts of upcycled foods (source: Thorsen et al., 2024, p. 5)

In regard to environmental impacts specifically, the nature of upcycling means that extra resources are typically needed to transform the food surplus/loss/waste into an upcycled product. This, in turn, may make the upcycled ingredient/product less resource efficient (both environmentally and economically) than other avenues of food loss and waste prevention (e.g., food rescue and donation) (see Aschemann-Witzel et al., 2023; Thorsen et al., 2024). Such a perspective led Aschemann-Witzel et al. (2023) to suggest that upcycled food needs to be evaluated on a case-by-case basis to ensure that they are best utilising resources. This also aligns with work by Melikoglu (2020), who found that some food valorisation techniques may in fact create more environmental damage than benefit. In turn, Thorsen et al. (2024) has suggested lifecycle assessments should be carried out to ensure the environmental trade-offs have been considered. Alternatively, Rao et al. (2021) offer a 'decision tree' to help upcycled food manufacturers determine whether a food or food by-product should be upcycled and thus remain within the food supply chain (see Figure 5). The differing environmental impacts among upcycled food products also may mean general campaigns about upcycled food and their benefits, and generic claims regarding upcycled food on products that indicate environmental benefits to a consumer, may not be appropriate.

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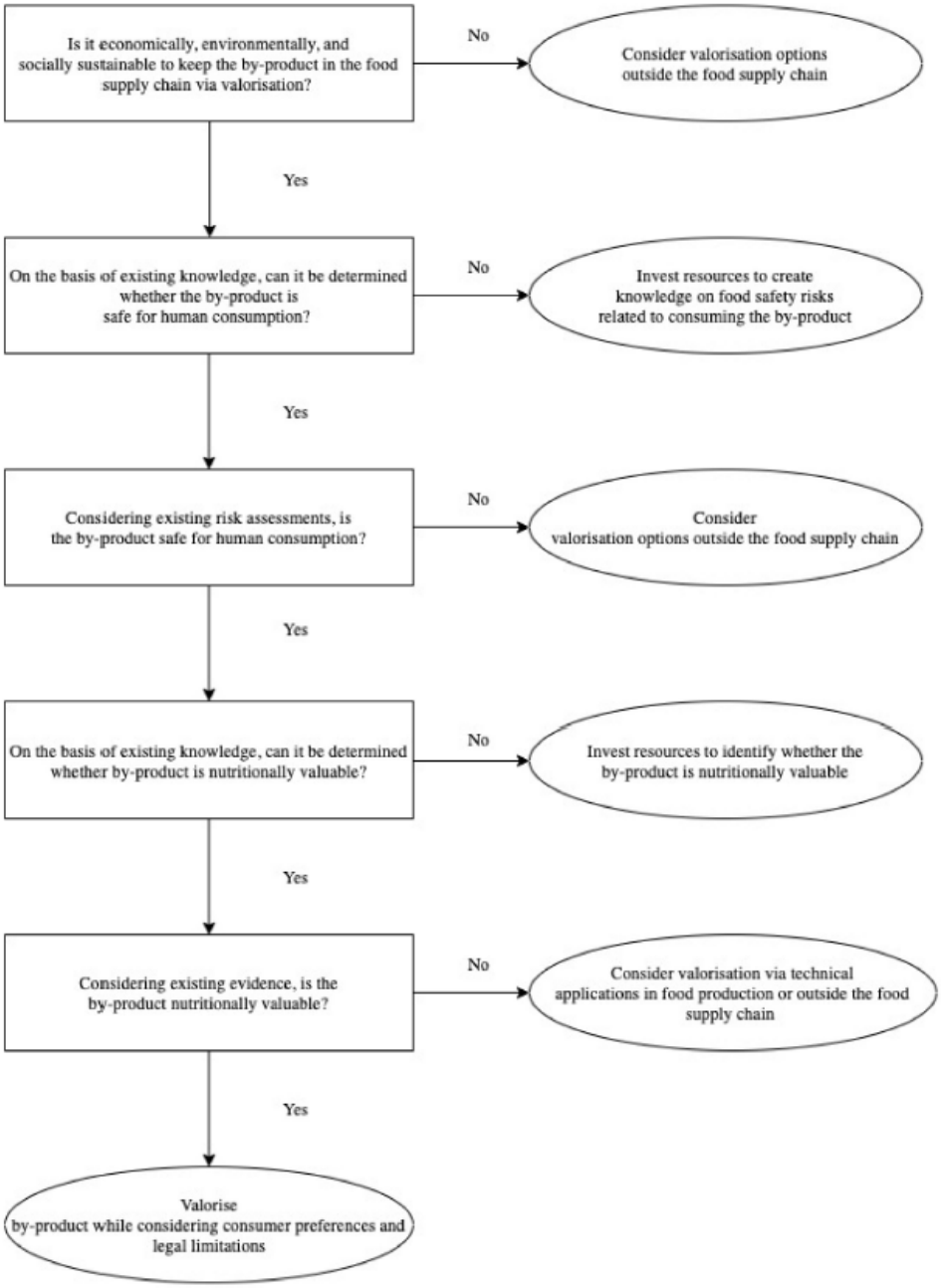

Figure 5. Decision tree for upcycled food (source: Rao et al., 2021, p. 12)

Scholars have also pointed to the potential for unintended social impacts of upcycled food, though this debate tends to be more nuanced and multifaceted, and largely talk to the question of 'value' and how value is perceived. Aschemann-Witzel et al. (2023, p. 136) offer a useful illustration of this:

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> *Reprocessing ugly fruit and vegetable into an alternative processed product is only adding value to the extent that these fresh products cannot be sold. If consumers aesthetic standards shift and a broader variety of 'ugly' fruit and vegetable can be sold 'as is', doing so might be the more resource efficient option. Another example is old or close to/past the date bakery products used to produce high-end alcoholic beverages. As long as the bakery products are disposed as waste, this is of value. However, in case an opportunity arises to redistribute the bakery products to populations in need before they become old, this might be of even higher value from a sustainable development goal perspective.*

This quote – and the notion of value – circles back to previous points raised in Section 2.1 and 2.2 about where upcycled food sits within the food waste hierarchy and which prevention strategies are prioritised, as well as whether it originates from food surplus, waste, or loss. To further explain this, if upcycled food is placed higher on the food waste management hierarchy than food donation, this may inadvertently exacerbate food insecurity, particularly in instances where the food being upcycled was traditionally distributed to food rescue organisations (see Leipold et al., 2021; Thorsen et al., 2024).

The point above also talks to implications–which may be unintended–for the food value chain as a result of upcycling food. Here, two additional perspectives are worth noting.

First, it has been suggested that upcycling food may in fact create a demand for particular products or food products, so much so that it leads to waste generation to meet that demand (i.e., additional food is produced so that it can be 'upcycled') (see Thorsen et al., 2024). Aschemann-Witzel and co-authors (2023), may have a solution to this, whereby they argue that "upcycled ingredients and foods should only be called upcycled as long as they are commonly wasted" (p. 136). To illustrate this point, they suggest that once brewers' spent grain, for example, becomes "commonly used for food, using this ingredient in food ceases to be an avoidance of food waste–the ingredient is not 'otherwise wasted' anymore" (p. 136). Thus, this suggests what is labelled as an upcycled ingredient/food needs to be routinely re-evaluated.

The second point is that upcycling food and/or ingredients may result in food being diverted away from being 'food'. Altintzoglou and Aschemann-Witzel (2024, p. 3) illustrate this point, drawing on existing research that considers the value of seafood waste and that its 'value' is often created by converting this waste into ingredients for cosmetics, rather than food or food ingredients. While such an approach arguably has the potential to generate greater profits for producers, it does remove 'food' from the food system, but not necessarily from human consumption (depending on how the latter is defined). Again, raises the question of value, and whom this is determined by as it relates to upcycled food and ingredients. Such a perspective has led to calls to adopt a ""food first, feed second, cosmetics last" approach" in relation to upcycled food and ingredients (Altintzoglou & Aschemann-Witzel, 2024, p. 4).

2.5 Summary and Future Research

As this literature review has indicated, upcycled food is an emerging area in the academic literature. While considerable work has been done to define upcycled food, how it is defined and where it sits within the food waste hierarchy has implications–both intended and unintended–which warrant further consideration. A central argument to the existing literature is that upcycled food needs to be considered comprehensively (including social and environmental impacts) and on a case-by-case basis given the complexity of its environmental and social impacts before conclusions can be reached about its positive contributions (Aschemann-Witzel et al. 2023). Further to this, while there is emerging work which highlights the challenges and/or barriers to upcycled food, there are very few studies which explicitly explore these challenges and/or barriers (and in turn, opportunities and/or enablers) and none from an Australian context. The stakeholder interviews outlined in Section 4 of this report, as well as Phase 2 of this project, seek to address this gap. In a similar vein, while there is, comparatively, an emerging evidence base exploring how to increase consumer acceptance of upcycled food and ingredients, very few studies have been undertaken in an Australian context specifically. Phase 4 of this project will address this gap.

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3. Methodology

Given the fairly 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. Semi-structured interviews, more broadly, have been recognised as the most suited method to gathering contextualised stakeholder accounts of barriers and enablers (Blandford, 2013). The questions asked during the semi-structured interviews were developed from our overarching research questions for Phase 1 on the project and from the relevant literature, and were amended at times in response to new information (Denscombe, 2014, p. 186). Ethics approval was obtained from QUT (Review Reference: LR 2023-6940-16968).

3.1 Participants and Recruitment

We developed a database of potential participants using existing contacts and online searches of upcycled food manufacturers. Participants were then formally recruited via email and provided with a participant information sheet and consent form. In total, 15 participants agreed to be interviewed for the project. Participants included those who sold produce that was upcycled and entrepreneurs who manufacturers upcycled food products (n= 12), as well as government and non-government actors (n = 3). Of the 15, 13 participants were from Australia; the remaining 2 were from New Zealand. To protect the confidentiality of participants – as per the University ethics approval obtained for this project – further details cannot be provided without potentially inadvertently revealing the participants' identity.

3.2 Interview Process

The interviews were conducted online (via Zoom) from September 2023-April 2024 and transcribed by a professional transcription service. Interviews ranged in length from 42 minutes to 96 minutes, with the average being 61 minutes. The transcripts totalled 409 pages. Most interviews were conducted with two interviewers to ensure the research team were across the ideas and concepts emerging. Following the interview, interviewers would share reflections as part of preliminary data analysis.

3.3 Data Analysis

Thematic analysis was performed on the interview transcripts using NVivo (QSR International Pty Ltd, Doncaster, Victoria, Australia) and following the six-step process developed by Braun and Clarke (2006): familiarisation, coding, generating themes, reviewing themes, defining themes, and summarisation. Following Braun and Clarke (2006), an initial open coding of the transcripts was conducted to develop a set of general codes comprised of key words or concepts. This phase was in part informed by the researchers' familiarity with, and experience of, the interviews and transcripts. Following this, codes were grouped into themes based on common content amongst the codes and were refined and named by the research team.

4. Results

As noted in Section 3, the primary purpose of the interviews was to explore participants' understanding of, and views regarding, the barriers and opportunities related to upcycled food in Australia. Thus, in this section, the findings are the outcomes of the data analysis of the interview transcripts focusing on key themes related to how participants understood or conceptualised 'upcycled' food and what they perceived to be the key barriers and opportunities impacting the upcycled food industry in Australia. Furthermore, while participants were not explicitly queried about unintended consequences and certification, these themes did emerge during the interviews. Given the alignment with topics discussed in the literature review, the notion of unintended consequences and certification are also discussed in this section.

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4.1 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', with one participant explicitly acknowledging this: "It's one of those things that you hear and talk about all the time, but you don't… put the words behind it" (#14). Only one participant (#13) explicitly referenced a recognised definition, stating that they drew on the Upcycled Food Association's definition. Interestingly, one participant (#9) did explicitly highlight the need for clarity on the definition, stating:

> *"I think there is a really good opportunity where regulation could or should play a part in it is, what is defined as upcycled and having that common X percentage of a product must be upcycled [now] definition of upcycled. I think if we could as an industry get that now, then, as we're all new players, fundamentally, that would just be – because consumer doesn't understand. So, if it was simple and clear, I think it would be really good".*

While none of the participants described upcycling or upcycled food in exactly the same way, a common theme was that it was broadly about taking food and turning it into something else. Words like 'repurposing', 'transforming', and 'creating' were often used. For a number of the participants, upcycling was linked to value adding (#1, #4, #8, #12, #14), with one participant proposing that its "basically value adding" (#1). Interestingly, participants were not always clear on what they meant by 'value', with only one participant explicitly referencing economic value (#1).

Another common theme was the general view that upcycling was connected to ensuring food was not wasted. For some, an upcycled food or ingredient was defined in the context of food waste, though the analysis revealed nuances in whether or not the ingredient or product was 'waste'. For example, participants described upcycling or upcycled food as bringing a "food waste stream…back into the food system" (#3), as food that was "not yet food waste", but prevented "from becoming food waste" (#4), avoiding the creation of "food waste" by processing it into something else (#4), diverting food that "would otherwise go to landfill" (#6), and repurposing "food waste" (#18). Some participants (#6, #8, #12, #13) explicitly expressed that that the industry should avoid using the term 'food waste', because, for example, the perception that it involved the use of an ingredient or food that was of a lower standard (#6). Terms like "by-product" (#1), "surplus" (#13) or "side-stream" (#14) were sometimes used instead.

The analysis also revealed some conjecture about what could – or should – be classified as 'upcycled'. For example, one participant explicitly queried whether the term upcycling food could be used when the end product was not a food (#7). Others defined upcycled food in the context of the "food system" (#3) or "human consumption" (#3, #6), thus implicitly signalling their view about whether or not the 'end product' had to be 'food'. One participant (#14) highlighted the difference between taking a product that "literally had no use" (e.g., stale bread into beer) and to a product that is already perfectly edible but does not meet quality specifications (e.g., apple into a smoothie) (#14) and what this meant in relation to upcycled food. This participant viewed the latter as simply value-adding and "smart processing", whereas the former was viewed as "upcycling more in the purist sense". This is at odds with other participants, as exemplified by Interviewee 3, who stated:

> *"Upcycled food is derived from food waste streams that are traditionally underutilised or undervalued, knocked out of the human consumption value chain and allocated to lower strata levels in the food waste hierarchy."*

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In addition to this, some participants, either explicitly or implicitly, recognised there could be nuance between whether or not upcycled food was an ingredient or a finished product (#3, #11, #14). This was best exemplified by Interviewee 14, who explicitly acknowledged that term might be used in reference to an "intermediate ingredient" or a "finished product".

While it was not a major theme, some participants expressed 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 really just "smart processing" (#14).

4.2 Barriers and Challenges

Participants explicitly highlighted a number of potential barriers and challenges for upcycled food in Australia, including those related to food standards, intellectual property, manufacturing capacity and capability, lack of industry knowledge, consumer awareness, economical access to surplus food, and access to markets. Additionally, while the notion of value was not explicitly recognised as a barrier or challenge, it was implicitly highlighted by some of the participants and could be perceived as a potential challenge. These themes are discussed in more detail below.

4.2.1 Food standards/food regulation

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. This is exemplified by Interviewee 11, who stated:

> *"The short answer is no, regulation hasn't been an issue at all. You're adhering to food standards. So, any of your processing et cetera is all within current legislation".*

In a similar vein, Interviewee 3 commented: "Don't get me wrong, food safety regulation in Australia is very strict, but it does mean that the consumer is very safe, like the integrity and safety, the quality there, is second to none around the world". Whilst Interviewee 9 described Australia's food regulation as "pretty straightforward", they did highlight difficulties once they sought to export their product to other markets. Whilst Australian regulation was not perceived as a significant barrier, the need for officers approving facilities at the local level to receive additional training and support regarding assessments of food facilities was highlighted, as some council areas do not have significant experience with approving food manufacturing facilities (#1). Further to this, participants that had to establish non-standard food safety plans, obtain third-party certification to promote the sustainability aspects of their product or had to interact with Australia's novel food regulation did acknowledge the costs involved and the complexity of the relevant process (#2, #5, #9). However, these difficulties are not unique to upcycled foods.

Participants also at times focused on intellectual property (IP) or therapeutic goods regulation. In relation to IP, some upcycled food companies have obtained IP, generally patents, for their particular approach to food processing or otherwise sought to keep their particular food and processing technique confidential. This incurs costs in relation to legal support, but it can also 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.

In relation to therapeutic goods regulation, some upcycled food products can be described as a 'functional food', i.e. a novel food that is claimed to have health benefits beyond conventional food. These foods exist somewhere between food and therapeutic good. Upcycled food companies involved in manufacturing functional foods are careful to align their product with the definition of food to fall within Australia's food regulation and avoid the application of therapeutic goods regulation. This was typically owing to a

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lack of knowledge about the regime, or the costs, time, and complexity of therapeutic goods regulation compared to food (#1, #2, #8).

4.2.2 Manufacturing capacity and capability

Participants often identified manufacturing capacity and capabilities as a key barrier to upcycling food in Australia (#1, #2, #3, #8, #12). In general, manufacturers were identified as either too large to assist with proof-of-concept or experimentation, while the few laboratories, namely CSIRO facilities, that would be suitable were difficult to secure owing to high demand and cost. As Interviewee 3 explained: "These existing institutions don't work fast. They're very capable of doing multi-year PhDs, CRC type research, very good at working with major corporates that have multi-year time horizons on projects, but if you're a fast-moving start-up with a sort of six months runway, a lot of them just can't survive entering onto that conveyor belt that works so slowly". There were also difficulties with sourcing the right equipment in Australia. Interviewee 8 described this issue as follows:

> *"Whether we're looking at high-pressure, HPP machine, or we're looking at a freeze drier, or we're looking at a dicer even, or an extruder; they all have to come from Europe or overseas and that is very expensive, and the capabilities just aren't here. It's not like you can just go down the road then buy a machine and start running [it]. They all go through some third-party Australian representative supplier and then they source it for you overseas. Then it's a very long process for them to get it imported in here, and once it's already here, they still need to send people from Europe to commission the equipment."*

Interviewee 12 extended on this, pointing out that the novelty of upcycled food processes is also a challenge in terms of sourcing the right equipment: "There isn't one piece of equipment that can do this from start to finish. We've had to test and trial what can go together, what will work and there's not a lot of R&D support available in this country to do that. There are very few companies that you can talk to to actually help you work this out without actually investing in the equipment to bring it in, which can be millions of dollars, or sending the product offshore, which can be tens of thousands of dollars." Interviewee 2, on the other hand, had a slightly different perspective: "… we do have manufacturers who do have technology, et cetera, but we don't have the capability, a manufacturing hub or development hub, if I can call it that, for food products that are new, unique, innovative, that can be tested and then try to [tried in] market."

4.2.3 Lack of industry knowledge

Participants indicated 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. As Interviewee 1 explained "…going from growing a crop to actually running a food processing factory is like going from a butcher's shop to a surgery in a hospital". Further to this, as Interviewee 8 explained, for many growers, the incentives to expand their business to upcycled food was not strong:

> *"At the end of the day, they're growers, they're farmers, many generations; that's what they're good at. Going to upcycled food is a completely different game. They might not*

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even be aware of the requirements or the running costs, et cetera, et cetera, but they're just in the comfort zone. They're already making good profit on the current product."

Interviewee 5 also observed that the willingness of growers to engage in upcycled food manufacturing often depended on their personal desire to expand into other products rather than how long they have been in the industry.

4.2.4 Consumer awareness

Consumer awareness, perceptions, and/or the need for more consumer education were noted as a challenge by a number of the participants (#2, #8, #11, #12, #13, #14), with one participant stating that consumer education – or lack thereof – is a "major barrier" (#11). As Interviewee 2 pointed out: "you can throw as much money at it [upcycling], [but] if consumers aren't on board it's going to fall over fairly quickly". Further to this, some participants (#2, #11) 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. As Interviewee 2 stated, this meant they did not refer to their upcycled product in the context of food waste:

"…the New Zealand study found people's perception of it is, if it's upcycled waste it should be cheaper and that's why we don't talk about it that way. We talk about it as transforming surplus produce into new products… we've based that on what's coming out of the US and New Zealand studies because once you start talking about waste, people perceive that, that's going to be cheap, right? Well, not really, no, because the story's the same, supply chain costs and by the way, we do want to help farmers get a better yield so we do need to pay them a bit more, but there is a very big perception problem there.

Some of the participants highlighted the need for more consumer education around upcycled food. For example, Interviewee 8 stated: "… one way that we could help them is actually change the consumers; help to change the consumer perspective on these products to begin with. So, it's almost like it needs to be culturally acceptable, culturally wanted, so then when the demand is there, that will also give them confidence and drive." However, as Interviewee 11 acknowledged: "Doing it [raising awareness about upcycled food] as an individual or organisation, it's just actually prohibitive [from a cost perspective]." They went on to state that: "building consumer awareness and understanding of what upcycled stands for, what the standards associated with it are and why it is good is a really big [thing] to the sustainability of the industry" was something the government could undertake.

4.2.5 Economical access to surplus food

Some participants noted that upcycled food companies have issues obtaining economical access to surplus food (#3, #5, #13). The type of access issue 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. As Interviewee 5 explained:

"The biggest challenge that we have found certainly as a startup in Australia is that most of those types of crops are still hand harvested and so for us to recover that [plant material], it would actually require a second run of harvesting once the main crop has

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been harvested. Then that's where the cost of running it with the people makes it become not that sort of [cost efficient]–the economics don't stack up for us unfortunately."

4.2.6 The 'value' of food

In a similar vein, 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 a 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 (#3, #15). 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 (#11). 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.

4.2.7 Relationships and access to markets

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, with one participant (#13) designating these as "fundamental". Some participants spoke of the 'luck' involved in developing these relationships (i.e., we knew someone who knew someone) (e.g., #3, #15), though it was also acknowledged that these relationships are hard to cultivate (#11) and have often "taken years" to build (#3). Another participant (#12) inferred a need for a third-party to help organisations connect with other relevant actors. As this participant explained: "I know there are some hubs that are being established at the moment, but it's access to equipment, in particular, that was one of our key barriers, but also access to resources and people that can help companies that might not be able to have a dedicated resource to be able to understand where their opportunity is and what their path might look like." On the notion of relationships, some participants did recognise challenges associated with access to markets owing to the role and power of supermarkets (#2, #3, #4, #10). Here, participants articulated that without the supermarkets stocking their product, they had limited access to consumer markets. Interviewee 2, however, also highlighted a level of distrust of the supermarkets: "Well I don't want to deal with retailers because they inevitably, if it's a good thing, try to reproduce it and they charge you a fortune to put your product on those shelves."

4.3 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. Of note, in comparison to the barriers and challenges, participants highlighted fewer opportunities and enablers. 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

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environmental motivations of upcycled food companies were highlighted by participants. These themes are discussed in more detail below.

4.3.1 Funding

Overwhelmingly, participants identified government grants for upcycled food start-ups as a key way to enable and support the upcycled food industry in Australia (#1, #2, #7, #12, #15), however, during these discussions, participants generally also highlighted the difficulties they faced in accessing funding. Existing grant schemes and one-off funding initiatives in particular were identified as a key enabler when an upcycled food company was able to access them. Yet, participants highlighted that small upcycled food start-ups struggled to access these schemes owing to limited resources for putting together applications or being unable to meet criteria (e.g., already making a profit or being ready to go to market). As Interview 12 observed:

> *"[Government agency] helped us with funding to buy the dryer, but only after we proved the whole concept, and we were at commercial-ready. We'd already invested a million and a half by then to get to that point. So, I think if we're going to make significant changes and do a better job of not wasting in our supply chain, there is a level of support that government can provide."*

4.3.2 Third-party enablers

While noted as a barrier, the importance of relationships – or perhaps more appropriately, third-party enablers – were also implicitly highlighted by a number of participants (#2, #3, #7, #11, #12, #15) as an enabler to upcycling. These 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 (#7), as well as networks or a facilitator who can help connected various actors within the supply chain to enable upcycling (#11).

4.3.3 The support of supermarkets

Upcycled food companies that had the support of supermarkets were also much better placed in terms of access to resources and markets (#11, #12, #13). Hence, working with supermarkets to support upcycled food products and companies was viewed as an opportunity to expand the industry. As Interviewee 13 explained:

> *"I don't think we would have an option anywhere without the support of [name of supermarket] and the timing. They were already looking for solutions. We just happened to be what they were looking for. If they hadn't been, honestly, I don't think we would have got engagement from anyone at that time."*

Some participants saw a role for governments in encouraging supermarkets to engage with upcycled food start-ups. Participants typically did not expand on this further, except for one participant who suggested that policy makers could "lobby" supermarkets to dedicate shelf space to upcycled food products (#1).

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4.3.4 Government procurement policies

Some participants identified the opportunity for government support and intervention through the procurement policies of food that would otherwise enter a waste stream. As Interviewee 14 noted:

> *A whole conversation or a key enabler, in my mind, for systems to work is when government procurement starts to invest in this and demand from their suppliers that you have a sustainability score of this type thing, and upcycling is a key way that they can help achieve that goal.*

As suggested by Interviewee 14, by requiring a certain percentage of upcycled food to be used within organisations (such as those controlled by the government—schools and prisons) as part of government procurement guidelines or policies, there would be a more sustainable route for some types of food waste and a guaranteed demand for the products.

4.3.5 Mobile manufacturing

Mobile manufacturing was also put forward as an opportunity by some participants. This would involve, for instance, transporting equipment that could stabilise a freshly harvested crop on farms. While this sounds like a useful idea for preserving perishable surplus, other participants thought mobile manufacturing was not a viable option. As Interviewee 8 explained: “I feel like that’s another level…because just doing a stationary standardised product is already that difficult…Even just the set-up cost, just to move it into an approved food safe place and having the facility do that, is already very prohibitive…it might just be easier for them to just transport the food to the facility.”

4.3.6 Motivations

The motivations of upcycled food companies was also identified by the research team as an opportunity and enabler. A consistent theme across participants was that upcycled food companies are generally motivated by a strong desire to reduce food waste and create a food product that can contribute to healthy diet (#2, #3, #5, #6, #9, #11, #15). Broadly, the upcycled food companies saw the food surplus (or waste streams in the case of manufacturing) as an opportunity to address a significant environmental issue, but they are also equally as focused on creating a product that contributes to healthy diet for consumers. These motivations kept businesses moving forward despite technical or financial challenges. In comparison, very few of the participants highlighted an economic motivation, and when they did, this was typically linked to a sustainability-driven motivation. For example, as Interviewee 14 stated: “yes, we can do something with this, and we can make money off of it and it helps solve these other problems as well”. While recognising that a sustainability-driven motivation was an enabler for many of the participants, it is worth highlighting that this could also be a potential challenge for growing the upcycled food industry in Australia. To illustrate this point, as Interviewee #5 elucidated, there can often be a tension between sustainability versus economic motivations: “At one stage we were very, very focused on taking our input material from [the] waste source because there's so much out there and at farm gate and all of that. I had one investor really question whether or not that is economically sustainable. So, even if it might be sustainably better, if you're not economically sustainable then the business collapses at the end of the day and you can't be sustainable.” This highlights that while sustainability-related motivations may be a key driver for upcycled food manufacturers, unless they can demonstrate a strong economic value, they may not be able to obtain the necessary funding needed to carry out their business.

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4.4 Unintended consequences

While participants were not asked directly about unintended consequences, it did emerge as a theme mostly from the perspective of participants being cognisant of the potential for unintended consequences. For example, Interviewee 5 pondered: "… are we displacing something else that is—are we being more beneficial in what we do versus what we're displacing?". In a somewhat similar vein, Interviewee 15 highlighted that they would only use materials that did not "impact food security". This notion of unintended consequences is arguably aligned with the tensions highlighted previously in regard to both value and the definition of food waste, in the sense that it is important to recognise that upcycling should be about using food surplus, waste, loss, or by-products, rather than about producing food for the sole purpose of being 'upcycled'. It also highlights the importance of considering the implications of using that product, and whether it creates issues elsewhere in the food hierarchy (e.g., repurposing food that might have gone to animal feed, which keeps the food in the human consumption chain, however, its means that livestock producers may need to find alternative feedstocks that might be less environmentally sustainable or result in the production of more 'food').

Relatedly, while it was noted that many of the participant s engaged in upcycling because of a desire to reduce food waste, and therefore, reduce environmental impacts, the notion–or better yet, question–as to whether upcycled food is 'sustainable' was highlighted by some of the participants (#1, #4, #7, #11). For example, as Interviewee 4 noted: "you can add value to the food waste but if you only generate another type of food waste that's been processed, it's not a good idea". Similarly, Interviewee 1 noted: "Everyone's currently using natural gas for drying and that negates the entire sort of environmental impact thesis of what we're trying to do [when it comes to upcycling]". As the quotes exemplify, there was some acknowledgement that whilst upcycling a food that would otherwise have been wasted appears to be more 'sustainable', the added cost of processing, manufacturing, and/or transport may actually make it less environmentally sustainable in the long run. This would suggest that 'sustainability' in the context of upcycled food may be somewhat subjective and highlights the need for lifecycle assessment to determine the true 'cost' of the end product in comparison to other food waste destinations.

4.5 Certification

Some participants (#3, #5, #6, #9, #12, #13, #14) did broadly reference the notion of certification. This was in relation to the certification they had (#3), the cost of third-party certification (#9), or around compliance (#6, #13). Four of the participants acknowledged they knew about upcycled food certification systems elsewhere in the world (#3, #5, #12, #14). Of these, one suggested that were looking into it (#12), one simply noted they had "heard about new labelling" associated with a scheme (#5), and one noted that they did not think it would make much difference for consumers (#14). In contrast to this latter point, one of the participants (#3) lamented the need for consumer education, going on to state: "…if upcycled certification bodies are expecting us to put the logo on our packaging and then also try to educate the market, it becomes really difficult because people just assume that you're just biased and obviously you'd say that and then [that pulls] into question that certification in of itself". As this quote suggests, without people knowing what upcycled food it, a label with 'upcycled food' is unlikely to be helpful. Further to this, the quote highlights that education may not only be needed around what 'upcycled food' is, but also to raise awareness about the certification bodies so that they are recognised and trusted by consumers.

4.6 Summary

In summary, this section has reported on the key themes that emerged from the analysis of the interviews. As highlighted, participants had varying views about what could – or should – be labelled as 'upcycled'. Participants explicitly noted a number of barriers and challenges associated with upcycling food in Australia, including manufacturing capabilities and capacity, as well as concerns around consumer awareness, perceptions, and/or education around upcycled food. Interestingly, government regulation was not identified as a barrier at present, however, it was acknowledged that upcycled food companies involved in manufacturing

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functional foods are careful to align their product with the definition of food to fall within Australia's food regulation and avoid the application of therapeutic goods regulation. Overall, participants identified fewer opportunities and enablers than barriers, however, funding, retail relationships and entrepreneurial motivation were identified as key enablers. Unintended consequences emerged as a theme owing to participants engaging with questions about the sustainability of upcycling or taking steps besides upcycling to ensure sustainability. Certification schemes were not explicitly highlighted as an enabler, though a number of participants referred to these at some point during the interview.

The next section brings together the key observations from the literature review and interview analysis.

5. Discussion

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, fundings and certification were noted as potential enablers in both the literature review and 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 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 (Curll et al., 2016). A nuance to this finding, however, is implications relating to the lack of knowledge about therapeutic goods regulation, and in 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, that 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.

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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 somewhat paradoxical problem. 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, upcycling economically unviable.

Many of the participants interviewed for this study turned to upcycled because of altruistic reasons, not necessarily because there was a clear business case for upcycling, that is, a clear economic rationale. While not explicitly expressed by participants, it is feasible to suggest that 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.

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Finally, while research has been done in international contexts to explore consumer's 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.

6. Conclusions & Recommendations

A number of emerging recommendations can be made based on the literature review and participant interviews conducted in this phase of the research. These are summarised below.

1. There is a need to develop a clear and shared definition of upcycled food by academic, industry, and consumers.

Whilst it is acknowledged that several definitions of upcycled food have been proposed within academic and industry literature, these do not currently take into account the perspective of experts (academics), consumers, and manufacturers/food companies together. A definition that is constructed based on the meaning interpreted by all three groups would establish a common language and understanding among these groups, which in turn, would serve as a foundation for communication between these groups. A clear definition of upcycled food will assist consumers, manufacturers, and food companies to understand the concept and make informed decisions regarding upcycled food. It may also assist in determining certification for upcycling and play a role in informing other regulatory instruments. In line with the academic literature, is also acknowledged that what is labelled as an upcycled ingredient/food needs to be routinely re-evaluated, depending on how the definition defined upcycled food or products in the context of waste and surplus.

2. There is a pressing need for consumer studies relating to upcycled food in Australia.

There is growing academic literature around consumer perceptions toward and/or awareness of upcycled food, however, there are limited studies that explicitly look at the Australian context. In light of the literature that acknowledges consumer awareness is a significant barrier to upcycled food, as well as the comments made by participants in this study, there is a need to better understand Australian consumers' awareness and understanding of upcycled food, what they view as the key benefits and drawbacks of upcycled food relative to other food types, and the likelihood whether or not they would purchase of upcycled food. Without this knowledge, it will be difficult to ascertain whether or not there is a strong market for upcycled food in Australia, and in turn, whether upcycled food will result in the anticipated levels of food waste reduction.

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

While by definition, upcycled food is likely to be perceived as being more sustainable, because it is turning a waste or surplus product into something of value, as the literature highlights, in some cases, the end product is not necessarily 'sustainable'. Thus, it has been suggested that lifecycle assessments should be carried out to ensure the environmental trade-offs have been considered (see Thorsen et al., 2024). Alternatively, upcycled food producers and manufacturers could utilise the 'decision tree' created by Rao and colleagues (2021) (see Figure 5 in Section 2.4), to help determine whether a food or food by-product should be upcycled and thus remain within the human food supply chain. Further to this, while it was noted many of the current upcycled food producers avoid health claims so that they do not run afoul of food regulation (or comply with therapeutic goods regulation), sustainability claims are also receiving increased attention both internationally and in Australia. Thus, if upcycled food producers want to promote the sustainability aspect of upcycled food, they are going to need comprehensive supporting evidence, such as may be provided by lifecycle assessments.

4. There is a need for improved manufacturing capabilities in Australia.

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A key barrier to upcycling in Australia is current manufacturing capabilities and capacity. In particularly, low cost, proof of concept facilities will be needed to help support the growth of the upcycled food industry in Australia. While specific recommendations for this are beyond the scope of this study, the current Senate Inquiry into Food and Beverage Innovation may deal with this issue.

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

Whilst it is acknowledged that various state governments have provided funding to supported upcycled food, participants noted a need for more relaxed eligibility criteria that supports innovation. Hence, consideration could be given to the development of upcycled food start-up specific grants. Additionally, government procurement policies could also play an important role in enabling upcycled foods.

6. **Consumer education will be needed to raise awareness about upcycled food.**

Both the literature and interview data point to the need for consumer education to promote upcycled food, and in turn, support demand for upcycled food. However, further consumer research (see Phase 4) about upcycled food in Australia is needed before such an approach is implemented.

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

The results of this study suggest the creation of a third-party – whether it be an industry body or government created body – to act as a facilitator for upcycled food companies would be beneficial. The role of these facilities would be to help link these companies to grant schemes, provide information (including broad information about potentially relevant regulations), and build relevant connections such as with supermarkets, manufacturers, or investors.

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

The findings of this phase lend themselves to the need to establish a business case for upcycled food, which, in turn, may help illustrate the viability of upcycling surplus food in Australia to both potential upcycled food companies and to producers who are not currently maximising the economic value of their surplus produce. For upcycled food companies, whilst acknowledging our sample was fairly limited, the participants involved in this study typically engaged in upcycling for altruistic motivations, rather than economic. This is likely to place limitations on the types of companies willing to engage in upcycling and suggests a clearer business case for sustainability is needed. For producers, harvesting surplus food is seen by many as a cost, rather than as a potential avenue to generate value. However, it is noted here that whilst a business case may highlight the potential returns associated with upcycling, it likely needs to be coupled with processes to encourage the harvesting of ‘surplus’ food.

To conclude, this purpose of this phase was to explore the literature and conduct interviews with upcycled food producers and manufacturers in Australia to understand the potential barriers and challenges, and enablers and opportunities, related to upcycled food. The next phases of this research build on the preliminary findings of this research and will address some of the above recommendations by (a) exploring the relevant regulation (and potential regularly barriers) (Phase 2); (b) creating case studies that showcase the business case for upcycled food (Phase 3); and (c) conducting focus groups and a national consumer survey to understand Australia consumers’ perceptions of upcycled food (Phase 4).

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