



# Opportunities and **Barriers** for the **Australian Packaging and Processing Machinery Sector** to Tackle **Food Waste**

SECTOR LANDSCAPE  
STUDY



**FIGHT FOOD WASTE**  
Cooperative Research Centre  
REDUCE - TRANSFORM - ENGAGE



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Australian Packaging and Processing  
Machinery Association Limited





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## About the project

Across the food supply chain, the use of some technologies and processes can directly result in food waste generation, including during harvesting and processing, in customising portion sizes, through product and date labelling, shelf-life extension and product packaging. For food producers often the type of packaging and processing machinery available dictates how effectively resources are used and the volumes of food waste produced. Equipment manufacturers may not be aware of the critical role they play in reducing food waste.

Understanding how the Australian packaging and processing machinery sector can promote these technologies and services to the food industry to realise new opportunities to reduce and/or transform food waste is the challenge being addressed. The aim of this project is to consolidate the ways that Australian packaging and processing machinery can reduce and/or transform food waste and to provide equipment manufacturers with improved knowledge and understanding of the food waste challenges. In isolation, a single initiative will not address the issue at scale, however driving collaboration across the APPMA with the various packaging providers and processing companies can achieve this.

### About the APPMA

The Australian Packaging and Processing Machinery Association (APPMA) was established in 1983 to promote, integrate and foster participation and development at all levels of the packaging and processing machinery industry in Australia. Within the APPMA membership there is a diverse range of technology and service providers.

Our first report Opportunities for packaging and processing machinery and technologies to tackle food waste: Baseline Review Insights can be accessed here (<https://fightfoodwastecrc.com.au/project/the-opportunities-for-australias-packaging-and-processing-machinery-sector-to-tackle-food-waste/>)

The Project Partners:



## Executive summary

This report presents the results of a study among companies in the Australian food packaging and processing machinery (PPM) sector and their role in the food waste challenge facing Australia and the rest of the world. The study presents the results from a cross sectional survey of 27 industry participants and interviews with five companies to provide rich case information about specific experiences, challenges, and outcomes in the context of food waste reduction ambitions and projects.

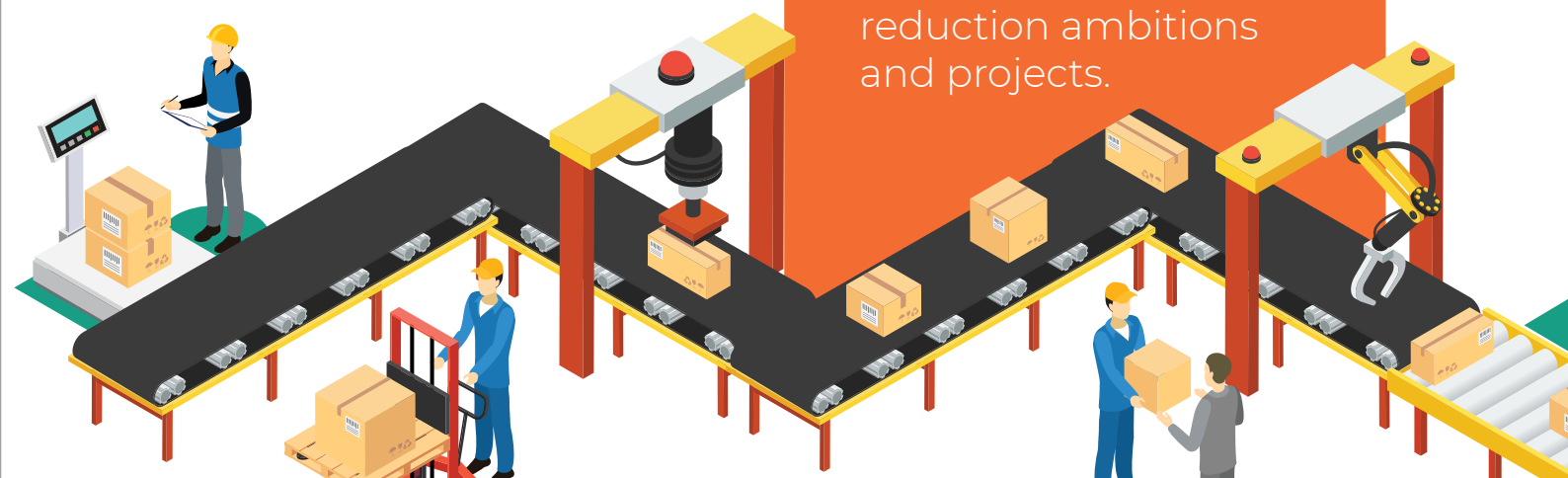
As a partner industry to the food supply chain, the direct and indirect impact of packaging and processing machinery and its related technologies on food waste reduction is poorly understood. So far, only limited empirical research has been conducted on this partner industry to the food supply chain.

The focus of this Australian study is to describe the PPM landscape in more detail and describe current organisational practices and perceptions regarding food waste issues and achievements. The study will identify the potential barriers and opportunities to help address a critical environmental, social, and economic challenge in Australia and the world: food waste.

### Key findings from the study:

1. Organisations in the PPM sector have a positive attitude towards the need to reduce food waste and are involved in a range of efforts already. More than two thirds (69.6%) of the responding firms indicated that their organisation has been successful in reducing food waste, either through participation in projects with other organisations or through internal initiatives. More than half (52.1%) of the organisations state that their efforts have a significant impact on food waste and loss reduction.

The study presents the results from a cross sectional survey of 27 industry participants and interviews with five companies to provide rich case information about specific experiences, challenges, and outcomes in the context of food waste reduction ambitions and projects.



2. The COVID-19 pandemic is a human health tragedy that has resulted in major economic and social disruptions across the globe. However, the pandemic and its impact on supply chain disruptions is also perceived as an opportunity for the PPM sector.
3. The broad push for sustainability in general and the need to remain competitive appears a strong motivating factor behind current sustainability and food waste reduction efforts and investments in the sector. This shared motivation shows that the PPM sector generally does not perceive a trade-off between food waste reduction and economic return on investment. More than half (56%) of the organisations believe that sustainability and profitability go hand in hand.
4. Packaging and processing machinery and related technologies cover an extremely broad array of approaches, technologies, and capabilities that can potentially impact food waste and loss positively. The ability and need to collaborate and build an innovative ecosystem with the food manufacturing stage and beyond was highlighted by participants as a strategic priority. Given the speed of innovation and the indirect relationship between the technology providers and the supply chain, broader awareness of the nature and potential impact of emerging technologies, based on blockchain and artificial intelligence (AI), for example, needs to be increased.
5. To accelerate food waste and loss reduction, the survey results show that there is a need to increase collaboration, while continuing to lower running costs and build supportive policy and regulatory systems. Government policy is seen more as a wasted opportunity for supportive measures and coordinated incentives and less a top priority challenge or impediment. Client education and willingness to pay, labour costs, and lack of impact measurement capability in the chain are seen as the top challenges.
6. The challenges related to food waste reduction and loss are multifaceted and therefore complex. The PPM sector was seen by participants as a partner in the food supply chain without control over waste, but also as a collaborator that already has a significant impact on food waste and loss reduction. Going forward, the knowledge in the sector regarding packaging machinery and technologies, shelf-life extension, sustainable manufacturing, distribution and handling, and cleaning capabilities are important areas for future gains. At the sector level, relationship brokering may lead to identifying leadership that can build collaborative investment cases, manage the innovation process, and create more circular outcomes and food waste reduction.

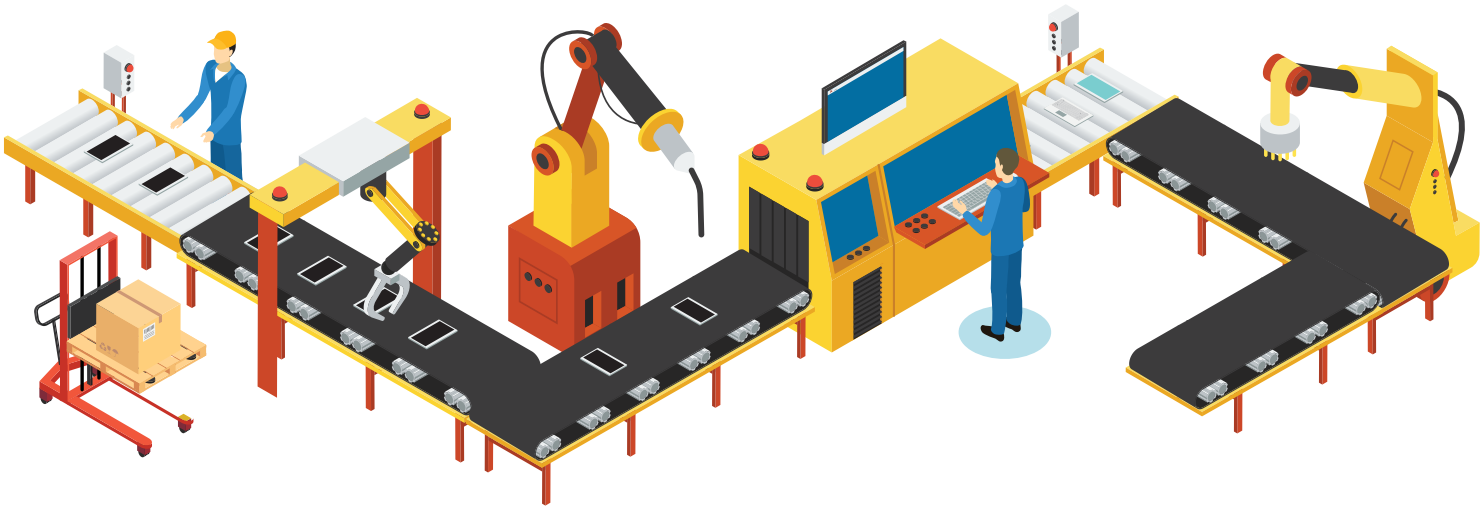
7. There is a continued need to educate stakeholders on the role of packaging and processing machinery in reducing food waste and loss. Different approaches to packaging, for example, create opportunities for the machinery sector. The industry's knowledge on shelf-life extension, damage prevention, hygiene, software and hardware integration, and batching offers clear opportunities. Both consumers and governments need to understand the broader context and the complex interrelationships between technology and machinery, the larger food supply chains, and waste and loss as a critical outcome (see the development opportunities in Finding 8).
8. Future leadership development around innovation ecosystems, circular strategies, and food waste reduction may stimulate the understanding of joint goals and joint value creation opportunities. The key sector development areas are (in no particular order): networking relationship building; understanding and integrating emerging technologies; understanding and influencing policy, circular leadership, impact measurement and business case development; funding models; and stakeholder education.



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# 1. Introduction

It's maybe 100 times harder to design the manufacturing system than the product itself.

**ELON MUSK**

This report is part of a larger study on the opportunities for food packaging and processing machinery companies to tackle food waste and loss. The aim of the project is to understand the current state of play in the sector regarding food waste reduction and potential barriers and opportunities for the technology and machinery suppliers to contribute to food waste and loss reduction in Australia. The study is funded by the Fight Food Waste Cooperative Research Centre in partnership with the Australian Packaging and Processing Machinery Association (APPMA) and RMIT University.

It is estimated that food waste costs the Australian economy approximately \$20 billion each year and over 5.3 million tonnes of food intended for human consumption is wasted each year from households and the commercial and industrial sectors [1]. Food waste is a critical metric of the food

supply chain, indicating economic, social, and environmental performance. Food waste and loss occurs at every stage along the food supply chain – from farm to fork – and food waste is known to be a major contributor to greenhouse gas emissions, with estimates that up to 10% of emissions come from food that is ultimately not consumed [2].

The United Nations (UN) Sustainable Development Goals (SDG) clearly show the need to reduce food waste across all parts of the supply chain. In particular, Target 12.3 aims to “By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses” [3].

Environmental, economic, and social changes in the food system cannot take place without transformational innovation. Traditionally, economic efficiency was driven by the need to handle high volumes of food and deliver it to consumers. Changes in society and attention on social and environmental sustainability require significant re-prioritizing and new capability development. In particular, the concepts of efficiency and cost in manufacturing and the system boundaries and goals beyond economic returns are rapidly expanding. It is safe to say that the indirect suppliers to the food supply chain are often forgotten, as the boundaries drawn around stakeholders and their innovation capabilities are often drawn too narrow.

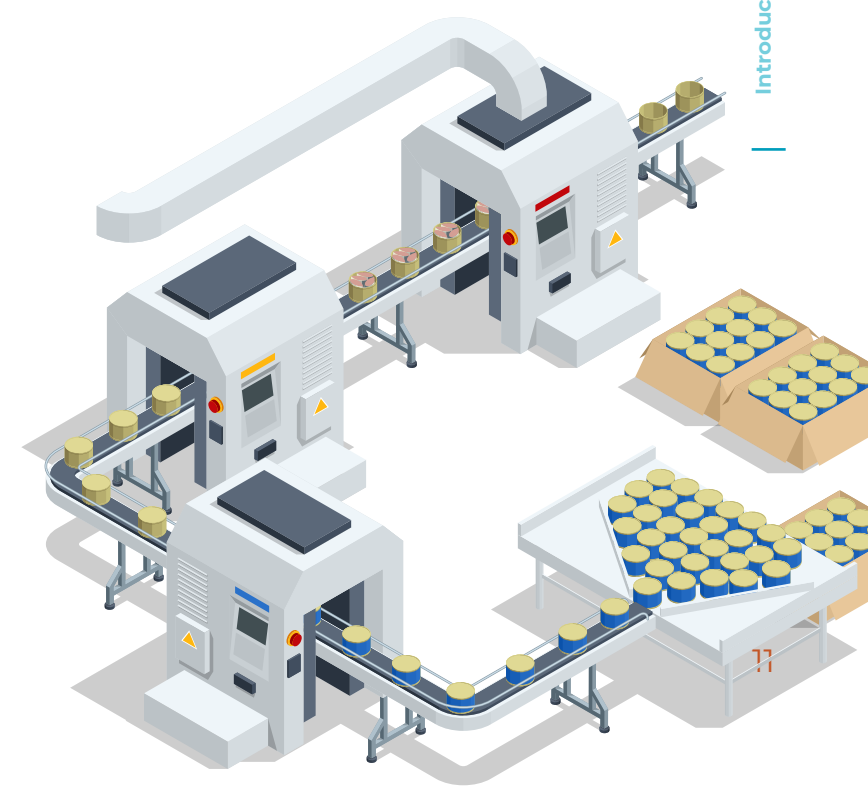
This study is unique in that its focus is on an often-forgotten part of the food supply chain: the suppliers of technologies and machinery to process and package food. These suppliers are often identified as the ‘manufacturing stage’, but this study also includes farm, transportation, retail, and consumption stakeholders. The global market for food waste management has been growing annually. It reached \$31.3 billion in 2019 and should reach \$43.1 billion by 2024, at a compound annual growth rate (CAGR) of 6.6% for the period of 2019-2024 [4]. Australia traditionally plays a very important role in this sector given its strong food production role in the region and beyond.

The packaging and processing machinery industry is likely to play a key part in the global transformation of food supply chains, but it is also clear that the technology and machinery industry is not ‘in control’ of any aspect of the chain itself. It is an industry dependent on relationships, collaboration, joint goals, and the ability to innovate in a rapidly developing technology arena with increased awareness about the need to be sustainable in general, and to reduce food waste in particular.

During the first stage of the project, a global literature study was conducted across both academic and industry publications published up to 2020. The review provided an overview of the many manufacturing technologies and machinery that are used

in the food supply chain and what is known about their (potential) impact on food waste and loss. A key finding from the literature study was that packaging and processing machinery is an important partner in the food supply chain, with critical capabilities for the food supply chain of the future [5]. It also showed that a whole-of-chain approach is needed to measure the impact of food waste reduction initiatives and innovations.

This second report is part of the next stage of the larger project, and it reports on an online survey and subsequent interviews with packaging and processing machinery organisations in the APPMA member community. This report presents the second deliverable of the larger project: the results of a stakeholder survey and follow up case study interviews. The research gathered insights of members’ awareness of and current and planned activities and investments centred around food loss and waste reduction.



2. METHODOLOGY

An online questionnaire was developed and administered during the second half of 2020 (outlined in the Appendices). Australian-based companies in the packaging and processing machinery sector were recruited through an opt-in invite link in line with ethics approval from the Human Ethics Advisory Network at RMIT University. Participation was voluntary and was advertised through the APPMA member database via email to 103 members. A total of 27 usable responses were received (26%).

The survey was conducted online and was open in the second half of 2020. Although this period coincided with the COVID-19 pandemic and significant interruptions in terms of lockdowns (in Victoria in particular), the engagement with the study and the response rate was good, largely because of the support and communications provided by APPMA. Questions consisted of both open and more structured questions, such as 5-point Likert scales asking for the level of agreement with a statement (from 'strongly agree' to 'strongly disagree').

TABLE 1

Interviewed companies

COMPANY	INTERVIEWEE ROLE	FIRM SIZE	TYPE OF MACHINERY
Company A	General Manager/Owner	Smaller (<40 FTE)	Food packaging
Company B	Sales	Smaller (<40 FTE))	Food packaging
Company C	Owner	Larger (40+ FTE)	Food packaging
Company D	Managing Director	Smaller (<40 FTE)	Food processing
Company E	CEO	Larger (40+ FTE)	Food labelling

Five interviews were conducted after the survey during the first quarter of 2021. They provided rich information about specific efforts and projects of PPM suppliers trying to reduce food waste. The convenience sample of companies was recruited through an expression of interest process and conducted in line with the ethics approval. The five interviews were conducted on Microsoft Teams and Zoom, lasted between an hour and an hour and a half hour and were anonymised, recorded, and transcribed. Table 1 shows more detail about the interviews. A selection of quotes from interviews have been attributed for impact and where permission has been granted by the interviewee.

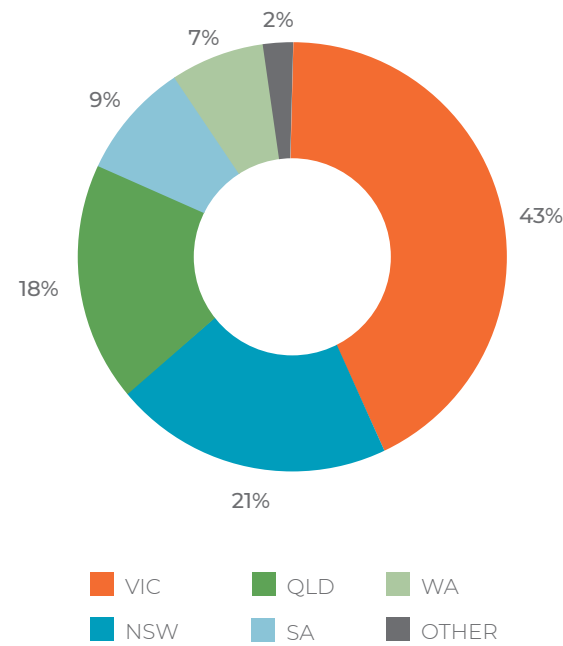
The questions for the survey and interviews conducted for the study are included in the Appendices.

2.1 Geographic location and firm size

The survey was conducted in Australia and all companies have operations in at least one state or territory. The majority of operations (43%) took place in Victoria, with 21% in New South Wales, 18% in Queensland, 9% in South Australia, 7% in Western Australia, and 2% in other states and territories (Figure 1). All companies are active in the food industry, with 85% indicating that the food industry is 'very important' to the company and the rest saying it is 'important'.

FIGURE 1

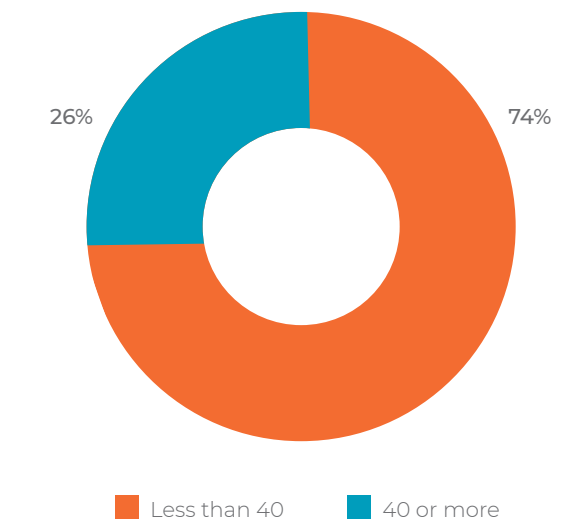
Principal state of operation



The companies in the sample are generally small- to medium-sized companies (less than 200 staff). The average number of fulltime equivalent (FTE) employees employed in the organisations is about 40 (42.7 FTE). The minimum size is 3 FTE and the maximum is 220 FTE. While many of the companies also have overseas locations, the standard FTEs are based on Australian norms. The median size is just below 25 FTE. Interestingly, the companies that have 40 FTE staff or larger represent 25% of the sample (top quartile) (Figure 2). In the analyses that follow, the top quartile (larger companies) will be compared to the smaller companies in the sample to explore differences in their response to the challenge of food waste reduction.

FIGURE 2

Number of employees - FTE

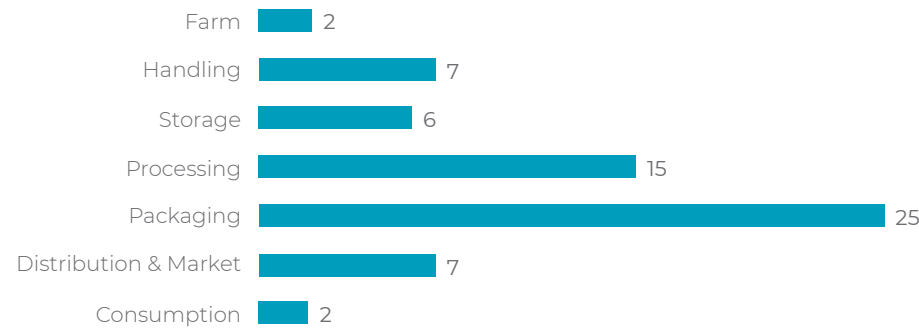


## 2.2 Strategic focus in the supply chain

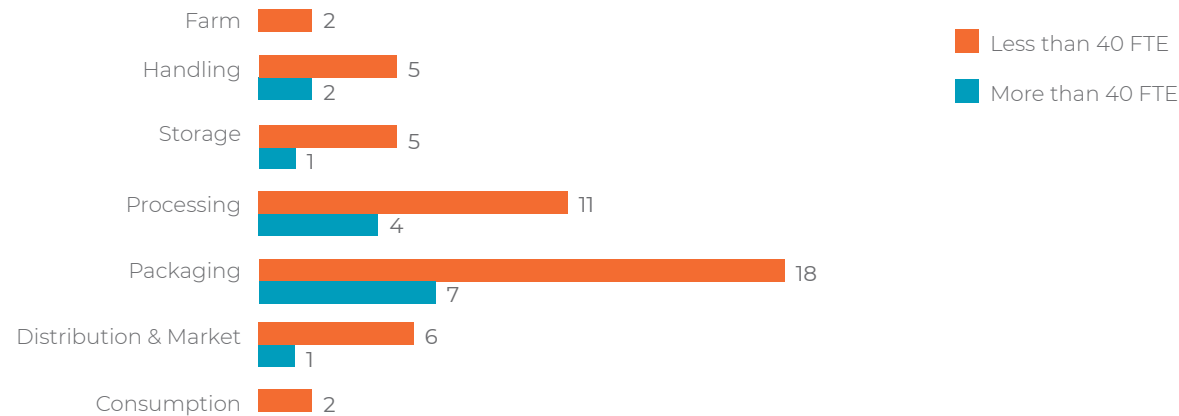
The PPM companies were asked to identify which part or parts of the food supply chain they operated in (Figure 3). The organisations were able to select multiple options. Figure 3 shows that the PPM companies have a core strength in the heart of the larger food supply chain. As expected, the strengths are in the manufacturing stage, in the packaging and processing stage. However, it is evident that the companies also have a meaningful contribution to other parts of the food supply chain, including handling, distribution, and storage, and in relation to consumption. The

nature of the PPM ecosystem becomes more clear after splitting the data into smaller and larger companies (Figure 4). Smaller companies seem to play a role across the food supply chain whereas larger companies seem to be more focussed on and located in the centre of the chain. In terms of the innovation ecosystem, this shows a need to cooperate across different sized firms and with different capabilities, in order to offer integrated solutions to complex problems such as food waste and loss reduction in the food supply chain.

**FIGURE 3**  
Strategic focus and location in the supply chain



**FIGURE 4**  
Strategic focus in smaller vs larger companies



Apart from target areas of the supply chain, the type of technologies and capabilities are very heterogeneous across the various firms. Respondents listed numerous technology and capability areas, averaging about seven types per company. One company indicated activities in 23 different technologies and capabilities. This shows that the sector is very diverse. It may also indicate that the companies face challenges in terms of their strategic focus, as the market may not support high levels of specialisation. It is important to note that the industry clearly covers a very diverse set of technologies and machinery that cover both complex products and service and digital and/or brick and mortar assets, including emerging technologies such as robotics, vision systems and analytics, and software products. The larger technology and machinery landscape will be explored in more detail in Table 2.

Table 2 shows the expertise areas of the companies in the sector. Many of the 'products and services' are focussing on business-to-business clients and the manufacturing solutions offered to these clients and partners. The food-specific knowledge areas of handling, preserving, cleaning, environmental impact, safety, and keeping the machinery operational is strong.

It is also worth noting that the packaging and processing machinery sector in Australia is knowledge-intensive and driven by research and development (R&D). 88% of companies agreed or completely agreed that R&D plays an important role in the company, indicating that the practice and need to innovate is widely shared. 88% of companies also stated that services play an important role.

Overall, the sample description shows PPM organisations consist of some larger and many smaller companies. The firms have a core strength in the manufacturing stage of the food supply chain but also have impact on the other stages. Interestingly, the companies have significant innovation capabilities, and covering both the hardware and software side of available technologies. Some core technological areas lie in labelling, handling, filling and mixing, system integration, cleaning, and heating services and temperature control (Table 2). Interestingly, robotics scored quite high as innovation capabilities, with seven smaller and two larger companies mentioning it. All these technologies have a potential impact on food waste in the larger food system and the integrated application of these capabilities provide avenues for further food waste and loss reduction.



TABLE 2  
Core technologies by company size

TECHNOLOGY AND/OR MACHINERY AREA OF FOCUS	NUMBER OF COMPANIES	LARGER COMPANIES (40+FTE)	SMALLER COMPANIES (< 40 FTE)
Handling equipment	14	4	10
Wrapping	13	4	9
Palletising and depalletising	11	2	9
Sealing	12	4	8
Inspection systems	10	4	6
Cartoning	9	3	6
Filling	10	3	7
Labelling	10	3	7
Robotics	9	2	7
Vision systems	9	4	5
Weighing equipment	9	4	5
Boxes	8	3	5
Capping	7	2	5
Printing	7	3	4
Date labelling	6	1	5
Fillers	7	3	4
Services	6	1	5
Software	6	2	4
Cleaning/sterilisation/washing	5	2	3
Safety	5	1	4
Material supply	5	3	2
Fabrication	4	1	3
Blending	5	3	2
Pasteurisers	5	3	2
Environmental	4	1	3
Cookers	3	2	1
Homogenisers	2	1	1
Granulation	2	1	1
Part supply	2	2	0
Temperature management	1	0	1

3. RESULTS

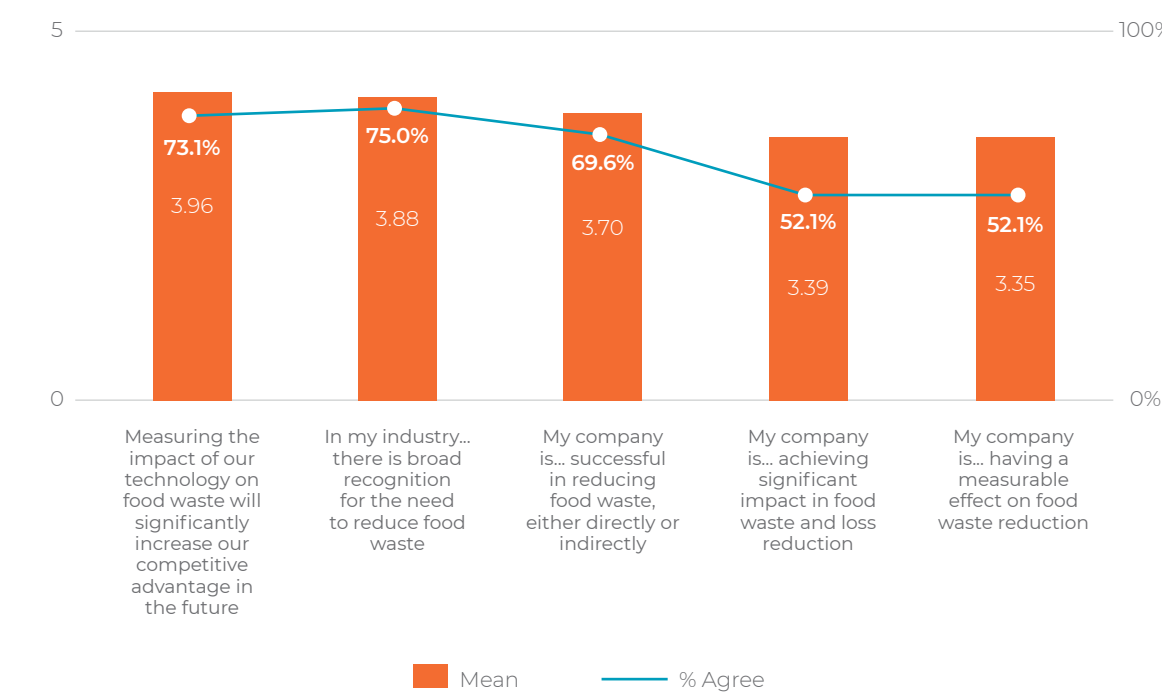
3.1 Introduction

In Section 3, the key findings from the survey will be presented. Using the responses from 27 PPM companies, we will describe the sector landscape in relation to food waste and loss efforts, outcomes, and strategic priorities. These findings will be illustrated and enriched using the results from the five interviews.

3.2 Food waste impacts of the packaging and processing machinery sector

The data from the online survey shows the level of awareness, activity and perceived impact of the PPM sector on food waste reduction. Each statement was scored by the responding company (1 = ‘completely disagree’ to 5 = ‘completely agree’).

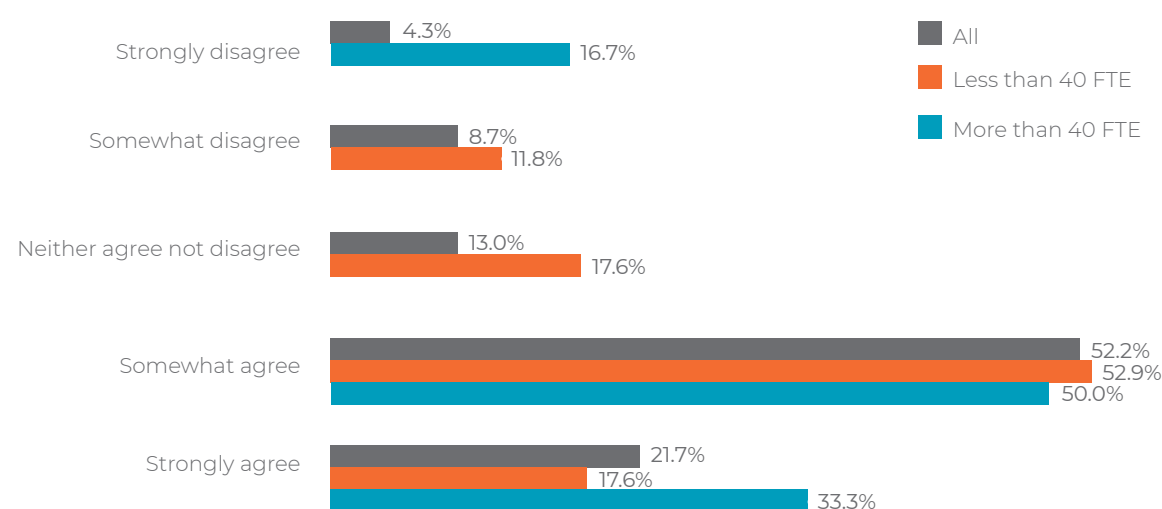
FIGURE 5  
Food waste impact of PPM sector



The PPM companies in the sample show high levels of awareness about the need to reduce food waste (Figure 5). 73.1% of the companies in the sample reported they believed measuring the impact of their technologies would increase their competitive position in the marketplace. 75% of the companies agreed that there is a broad recognition in the sector of the need to reduce food waste. These metrics show that food waste reduction is seen as an important area of attention in the organisations and sector in general. More importantly, 69.6% of companies stated they have been successful in reducing food waste directly or indirectly. 52.1% stated that their organisation has a significant and measurable effect on food waste reduction.

Figure 6 shows that 73.9% of the firms believe that the COVID-19 pandemic offers innovation opportunities in the sector. However, this optimism is somewhat more pronounced in larger organisations than in smaller organisations (83.3% versus 70.5%). The optimism about innovations and COVID-19 is not uniform: 16.7% of the larger companies strongly disagrees and 11.8% of the smaller companies somewhat disagrees (all valid percentages that correct for missing values).

**FIGURE 6**  
Statement: the COVID-19 pandemic creates some innovation opportunities



One of the interviewees, Mark Dingley of Matthews Australasia, stated that the impact of the COVID-19 pandemic on the food industry had been multi-faceted. Many firms experienced a rapid growth in demand (for ready meals, convenience foods, and small portion foods) as people were forced to shift away from restaurant meals and into their own kitchens. “They all saw significant volume increases. As we saw, Woolworths and Coles struggled to keep pace with the volume. And we saw the uptake of home delivery. Talking with some of the retailers – they experienced in that first three months of COVID-19 – online orders in the three months grew to what they’d forecasted to grow in three years.”

Another interviewee, Mark Emmett of HMPS & Propac, spoke at length about how innovation in the industry had been accelerated by pandemic-related developments. They suggested that Australia was seeing significant investment in food packaging technology (and related these developments to a corresponding reduction in food waste). “We’re building 50% more machines, and we’re getting better margins because people are saying, ‘Well, I used to buy that machine from Europe. But I can’t communicate with them at the moment. [...] I don’t know whether the technicians are going to be able to come out and install the machines. I can’t go to Europe and see the machine being tested before it’s shipped.’ So, we’ve seen a real push to work with machine builders in Australia. And that’s us.” The participant argued that government incentives and economic factors also contributed to the growth in Australia.

Pandemic grants were also a source of opportunity, even those not directly related to food: “We’ve just received a government grant to exhibit at [an industry exhibition]. Now, we were already exhibiting but because the exhibitions industry has been devastated by COVID [...] so the government has offered \$50 million worth of packages to assist that industry, in just keeping it going.”

A number of interviewees highlighted growth stimulated during the pandemic:

**“Overall, the growth has positioned the industry for significant investments in innovation. This can be seen ramping up in food machinery manufacturing.”**

“Everyone I know [in the industry] is seeing massive growth in all sorts of machinery and automation, because all of our customers are busy and have cash.”

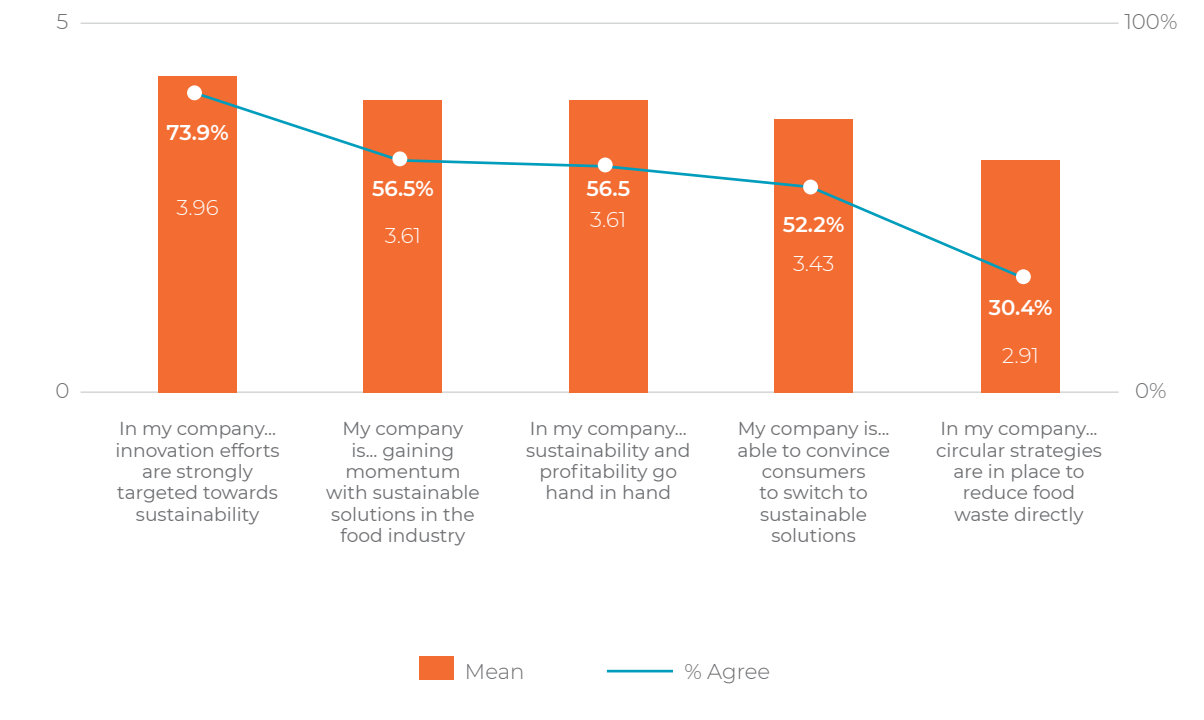
“That was probably the initial part of COVID was just the volume increase in that online ordering. But then the transition across to home eating, delivery, ready meals coming online, healthy eating, getting back into the kitchen, which created new products. A lot of our customers in the last 12 months [are] really gearing up to that market. That’s what I’ve seen. That’s been the growth of my business – is through supporting our customers, managing that volume increase, and then moving into the new product categories with that convenience eating at home. And again, I think it’s here to stay.”

### 3.3 The larger sustainability agenda in the PPM sector

While the COVID-19 pandemic has had – and probably will continue to have – an impact on operations and investments going forward, sustainability in general has already been a very important theme in the industry for years. **Figure 7** charts the larger sustainability context of the PPM sector. Overall, the results show that sustainability is an important component of the innovation

efforts in the sector, with 80% agreeing that their innovation efforts target sustainability. Interestingly, most firms stated that sustainability is gaining momentum, that profits and sustainability go hand in hand, and that most customers are aware of the importance and benefit of sustainability. Finally, the results show that circular strategies are in place in some firms.

**FIGURE 7**  
Sustainability agenda in PPM sector

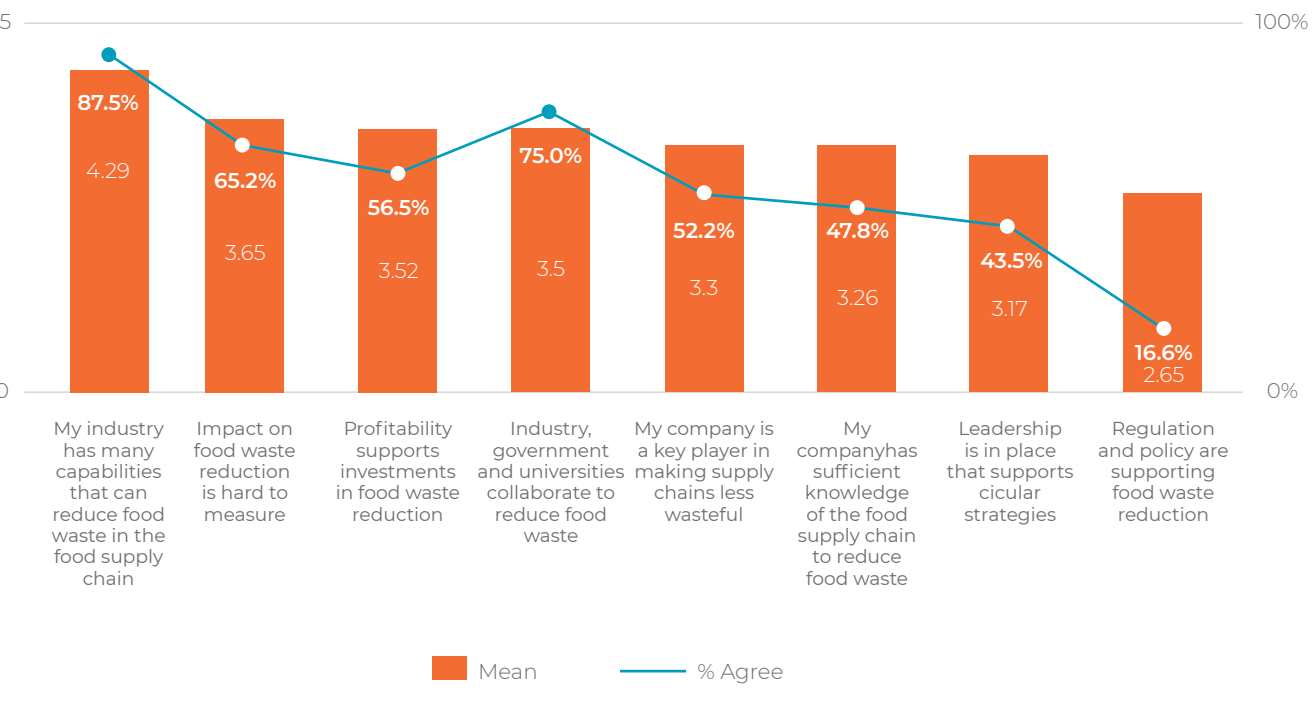


### 3.4 The food waste opportunity and challenges

**Figure 8** shows that the packaging and processing machinery industry has a broad array of capabilities to (potentially) reduce food waste and loss. Interestingly, there is some level of collaboration in the triple helix of industry, governments, and academia, but most firms think that more knowledge is needed (more detail in **Figure 8**).

The difficulty of measuring food waste and loss emerged as a significant issue, and most companies agreed that food waste and reduction impact measurements need improvement. This probably also relates to the need for a whole-of-chain approach as mentioned previously. A known issue of a heterogenous ecosystem with different types

**FIGURE 8**  
Food waste opportunity and challenges





of organisations and capabilities is often that no single firm can achieve success by itself. Only a minority of the firms (16.6%) agreed that the right policies and incentives are in place and that more needs to be done in terms of facilitation through government policy but also industry innovation in relation to financing. This also came up in the interviews:

Participants spoke of government incentives such as R&D tax concessions and new asset depreciation rules which supported the development and purchase of new technologies. One participant indicated that their organisation was working to reduce the initial financial burden related to investing in new technology for their customers: "We've even offered to help the industry by offering extended payment terms, minimum reduced down payments on machines to allow cash flow to get back into the companies to make it easier to transition across to [our technology]".

Interestingly, the interview quote above shows that there is a push for financial innovations in the marketplace. The ability to monetise investments and provide customers the ability to get returns in the long run seems to go hand in hand with incentives to reduce short term financial burdens for business-to-business clients.

### 3.5 Current PPM food waste reduction efforts in more detail

According to the organisations surveyed, companies have already developed and implemented a variety of food waste reduction strategies and technologies. These include specific investments made by the organisation listed below (in no particular order):

- Direct food contact conveyor belting with improved sanitation capabilities
- Thermodrives to increase product release from the belts, which improves yield
- Technology suites of gentle, touchless package handling to reduce damage
- Reclose and reseal machinery and materials targeted at soft plastic packaging
- Packing technology, safety, cleaning, and automation
- Spiral conveying systems, which reduce the time needed to chill or freeze products
- Software to measure rejects and products entering and exiting the line
- Sterilisation and waste reduction technology
- Extrusion technology
- Replacement of non-hermetically sealed packaging with top sealed products
- Equilibrium modified atmosphere packaging (eMAPS) solutions for shelf-life extension of fresh produce (see case description on the next page)

- Reclose and reseal systems on soft plastic packaging
- Efficient use of raw materials in packaging products
- Corrugated materials aimed at temperature control and creating moisture barriers for food
- Materials that are fully recyclable and environmentally favourable
- Recycling automation
- Processing system technologies

From the above list of investments, the key themes are manufacturing cleaning, energy, handling, system integration, packaging technologies, shelf-life extension, and recycling and sustainability. While the survey examples provided some level of richness and depth of the current practices in the PPM sector, the interviews highlighted key initiatives by specific organisations in full detail. One interviewee spoke about modified atmosphere packaging solutions.

Equilibrium modified atmosphere packaging (or eMAP) is a form of modified atmosphere packaging used by food packaging suppliers. One of our participants described eMAP: "So these are micro perforations of film, which allows the product to continue to breathe and to retain the balance of CO<sub>2</sub> and oxygen in the air so that you don't get an increased oxygen rate, which will then allows the product to actually spoil quicker." The aim of such packaging is to maintain the optimal atmosphere within the packaging.

**The benefits of eMAP and other film technologies was seen by participants as a key way to increase shelf-life and thus reduce food waste.**

Machinery manufacturers spoke of ongoing collaboration with packaging suppliers to support increased shelf-life:

"We're constantly talking to the film suppliers about the types of films there are. And there's a real push throughout all the film suppliers to have films that give longer shelf-life." Another participant spoke of an eMAP packaging experiment undertaken with growers that showed increases in shelf-life of up to six days.

Further, increased shelf-life was seen as a key metric that offered gains for all industry players, as it not only reduces food waste, but also offered financial benefits to growers and retailers. "If I could get another two days in my fridge, because I'm not throwing the strawberries out, that's something that's going to benefit everyone. And then there's knock on effects in terms of cheaper packaging for the grower, longer shelf-life for the retailer, the reduced logistics."

### 3.6 Emerging technologies to reduce food waste

As the technology is changing, new opportunities emerge on the horizon. While not all companies will focus on all, or even one, of these technology platforms, it is interesting to see how the industry perceives the usefulness for food waste innovation in the future. Companies in the study were asked “How likely do you think the following technologies will have an impact on reducing food waste?” (Table 3).

Table 3 shows that respondents saw blockchain as the most impactful technology. However, the number of firms knowledgeable about this approach – often used to process transactions and build trust in supply chains – was low, with only 10 firms stating that they are knowledgeable. The internet of things was seen as both



impactful and had broad industry awareness, as 23 firms indicated to be knowledgeable. Overall, participants identified a range of technological platforms that can reduce food waste and loss further. Respondents also suggested other technologies:

- better packaging materials (6)
- improved cold chain (2)
- enhanced regulation (1)
- monitoring software (1)
- automation/robotics (1)
- consumer education (1).

**TABLE 3**  
Perceived likelihood of impact of technologies

(M= mean; N= number of knowledgeable firms)

TECHNOLOGY	FUTURE IMPACT LIKELIHOOD (SCORE 1-5; 5= HIGHEST)	NUMBER OF KNOWLEDGEABLE FIRMS
Internet of things (IoT)	M= 3.96	N=23
Artificial intelligence	M= 3.72	N=18
Blockchain	M=4.10	N=10
RFID	M=3.56	N=18
QR codes	M=3.89	N=19

Note: Total number of companies that completed the survey was 27.

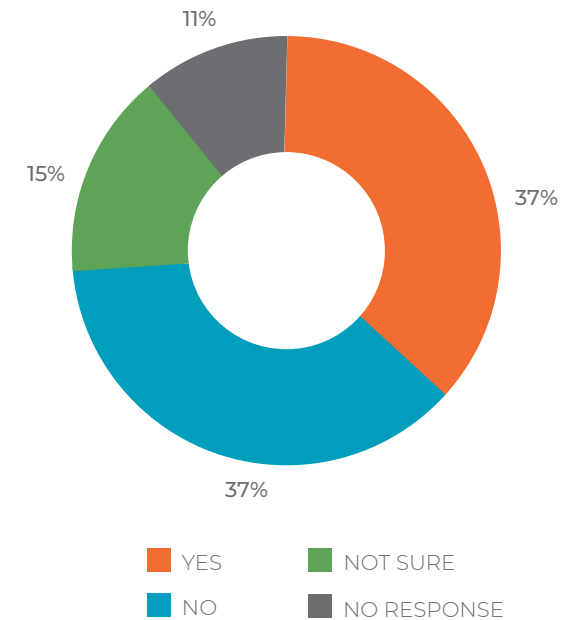
Interestingly, the cold chain emerges here next to product packaging, regulation, system integration, and customer education. The cold chain seems to be an important aspect of the supply chain where further integration with the PPM industry’s capabilities may be beneficial. Robotics also emerges here as an important approach to future food waste gains. The industry’s identification of robotics may be linked to the need to integrate control and handling platforms and reduce labour costs where possible. That said, the integration of robotics into the industry will also create a new wave of job skills and roles in both the development and implementation of these advanced systems. Interestingly, one of the large food retailers in Australia recently announced a complete new robotised facility for online order handling [6]. Finally, given that the PPM industry is talking about their core areas for future gains, the need to make changes to the practices in households and food service needs to be present as well.

Finally, all these technologies need investment to develop and implement them across the larger food supply chain. In the survey, a question on further investments was included: “Is your company currently investing in technologies and other solutions aimed at contributing to food waste reduction?” In terms of current investments, Figure 9 can be read as a glass half full. The responses to this question illustrate a substantial untapped opportunity for technological innovation in reducing food waste, with 37% of the responding companies stating that their organisations

have not invested in such solutions, and a further 15% being unable to supply details.

The list of current investments and projects show the indirect relationship between the PPM industry and the food supply chain. The core capability that the participants reported applying and developing include knowledge about handling and cleaning machinery in relation to moving and processing food. The existing investments also show the need to integrate the technological components and use measurement, data analysis, and control systems to optimise operational and maintenance workflows. One interviewee spoke about their innovative solutions using barcodes to help retailers capture better data that can benefit the retailer and the consumer.

**FIGURE 9**  
Is your company currently investing in technologies to reduce food waste?



One of the interviewees, Mark Dingley of Matthews Australasia, spoke at length about the opportunities presented by so-called '2D' data embedded barcoding, a system of barcoding that captures dynamic data. These upgraded barcodes allow retailers to capture a greater amount of data (than a standard '1D' barcode), including production dates, best before dates, and use by dates. An important initiative in food safety and security, this system has seen significant investment by a major Australian retailer.

However, our interviewee also claimed that the system had important implications for food waste, as retailers could more easily track stock, including stock that was near the end of shelf life, which they could then discount for quicker sale, reducing the possibility that it would be thrown out.

They also outlined its use in instances of food contamination outbreaks, suggesting that it would limit food wastage as contaminated batches of product could be easily identified (and thus limiting cases where larger quantities of food would

have to be discarded when batches could not be identified). Overall, the interviewee saw this technology as a great opportunity for businesses in the industry: “Clearly, there's advantages for all businesses that support manufacturing with coding and labelling technologies that can shift and support all manufacturers in driving improved traceability to support retailers.”

The optimism about labelling innovation opportunities was echoed by another interviewee, Michael Dossor of Result Group, who spoke of adhesive labels on packages that could monitor and show temperature compliance during the supply chain movement as well as adhesive labels that are freshness indicators for consumers that once they've opened the product at home. Both are based on patented specialised colour changing properties. The participant noted the Australian active and intelligent packaging industry "is actually really in its infancy, yet growing at a significant rate, with a range of technologies currently commercialised and many other set to follow".

### 3.7 Practices and food waste reduction projects

Organisations have been involved in a range of projects to reduce food waste. Fourteen firms have embarked on projects in collaboration with customers and/or others, and one has launched internal projects. The projects mentioned in the survey include:

- Washing and re-using packaging to reduce waste
- Extrusion technology
- Replacement of non-hermetically sealed packaging with top sealed products. Use of eMAP for shelf-life extension of fresh produce (see case box in Section 3.5 for more on eMAP)
- Reclose and reseal systems on soft plastic packaging





### 3.8 Sectoral challenges and impediments to reducing food waste further

Figure 10 shows 'customer willingness to pay', 'labour costs', 'difficulty of measuring food waste and impact of improvements', and 'customer demand' are perceived as the most important challenge or impediment. Interestingly, government policy is in the middle with respect to challenges and impediments, but earlier results indicate a strong missed opportunity to provide support through government policy and incentives.

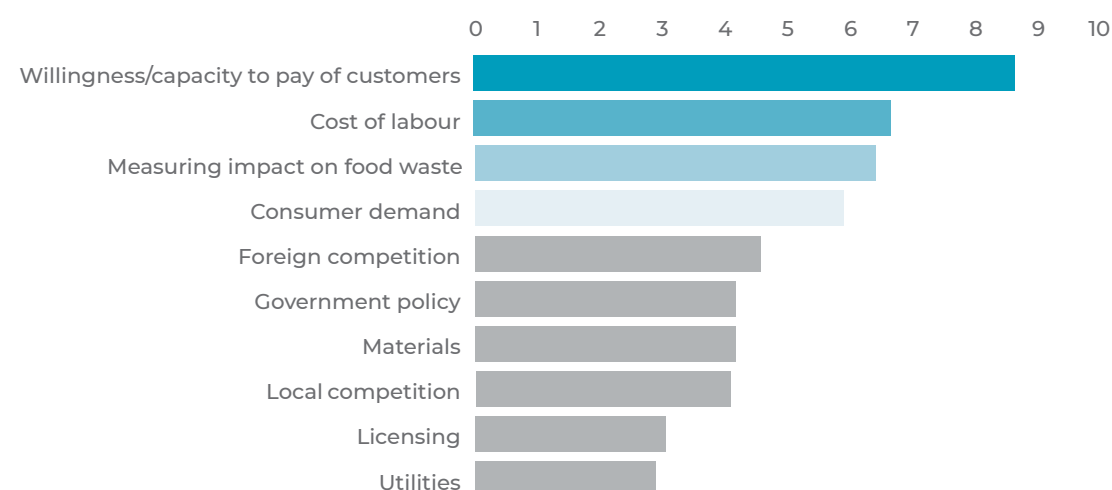
An interesting case that emerged from our qualitative interviews put the emphasis on retailers to dictate different standards

of packaging, such that new technologies would need to be adopted. A further example of the level of influence that retailers have can be seen in the move from the large supermarket chains to eliminate PVC in packaging. This has meant growers had to find alternative ways to package mushrooms for distribution to these retailers. The interviewee also argued that supermarket processes (such as moving goods in and out of chilled environments) can decrease shelf-life and thereby increase food waste.

"We've been banging our head against a brick wall for five years is the blunt answer. The only way it's going to move forward is if the retailers drive it. Simple as that."

FIGURE 10

Ranked challenges and impediments to adoption of new methods of manufacturing, packaging and processing that aim to reduce food waste.



### 3.9 Sectoral opportunities

Another interviewee highlighted the important role of retailers by detailing their years-long investment in 2D barcoding. The participant specifically indicated that the

retailer drove the project and suggested that it would have not been possible without their investment:

"A particular retailer was driving this, and...were the key driver in this." The participant further highlighted how important that retailer's role was in making such an investment: "The learnings [from that retailer] we can use that to support an industry wide transition to other retailers, because once we've achieved that, then that's going to significantly drive food safety, security, and food waste improvements for Australia."

Retailers also play an important role in the discussion about plastic. "You cannot look at food waste without looking at plastic. It is physically impossible to not have that tie in."

Transitions from chilled environments to non-chilled environments also came up in the context of retailers. "They still aren't taking advantage fully of the technology in terms of extending shelf life because...it's very important that the chilled logistics chain is in place. Because you're going from chilled to hot. ... And so what they're doing is heating it, chilling it, heating it, chilling it, and it actually adds to the spoilage."



Respondents indicated that the ‘packaging’ and ‘consumption’ stages of the supply chain have the greatest opportunity for food waste reduction over the next five years (Figure 11). They elaborated upon this by identifying the most vital capabilities to be developed within each of these sectors.

The most vital capabilities that the survey respondents identified included:

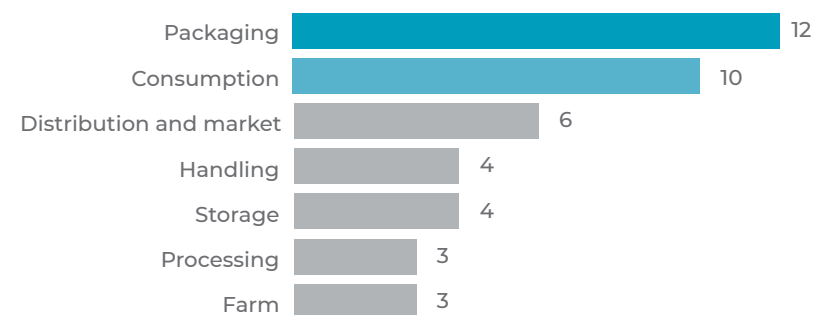
- Consumer education to reduce household waste
- Balancing shelf-life extension via packaging with waste reduction
- Education/communication throughout the supply chain
- Regulatory support/financial incentives
- Supporting infrastructure

- A relaxation of cosmetic measures of food appearance via major retailers.
- Automation
- Cleaning practices

The key themes that arose in responses to the future capability question relate to (1) the whole-of-chain approach i.e. including the household and optimizing control and cleaning in the other steps of the supply chain, (2) using packaging in a way that reduces waste and extends shelf life, (3) regulatory support, and (4) changing retail practices. From these examples, some changes in the practice and implementation of improvements have been adopted. It is also clear that more needs to be done. More collaboration, and a focus on the customer across the supply chain, are the underlying conditions for the adoption of innovations.

FIGURE 11

Sector opportunities in next five years for further food waste reduction



Perceived areas with opportunities for further waste reduction

The interview data shows a common concern about Australia being well-positioned for further food waste impact. For example, one participant indicated that Australia was lagging Europe in terms of packaging standards and thus had some catching up to do. Similarly, another participant, Rob Becher of INOX, indicated that Australian companies may be able to export waste-reduction technologies to Southeast Asia: “I think that will probably be a growing market. And if Australian companies can develop technology that reduces food waste, and processes that reduce food waste, then I think those companies will have opportunities abroad,

particularly in Southeast Asia where things are changing there a lot. Labour is becoming more expensive, and goods are becoming more expensive, so therefore, they're going to need to be more efficient.”

Interestingly, one participant indicated that an Australian retailer was a global leader in 2D data-embedded barcoding: “Some of these big global supermarkets have already reached out direct to [the Australian retailer] to understand what they've done, how they've done it, and how they've done it at scale, so they can be adopting similar strategies for their businesses around the world as well.”

## 3.10 Regulatory opportunities

Respondents were also asked to identify any opportunities for improving regulatory frameworks to support or enable the uptake of food waste reduction technologies. These responses are especially interesting in relation to the challenges and impediments presented earlier (Figure 10). The responses are grouped below by themes as they emerged across the responses.

Responses from the survey regarding the most vital regulatory change:

- Economic incentives:
  - “Making energy costs as cheap as possible for industry and food producers / manufacturers.”
  - “Unsure, but some means to reward companies who reduce unnecessary packaging (which is often used to reduce labour) to incentivise them to prioritise it over labour reduction.”
  - Giving concessions to companies that meet food waste targets.”
  - “R&D stimulus from government.”

- “Many technologies already exist. It’s all about brand owners adapting them.”
- Customer education:
  - “Sell By dates instead of confusing ‘use by’ and ‘best before’.”
  - “Ensuring consumers have appropriate measures in place to reduce food waste.”
- Enforcement:
  - “Clear national targets set by the Federal Government.”
  - “First measurement of impact and then enforcement of reduction based on sector specific norms.”
- Cosmetic standards:
  - “Don’t think regulations can achieve waste reductions, it needs to be an educated position. A lot of food goes to waste due to the fact it may have a blemish on it and consumers see this as not being edible even if the skin is removed.”
- Recycling system improvement:
  - “Develop a working structure within Australia for the recycling of plastics and to educate people on how to recycle. Remove the REDcycle system as this is flawed at its basic concepts.”
- Supply chain:
  - “Better tracking of products.”
  - “Regulation development for the food rescue sector to enhance network and distribution channels.”
- Other:
  - “Automation.”
  - “Local government support.”

The above feedback responses show there are a range of regulatory ideas and opportunities that can have a positive effect on innovation and food waste reduction. Some of these initiatives are already progressing in some way or form. For example, the Australian Recyclability labelling initiative by Australian Packaging Covenant Organisation is currently rolling out a new Australasian Recycling Label [7]. The food rescue sector is a focus of the Fight Food Waste CRC that is partnering with Foodbank and working on a case for tax reform to increase food donation by business for example [8]. Finally, there are a range of initiatives to grow the manufacturing capability in Australia the PPM sector is well positioned to play an important role in the manufacturing capability in the food industry and beyond [9].



## 4. CONCLUSIONS

Food waste reduction is a particularly complex challenge in making the food supply chain more sustainable. Too often, food that is destined for human consumption is not reaching the end goal of feeding people. Food waste and loss occurs across the whole supply chain and preventing waste therefore involves an integrated approach that is informed by a deep understanding of the factors and uncertainties that cause waste across the chain, from farm to fork.

The food supply chain and its indirect suppliers are actors who can offer capabilities and incentives to solve part of the puzzle. More importantly, there are systemic and incidental losses, and economic behaviours that try to deal with risks but also create waste. However, food waste is more than an environmental and economic metric needs to be improved; with global food insecurity growing, it is also a social injustice. Australian federal, state and local governments are investing millions to support research and new initiatives related to reducing food waste through initiatives such as AgriFutures Australia, cooperative research centres, the federally funded Entrepreneurs’ Programme, the CSIRO, and the Food and Agribusiness Growth Centre. Importantly for this research, industry and business are playing an important part in finding new solutions and building more efficient food systems. The packaging and processing machinery sector is investing in

new infrastructure for efficient packaging and processing and is playing an important role in making the food supply chain less wasteful.

The insights that emerged from our research led to the following conclusions:

### 4.1. Building the innovation ecosystem for the future

The companies in the PPM sector have a positive attitude towards food waste and loss reduction in the sector. Some existing innovations have already focussed on food waste reduction with direct and indirect impact on food waste in the food supply chain. While not ‘in control’ of any part of the food supply chain, this study shows that the packaging and processing machinery sector can play an important role in further reducing food waste and loss in the larger food system.

Technologies and machinery to support shelf-life extension, date marking and labelling, sustainable packaging for food services and hospitality, cold chain and logistics, and supply chain tracking are just some of the examples where this sector is and will continue to play an important role reducing waste across the food supply



chain. These also align with the Fight Food Waste CRC's Strategic Plan 2018-2028 and 2021-2028 Investment Framework [10, 11]. There are many opportunities for the PPM industry to become actively involved in new and emerging FFW CRC research projects, through insights, knowledge and expertise and access to equipment, technologies and machinery. Finally, the sector is ideally positioned to contribute to growing a responsible manufacturing capability in Australia and in other regions.

## 4.2. Developing circular strategies and leadership

While respondents generally stated their company has a well-developed sustainability strategy, there is room to implement broader circular strategies in the industry and develop circular leadership. Leadership may focus on building collaboration and starting initiatives that cross organisational boundaries and form a bridge between the PPM sector and the food supply chain. In addition, leaders need to be technology-minded across a range of platforms such as the internet of things, neural networks, and blockchain, as these technologies hold promise.

## 4.3. Policy and regulatory change as an opportunity

An important theme throughout all responses in the surveys and interviews was the need for policy as a force for good. Government policy was seen as a medium challenge or impediment to action, but also as a missed opportunity to further food waste reduction. There seems to be a clear need to liaise with government and develop pathways to accelerate current food waste reduction activities. Partnership with government departments may help with the adoption of the technologies by giving members confidence that regulatory issues can be addressed so that investment uncertainty can be reduced.

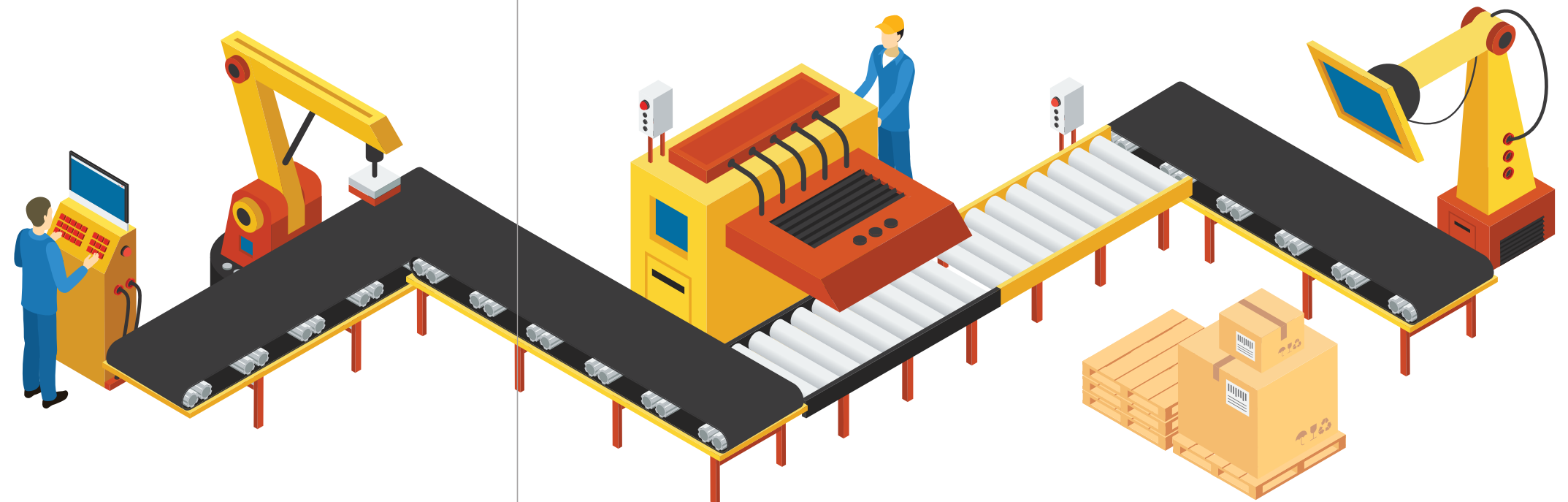
## 4.4 Leveraging the capabilities of the PPM sector

The capabilities and ecosystem of the PPM sector are broad and deep but also only indirectly connected to the food supply chain. Two strategies seem to emerge from the findings of this study. First, there is an opportunity to develop more in-depth food waste reduction capabilities in the packaging and processing area where the industry has core strengths. By building a full understanding of the needs of clients in that part of the food supply chain, the innovation development and adoption could be accelerated.

Second, by further integrating PPM capabilities that are adjacent to packaging and processing, the industry could broaden

their offerings and become more aligned with integrated whole-of-chain solutions. Again, this needs close interaction with food supply chain clients, as there are more technological and market risks in this approach. Ultimately, an innovation pipeline with short- and long-term outcome windows will need a whole-of-chain approach. This would require participation not only from the PPM sector and the food supply chain clients but also from academia and government, and an active involvement in larger policy debates.

These insights can also build upon the Fight Food Waste CRC Training Needs Analysis [12], which outlines the current state of play and opportunities to inform, develop, and disseminate future education and training, not only within the PPM sector but across the food supply chain.





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# APPENDIX A

## Questions used for the online survey conducted

Intro 1  
The following questions will give you an opportunity to tell us a bit about your organisation.

Q1 In which state(s) and/or territories(s) are your principle business operations based?  
[Select all that are relevant]

- TAS
- NT
- SA
- ACT
- WA
- QLD
- VIC
- NSW
- FED

Q2 Please indicate the number of full-time equivalent, Australian based, employees employed by your business?  
[Enter an estimated whole number]

Q3 Which sector(s) of the food supply chain does your business operate in?  
[Select all that are relevant]

- Farm
- Handling
- Storage
- Processing
- Packaging
- Distribution & Market
- Consumption

Q4 What is the focus of your business within the Packaging and Processing Industry? [Select the most appropriate ones]

- Handling equipment
- Inspection systems
- Palletising and depalletising
- Robotics
- Vision systems
- Weighing equipment
- Boxes
- Capping
- Cartoning
- Date labelling
- Filling
- Labelling
- Material supply
- Printing
- Sealing
- Wrapping
- Blending
- Cleaning/sterilisation/washing
- Cookers
- Electronics
- Extruding
- Fabrication
- Fillers
- Granulation
- Homogenisers
- Medical
- Part supply
- Pasteurisers
- Pneumatics
- Sortation
- Tabletting
- Environmental
- Services
- Software
- Safety
- Temperature management
- Not listed [please describe in text box]



Q5  
From the following statements, how much do you agree or disagree with each?  
[Please rate each statement once]

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
The food market is a very important market for our company	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
R&D plays an important role in our company	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Services play an important role in our market	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Measuring the impact of our technology on food waste will significantly increase our competitive advantage in the future	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q6 Can you please estimate the division of the following, within your business operations, as they are today. [Drag the slider to represent the percentage balance of each - totaling to 100% - with Option (A)'s value being where the slider extends to]

- Hardware (A) v Software (B)
- Products (machinery and/or packaging) (A) v Services (B)

Intro 2  
The following questions will explore food waste and technologies aimed at reducing food waste

Q7 To what degree is food waste an issue for the markets and clients you service?  
[Slide the scale between 0 and 10]

0 = It's not an issue      10 = It's a really big issue

0   1   2   3   4   5   6   7   8   9   10

Degree an issue ()

Q8a How likely do you think that the following technologies will have an impact in reducing food waste [if adopted at scale]  
[Select from very unlikely to very likely or 'Don't Know']

	Very unlikely	Moderately unlikely	Neither unlikely nor likely	Moderately likely	Very likely	Don't Know
Internet of Things (IoT)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Artificial Intelligence	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Neural Networks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Blockchain	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
RFID	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
QR Code	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q8b What technologies, not listed above, do you think will likely have an impact in reducing food waste?  
[Please name the technology(s) and say why you think it will have an impact]

Q9a Is your company currently investing in technologies and other solutions, aimed at contributing to food waste reduction?

Yes

No

Not sure

Q9b Please provide a short description of the technologies and other solutions, aimed at contributing to food waste reduction, that your company is currently investing in?

Q10a Please indicate your company's intention with regard to investing in technologies and other solutions, aimed at contributing to food waste reduction, in the future?  
[Drag the bar to represent your intention]

Low Intention      Medium Intention      Serious Intention

0   1   2   3   4   5   6   7   8   9   10

Intention

Q10b You indicated medium to serious intention for investing in technologies and other solutions, aimed at contributing to food waste reduction, in the future.  
For the following please record your intentions regarding that investment.

	Within the					
	Short term	Medium term	Long term	Small	Medium	Significant
Intending to invest in food waste reducing technologies and solutions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q11a Has your business already been involved in any projects (e.g. developing technologies and other solutions) aimed at reducing food waste? [Select one answer]

Yes - Internally only

Yes - In collaboration with customers and/or others [e.g. business and/or researchers]

No

Unsure

Q11b OPTIONAL Please describe the project(s) that your business has been involved in. [If you can, make sure to note how the project aims to or has impacted food waste reduction - and how that will be/has been measured]

Intro 3  
The following questions will explore the current state of the industry and your company

Q12 Please rank the challenges/impediments that prevent the adoption of new methods of manufacturing, processing, and packaging, that aim to address food waste?  
[Rank from most to least challenging - with 1 the most and 11 the least challenging - by selecting labels and dragging to reorder]

- Government
- Local competition
- National competition
- Foreign competition
- Consumer demand
- Cost of labour
- Utilities
- Materials
- Licencing
- Difficulty in measuring impact on food waste
- Customer willingness/capacity to pay

Q13 From the following statements, how much do you agree or disagree with each?  
[Please rate each statement once]  
In my industry...

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
...Regulation and policy are supporting food waste reduction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...The circular economy and waste reduction is seen to be very important	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...There are many capabilities that can reduce food waste in the food supply chain	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...There is broad recognition for the need to reduce food waste	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...Industry, government and universities collaborate to reduce food waste	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q14 From the following statements, how much do you agree or disagree with each?  
[Please rate each statement once]  
In my company...

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
...There is sufficient knowledge of the food supply chain to reduce food waste	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...Circular strategies are in place to reduce food waste directly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...Innovation efforts are strongly targeted towards sustainability	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...Profitability supports investments in food waste reduction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...Impact on food waste reduction is hard to measure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...Sustainability and profitability go hand in hand	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...Leadership is in place that supports circular strategies	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...COVID-19 creates innovation opportunities	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q15 From the following statements, how much do you agree or disagree with each?  
[Please rate each statement once]  
My company is...

	Strongly disagree	Somewhat disagree	Neither agree nor	Somewhat agree	Strongly agree
...Successful in reducing food waste, either directly or indirectly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...Gaining momentum with sustainable solutions in the food industry	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...Having a measurable effect on food waste reduction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...Able to convince customers to switch to sustainable solutions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...A key player in making supply chains less wasteful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
...Achieving significant impact in food waste and loss reduction	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Intro 4  
The following questions will explore the future of the industry

Q16 What sector(s) of the food supply chain has high potential for improvement, to help reduce food waste, in the next 5 years? [Please select up to two of the options below]

- Farm
- Handling
- Storage
- Processing
- Packaging
- Distribution & Market
- Consumption

Q17 What is the most vital industry capability that needs to be developed, in the coming 5 years, that will support delivering food waste reduction targets?  
[Please write your answer below]

Q18 What is the most vital regulatory change needed that will support delivering food waste reduction targets?  
[Please write your answer below]

End. End of Survey - Click forward arrow to submit



# APPENDIX B

Question guide for the stakeholder interviews conducted

Background and role

Firstly, I want to find out more about your background and role.

Q1. Can you tell me more about your background and role in the company?

PROBING QUESTIONS: For example, what role do you have in making decisions about developments in machinery and technology, or in forming or maintaining relationships with food processors?

Q2. Can you describe the size of your company in terms of how many employees?

Q3. What level of interest and/or involvement would you say you have, personally, in reducing food waste either in your own life or within your company?

PROBING QUESTIONS: What would be the reason for your level of interest?

Company involvement in reducing food loss or waste

Next, I would like to ask you more questions about your company’s involvement in a project or projects that aimed to reduce food loss or waste.

Q3. Has your company been involved in a project that aimed to reduce food loss or waste?

If YES:

Q3a. Can you explain the project, its partners and how the project came about?

Q3a.i. What were the internal drivers for this project?

Q3a.ii. What were the external drivers?

Q3b. What was your role in the project?

Q3c. What was the target outcome and was the target achieved?

Q3d. What were the benefits of the project, and who benefitted from the project?

Q3e. How was the impact measured?

If YES:

Q3e.i. Can you share the measurement results?

If NO:

Q3e.ii. Do you think there is scope for the impact to be measured?

Q3e.iii. What are some of the barriers to measuring the impact?

Q3f. What was the role of the machinery or technology component in the project and its outcome?

Q3g. Where does that technology touch on food within the supply chain?

PROBING QUESTIONS: Is that around, for instance, processing? Or distribution?

Q3g.i. How much food does the technology touch within the supply chain?

Q3h. What are the lessons learned from the initiative itself and perhaps also the technology itself?

Q3i. What has happened in your organisation because of the project or initiative results?

Q3i.i. Why do you think that is?

Q3.i.ii. What, if any, media exposure was there in relation to this initiative/project?

Q3j. Are you aware of any impact on the other organisation/s you were working with on this project?

If NO or YES to Q3:

Q4. Are there plans for food loss or waste reduction projects planned?

Q5. What is driving these plans?

PROBING QUESTIONS: What are the internal drivers for these plans? What are the external drivers?

Q6. What opportunities do you see for food loss and waste reduction in the processing and machinery sector more broadly?

Q7. In order for these opportunities to materialise, what is needed?

PROBING QUESTIONS: What capabilities need to be developed more?

Q8. In your view, does food loss and waste contribute to the bottom line of your company?

Q8.a. What might this look like in the 12-18 months?

Q8.b. What about in 2-5 years?

Q8.c. Why do you say this?

Interest in MBA project

There is an opportunity to involve an MBA team from RMIT (roughly 4 students in their final stage of the program) to further develop an opportunity to reduce food loss and waste and/or develop a plan or business case for further investment.

- Q9. Would you (and your company) be interested in such a follow up?
- Q9.a. If there is a particular project you have in mind for working with MBA students, how would you describe that project, briefly?

Final questions

- We are just about finished.
- Q10. [To observer] Were there any questions that arose for you while [participant’s name] and I were talking?  
[Observer to indicate that their questions have been answered; then ask questions below.]
  - Q11. Do you have any thoughts on reducing food loss and waste and current capabilities used with packaging and processing machinery and technologies that we have not discussed?

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