Consumer perceptions of the role of packaging in reducing food waste

Final Project Report

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Australian Government
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Industry partner foreword

Partnering on projects like these is enormously valuable to those of us working on such a complicated problem as food waste. Having a research team made up of academia and industry, and working across jurisdictions, enables us to test assumptions, provide evidence and truly understand the drivers behind food waste.

It provides a partner like Sustainability Victoria with insights that we can apply to designing and delivering programs, as well as education and behaviour change campaigns. Packaging can play a key role in reducing food waste for the consumer. This project has highlighted consumer beliefs and preferences for different food categories, but also the confusion arising from food packaging. It has also highlighted the tensions we cannot ignore – such as packaging waste being perceived as worse than food waste. With so many interventions needed across the supply chain to reduce food waste, research projects like this provide a broader view across the whole topic and ensure we are prioritising and focusing on areas we are each best placed to make an impact on.

Izo Lourival
Sustainability Victoria

Executive Summary

Food packaging has been recently framed as a significant environmental issue. Still, the relationship between packaging and food waste, and the impacts that food waste can have on the environment, have been underrepresented in sustainability campaigns for consumers. Existing research has found that packaging is often viewed as having a negative impact on the environment because it is 'left over' once a product is consumed and must be disposed of. However, in many cases, packaging protects food and prolongs its shelf-life, reducing food waste and the consequent negative environmental impact. If it is designed correctly, food packaging can reduce household food waste. Packaging designed with food waste in mind can extend the shelf-life of food products, cater to different-sized households (and therefore reduce leftovers), communicate the best way to use and store a food item, and assist households in using date labels to manage their food better.

To address the issue of household food waste and its complex interrelationships with supply chain factors, a deeper understanding of consumers' attitudes towards food waste in the home and food waste's relationship to packaging is required. This project aimed to develop both deep and broad insights into consumers' attitudes towards food waste and how food waste relates to packaging. In doing so, we aimed to provide industry with options to develop packaging design alternatives that draw on the knowledge of consumers' use and understanding of packaging to reduce food waste. With a greater understanding of how people appreciate and use packaging, along with the food waste they generate, we can design improved packaging and communication that will ultimately reduce food waste.

Objectives

This project aimed to understand consumer perceptions of the role of packaging in reducing food waste by:

- Discovering target areas that helped drive packaging design decisions.
- Discovering key consumer behaviours that could be adapted to reduce food waste.
- Determining potential consumer responses to labelling and packaging alternatives in relation to food packaging.
- Providing formative information for industry partners' new product development processes.
- Designing packaging solutions to reduce food waste.
- Designing more effective consumer education campaigns to reduce food waste.

Results

This project has produced rich insights into Australians' attitudes towards food waste and packaging and has used these insights to design packaging alternatives that may reduce food waste in the home. Moreover, in working closely with industry partners and representatives with an iterative, mixed methods approach

This project has developed design alternatives that prioritise both consumers' perceptions and industry priorities.

with multiple concurrent research stages, this project has developed design alternatives that prioritise both consumers' perceptions and industry priorities. Thus, this project bridges the 'gap' between consumer's expectations and the capability of industry to respond. Full reports for this project can be downloaded from the Fight Food Waste Cooperative Research Centre at https://fightfoodwastecrc.com.au/project/consumer-perceptions-of-the-role-of-packaging-in-reducing-food-waste/. Please contact the first authors if you need further details at linda.brennan@rmit.edu.au or lukas.parker@rmit.edu.au.

Summary insights

In terms of packaging design, some of the key insights from consumers include:

- Packaging design should provide information in short form with simple text and symbols. Consumers will use QR codes if available.
- People will pay to reduce waste overall, including food waste.
- Treat the various food product categories differently regarding packaging and labelling.
- Show consumers how to repurpose and refresh fruit and vegetables.
- Focus on safety cues for meat and seafood in packaging designs.
- Unpackaged food is problematic because there is no provenance or indicators of authenticity.
- Packaging needs to indicate portion size and serves.
- Offer thoughtful recipe ideas for leftover content.
- The term 'best before' is clearer than other terms like 'eat me' or 'freshest by'.
- The term 'Eat within X number of days' is helpful for consumers.

From industry, some of the key insights were:

- More consumer education is required to show consumers how to reuse and recycle packaging.
- More consideration is needed for portion-controlled packaging.
- The cost of sustainable packaging options and changes needed to machinery to produce sustainable packaging is too expensive.
- Government targets are not feasible without a whole-of-system approach to reducing food waste.

Next steps

These insights provide industry and government with foundational advice to pursue actions that may better inform and enable consumers to reduce food waste in the home regarding packaging. The project uncovered several key insights for industry – including food producers and packaging designers along the supply chain – for reducing food waste. These insights are based on consumer research

and extensive consultation with industry to balance industry priorities and capacities with consumer behaviours and expectations.

Further research is needed to use consumer insights for developing policy and affecting packaging designers' and producers' approaches to using food waste, particularly around date mark labelling and storage advice. These insights can also feed into interventions and education campaigns for consumers and industry to reduce food waste.

The next steps for this research lie in the development of the Fight Food Waste Cooperative Research Centre project regarding date mark labelling and storage information. The consumer insights developed in this project will be fed directly into the new study of consumers' understandings and behaviours in relation to best-before dates and use-by dates. This new study will work with industry to reform the date labelling system and educate consumers on the proper use of date labels. Prior research has found that consumer education and industry reform relating to date mark labelling is a hugely impactful way of reducing food waste in the home.

Timing

This project began in 2018, data collection is complete and final publications associated with this research will be submitted in the first quarter of 2023. The future date mark labelling project is in the late stages of development and is expected to commence in Q1 2023.

Project milestones

Milestone ID	Milestone	Complete
M1	Baseline literature review brief and ethics application	100%
M1.1	Prepare literature review briefing paper of consumer perceptions and role of packaging in minimising food waste (RMIT).	100%
M1.2	Prepare and submit ethics application (RMIT).	100%
M1.3	Determine a baseline for household food waste in Australia and agree (between project parties) on targets for what savings may be achieved through packaging design	100%
M2	Undertaken Journey mapping (rapid ethnography) [A] (RQ1) and Online Survey [A] (RQ2)	100%
M2.1	Prepare briefing paper for data collection and discussion guide (RMIT)	100%
M2.2	Undertaken Journey Mapping [A] – Rapid Ethnography (RQ1) (RMIT)	100%
M2.3	Begin Online Survey [A] (RQ2) (RMIT	100%
M2.4	Summary report of literature review completed (RMIT)	100%
M3	Analysis of insights from Journey mapping (rapid ethnography) and Online Survey and Think Tank 1	100%
M3.1	Preparation of report on Online Survey (RMIT)	100%
M3.2	Think Tank Sprint Series	100%
M3.3	Undertake journey mapping	100%
M3.4	Undertake online survey	100%
M4	Conduct PII packaging interviews	100%
M4.1	Prepare qualitative report on RQ3a in-home interviews (PII packaging)	100%
M5	Analysis of EPPS online survey and conduct second sprint of Think Tanks	100%
M5.1	Hosting of Think Tank 2 forums	100%
M5.2	Analysis of online survey data (EPPS)	100%
M5.3	Draft publications of online survey data (EPPS) and packaging interviews data (PII)	100%

Milestone ID	Milestone	Complete
M6	Implement CCS survey and Analysis of Consumer Choice Survey data (CCS)	100%
M6.1	Insight report for CCS data	100%
M7	Focus group implementation	100%
M7.1	Draft publications of consumer choice survey data (CCS)	100%
M7.2	Focus group preparation	100%
M8	Design and develop packaging options and test concepts	100%
M8.1	Conduct concept testing focus groups	100%
M8.2	Analysis of Focus Group Concept Testing (FGCT)	100%
M9	Draft insights report	100%
M9.1	Sense checking solutions with industry	100%
M9.2	Finalisation of report	100%
M10	Final project documentation	100%
M10.1	Draft final project report	100%

CRC Milestones completed:

CRC 1.13: Continuation of assembling and sharing industry case studies; Guidelines embedded into NPD processes; Consumer perceptions database built upon.

CRC 1.14: Updated consolidated packaging design guidelines and frameworks delivered; Industry case studies & consumer database expanded.

Utilisation/commercialisation opportunities

The packaging design options are freely available to CRC partners. Partners have been involved at all stages of the research. It is not known what use partners have made of the research in their designs or innovations.

IP

There are no outstanding IP considerations.

Confidentiality

The report is not confidential.

Approved by –

Bryan Coad, Research Director
Fight Food Waste CRC

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01

Introduction

Reducing food waste is widely seen as a significant way to lower production costs, increase the efficiency of the food system, improve food security and nutrition, and contribute toward a more environmentally sustainable food system. Food waste at the consumer level is often caused by poor purchasing habits, confusion over labels, excess buying, and poor storage. Packaging is often viewed as having a negative impact on the environment. However in many cases, packaging protects food and prolongs shelf life, reducing a product's overall environmental impact by reducing food waste. Food packaging can reduce household food waste when it is designed to extend the shelf life of food products, available in various sizes for different sized households, communicates the best way to use and store food items, uses date labels to assist households in managing their food better, and slow the degradation of minimally processed fruits and vegetables.

In Australia and New Zealand, it is estimated that about 5-6% of all food produced in 2016 was lost in the retail and consumer stages of the food system, while 13.8% was lost at these stages globally. It has been calculated that consumer food waste in Australia accounts for 34% of all food wasted across the food supply chain, with 92% of this waste ending up in landfill.

Five main food categories

This research focussed on five main categories of household food waste: (1) meat and seafood, (2) bakery, (3) packaged and processed foods, (4) dairy and eggs, and (5) fresh fruit and vegetables. These categories were selected as key priorities by industry in think tanks conducted before project inception.

Although leftovers have been identified in various studies as a major contributor to household food waste, this category is beyond this project's scope as cooked meals no longer involve the packaging in which the food was sold.

Research design

The project progressed through 13 interrelated and iterative research stages conducted over four years (Figure 1 and Figure 2):

- Stage 1: Background Literature review.
- Stage 2: Baseline conceptual model of food waste in Australia.
- Stage 3: Journey mapping.
- Stage 4: Existing perceptions of packaging survey.
- Stage 5: Industry Think tank online survey.
- Stage 6: Publications and reports.
- Stage 7: Packaging design consumer interviews.
- Stage 8: Design and develop packaging alternatives.
- Stage 9: Consumer acceptance of packaging design alternatives.
- Stage 10: Industry think tank sprint series.
- Stage 11: Re-design and re-develop packaging alternatives.
- Stage 12: Focus group concept testing of packaging alternatives.
- Stage 13: Report to industry and academy.

FIGURE 1

Stages of the project, part 1

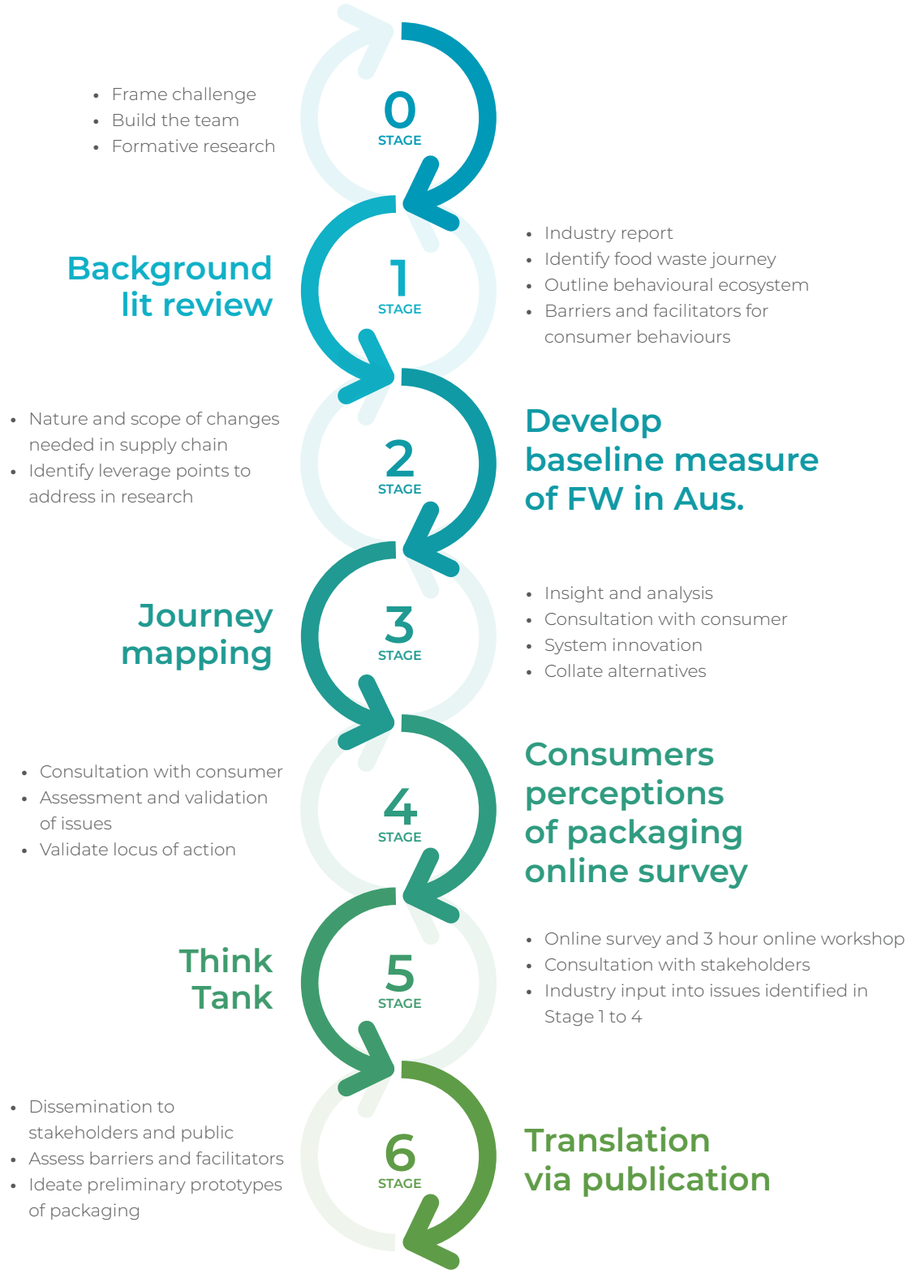
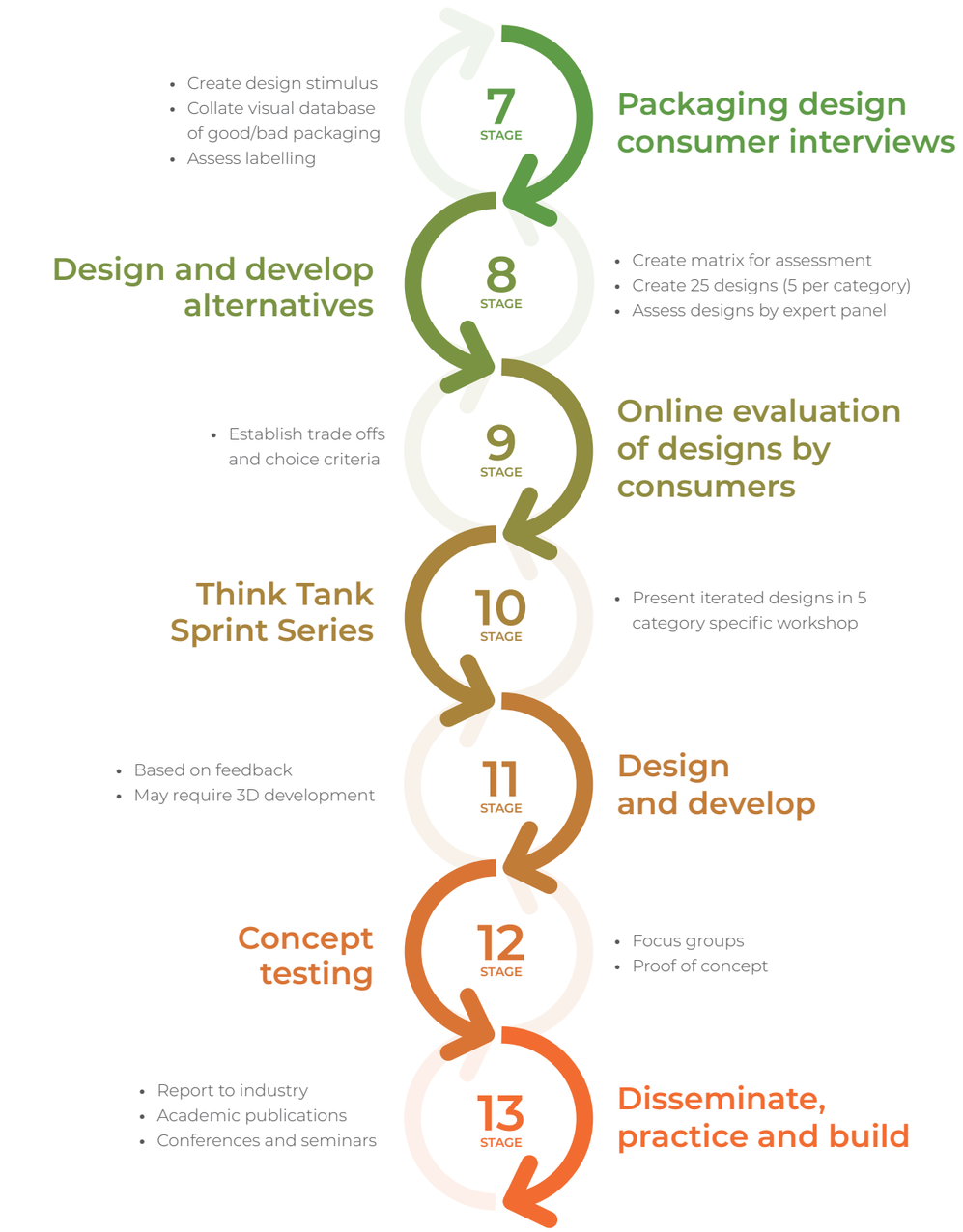


FIGURE 2

Stages of the project, part 2



These stages were often concurrent, and insights fed into activities in other stages. The loops denote iteration where information is fed forward and backwards dependent on the outcomes of the research. The research protocol was not linear or sequential.

Key documents:

These research stages were carried out mostly chronologically but with some concurrent stages. Findings and insights from each stage were fed into other stages iteratively.

This project produced several key documents that capture the findings and insights of the research. These can be found on the project page of Fight Food Waste CRC's website. A complete list of all publications resulting from the project can be found on page 87.

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Methodologies

This section briefly outlines the various methodologies used for the overlapping and intersecting stages of the research project. Complete detail of the methodologies can be found in the respective reports from each stage, available on the project page on the Fight Food Waste CRC's website. In addition, a book chapter has been written detailing the overarching approach and the methodologies of each project stage (Brennan et al. 2021a).

The Fight Food Waste Cooperative Research Centre and RMIT University conducted this project for almost four years, including pre-inception think tanks with industry. Based on the consumer stage of the food supply chain, the project focussed on food packaging, exploring both design and consumer perception complexities and their impact on food waste. The project entailed a comprehensive multidisciplinary approach to the research, applying multiple methods, including design, innovative qualitative and confirmatory quantitative techniques. All phases were conducted in collaboration with industry partners and thought leaders in consumer research and packaging design. The multi-staged approach was helpful, as it permitted several iterations to the design process, thus allowing for feedback to be incorporated into package designs and further research.

Stage 1 Methods:

Baseline literature review

Stage 1 consisted of a literature review on consumer perceptions of the role of packaging in reducing food waste. We conducted a systematised literature review of both academic and grey literature based on the methods put forward by Grant and Booth (2009). For more detail on the systematised literature review method employed for this research stage, see the Baseline review Industry report (Full) and Brennan et al. (2021b).

Stage 2 Methods:

Baseline conceptual model

Stage 2 established a national food waste baseline using the multi-levels identified by Social Innovation (Hubert, 2012). The Australian Food Loss Waste (FLW) baseline was mapped at:

1. The systemic (national) level.
2. Category (food) level.
3. Role (stakeholder) level.
4. Social (consumer) level.

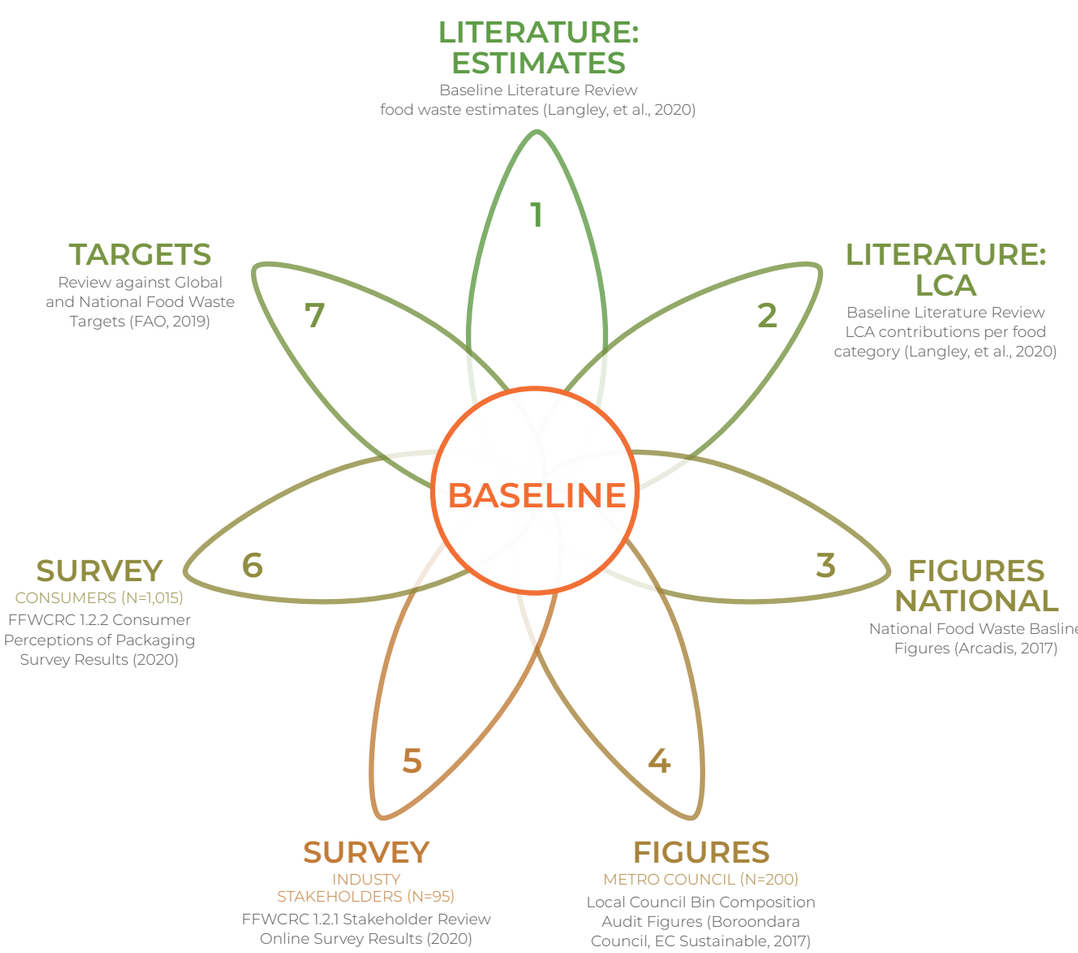
The baseline drew on a combination of sources (Figure 3):

- The literature review from Stage 1 (the Baseline Literature Review) referencing food loss estimates compared to Life Cycle Analysis (LCA) reported data for the five food categories.
- Figures taken from a national food waste baseline (Arcadis, 2017) were contrasted with a local council bin composition audit (conducted for the Boroondara Council by EC Sustainable in 2017).
- Two surveys consulting industry (a stakeholder survey from FFW CRC Project 1.2.1) and consumers (Existing perceptions of packaging survey (see below)).
- Finally, the resulting baseline was judged against global and national targets to recommend actions.

More detail on the methods used to form the food waste baseline can be found in the Conceptual model (video).

FIGURE 3

Composition of the Baseline conceptual model



Stage 3 Methods:

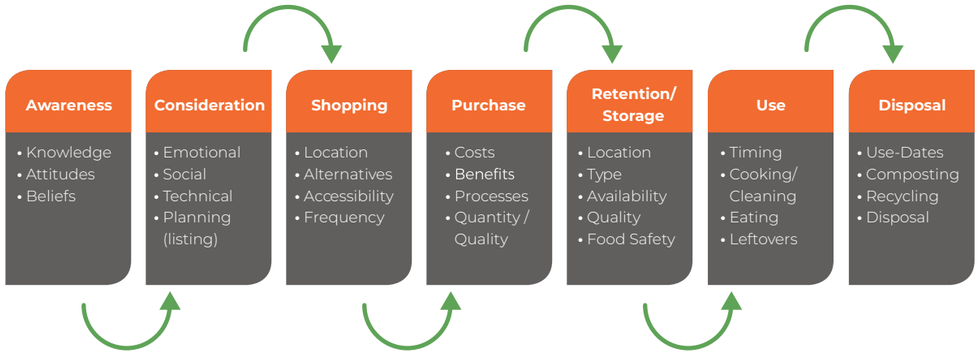
Journey mapping

Stage 3 used a rapid ethnography journey mapping methodology (Brennan, Fry, & Previte 2015) to determine consumers' experiences with food, packaging, and waste, from purchase to disposal. Journey mapping is based on theories of rapid ethnography (Millen 2000; Pink & Morgan 2013) and took the form of interviews. 37 journey mapping interviews were conducted in homes around Melbourne, Victoria and were managed by an external research supplier. Each journey mapping session was audio recorded. The interviewer created a handwritten map during the session and took photos of the participants' food and where it was stored and disposed of (see Figure 4). The research team then transcribed the interviews and analysed the transcriptions along with the digitised journey maps and food images. The images provided a useful context and even contradictory contrast to what was said during the journey mapping session.

More information and detail on the methodologies used in this project stage can be found in the Journey mapping (full report).

FIGURE 4

Journey mapping methodologies



Stage 4 Methods:

Existing perceptions of packaging survey

Stage 4 used an online survey to produce qualitative and quantitative data on consumers' existing perceptions of packaging and its relationship to food waste. Using a mixed methods approach, the survey used the Qualtrics XM platform to ask qualitative and quantitative questions informed by the findings of the journey mapping stage. A sample of 1,015 Australian participants was surveyed, with a final 956 consumers' responses included in the analysis. Their answers were analysed using multivariate linear modelling, and insights from this research stage were fed into subsequent stages.

More detail on the methodology of Stage 4 can be found in Consumer survey analysis (summary) and Consumer survey results (full dataset).

Stage 5 Methods:

Industry think tank online survey

This research stage surveyed key industry representatives to capture their insights into previous research stages' findings. Industry consultation progressed in three steps. First, an online survey was circulated to 155 participants, with approximately 80 responses included in the analysis. These questions specifically asked about industry's capacity to act in relation to the insights from the earlier research stages. Results were analysed by multiple investigators using an informal content analysis to identify key themes.

Second, an online workshop was held to further develop and discuss the ideas that emerged from the online surveys. Notes were made during the workshop, as well as de-identified transcripts, which were analysed by multiple investigators using an informal content analysis to identify key themes. Themes were then investigated in terms of contribution to packaging and food waste. Some themes that were not about food waste *per se* were included in the analysis because of the extent and importance of the discussion.

An additional third step was undertaken in Stage 10 of the project, the Think Tank Spring Series (see below).

More detail on the methodology of Stage 5 can be found in Industry Think Tank Results.

Stage 6 Methods:

Publications and reports

Stage 6 focussed on developing the insights gained from each stage into impactful and engaging research outputs for academia and industry. This included scholarly articles, book chapters, industry reports, data sets, videos, and infographics (see Project Publications section below). The rapid dissemination of knowledge through publication allowed for iteration and further ideation and expanded the knowledge network, as feedback was received throughout the research project. It also provided external validation of the methodologies of each stage and ensured rigour in the approaches.

Stage 7 Methods:

Packaging impact interviews

This stage measured the impact of packaging designs, including labelling, on consumers and their food waste behaviour. Stage 7 used a mixed methods approach of in-home, virtual, and semi-structured interviews, with questions drawing on insights from Stages 1, 3 and 4.

An external research supplier conducted 50 semi-structured interviews, in which participants across Victoria were prompted to reflect on examples of packaging and labelling. Interviews were recorded and transcribed, along with images supplied by consumers. These data were analysed through activity theory (Engeström, 2005), assessing the interactions and interrelationships between individual consumers, the packaging, and other elements that impact consumers' decisions.

More detail on the methodology used for this research stage can be found in the Packaging interview insights – Insights Report.

Stage 8 Methods:

Design and develop packaging alternatives

This stage used a double diamond method to develop and design new packaging solutions that might reduce food waste. Results from Stages 1, 3, 4, 5, and 7 were used in various stages of the double diamond process, with the results from Stage 1 and Stage 4 forming the benchmark of the problem the process was used to solve (see Figure 5).

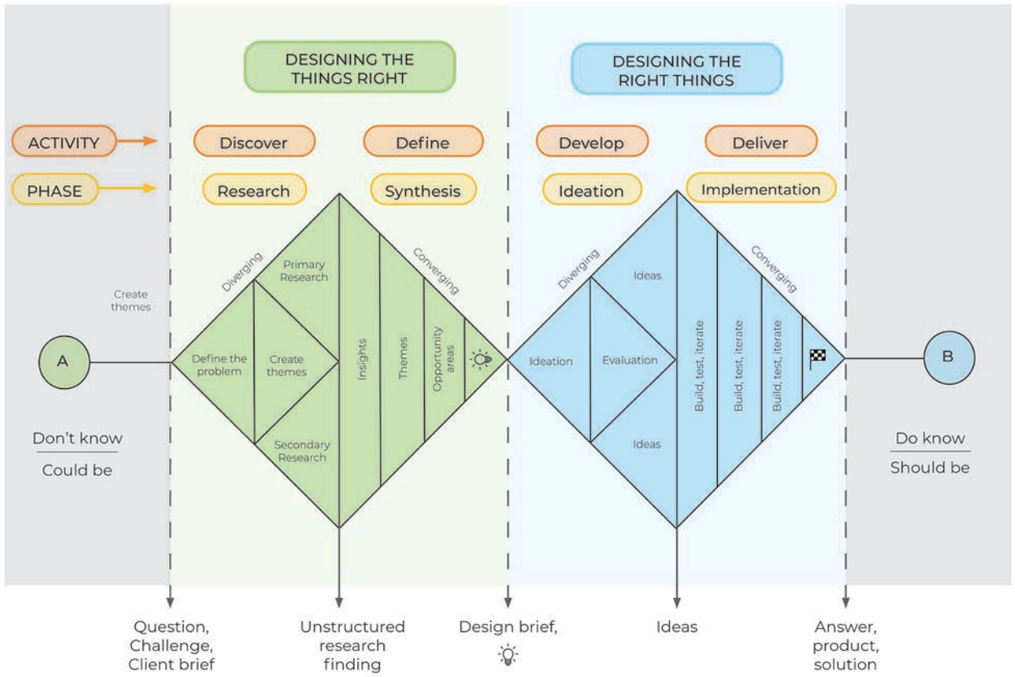
Packaging design scenarios were developed as the precursor to the validation stage of the double diamond method. These designs were developed based on information from the previous stages through a series of conceptualising procedures consisting of mind mapping, categorising/coding design ideas with a matrix, and 2D visual prototypes.

The packaging alternatives were developed through four distinct phases (with a fifth phase linked to Stage 9 and Stage 10 of the project, see below):

- Phase 1: Empathise—Collection of Insights.
- Phase 2: Define—Categorisation of Insights.
- Phase 3: Ideate—Populating Packaging Design Matrix.
- Phase 4: Prototype—Design Selection.
- Phase 5: Test—Think Tank Appraisal of Packaging Visual Prototypes, conducted in Stages 9 and 10.

FIGURE 5

Double diamond process used in this project



The final 25 prototypes were developed and made ready for testing with consumers and industry in the later stages of the research.

More detail on the methodology of Stage 8 can be found in Brennan et al. (2021a) and the Consumer acceptability of packaging designs (video).

Stage 9 Methods:

Consumer acceptance of packaging alternatives survey

Stage 9 consisted of an online survey of consumers to gain insights into their acceptance of the 25 prototypes developed in Stage 8.

Fifty users in each of the five main food waste categories under consideration were targeted and filtered into relevant food category packaging design review segments (250 people in total located Australia-wide, mainly primary grocery buyers). Each participant was filtered and only assessed packaging designs for one of the main/ five food categories that they qualified for – either Bakery; Dairy and Eggs; Packaged and Processed (inc. processed meat and seafood); Fruit and Vegetables (fresh produce); or Meat and Seafood (fresh or frozen).

The packaging designs developed in Stage 8 were rendered into two-dimensional images with up to 30 words of descriptive text. Consumers were then asked to evaluate the designs from a criteria matrix developed for the evaluation. The matrix was developed based on a literature review of best practices in packaging design (not published). The matrix is available on request. Consumers were also asked to report on the influence of packaging design on their purchasing intent and the effect of labelling on their choice to use or buy a product. Participants were then asked to specify their agreement or likelihood against several statements

(covering package design, labelling, likelihood to buy, and purchase intentions) on a 5-point Likert Scale.

An analysis of means was used to gain a general understanding of the data across the food categories in relation to packaging design alternatives, labelling and purchase intentions. Outcomes of the mean analysis indicated a pattern in the perception of the package designs across the food categories. Based on the analysis and the patterns, insights were developed and presented.

Furthermore, we also used correlation analysis to investigate whether there was any statistical association between the package and label characteristics and selected purchase behaviours. Although this analysis generated detailed insights regarding each specific package and label design characteristic, a general buying behaviour pattern could also be observed across the range of products investigated.

More detail on the methodology and analysis used in Stage 9 can be found in Consumer acceptance of packaging design alternatives (industry report).

Stage 10 Methods:

Industry think tank "sprint series"

Stage 10 was a recreation of the earlier industry think tanks in Stage 5 but with added capacity to drill down into insights developed from the design prototypes from Stage 8 and consumers' reactions to them (gathered in Stage 9). The series of food category-specific industry think tanks provided a form of sense-checking on the feasibility of design implementation. Questions asked in this stage covered two main topics: (1) the perceived barriers and opportunities for change within the industry sectors and (2) the feasibility and acceptability of the packaging designs.

Analysis of the sprint series adopted a problem-solving approach, and issues raised were concurrently fed into the re-design of packaging materials conducted in Stage 11 (see below).

More detail on the methods used in Stage 10 can be found in Brennan et al. (2021a).

Stage 11 Methods:

Re-design and re-develop

Stage 11 drew on insights from previous stages of the research to re-design packaging alternatives, using additional methodologies such as personal development, journey mapping, and systems mapping. Stage 11 was conducted concurrently with Stage 10, drawing directly and iteratively on insights from the think tank sprint series to feed into the re-design of packaging options developed in Stage 9.

An expert panel of designers then evaluated designs to ensure they met nominal criteria developed by the research team to sense check the environmental credentials of the designs.

More detail on the methods used in Stage 11 can be found in Brennan et al. (2021a).

Stage 12 Methods:

Focus group concept testing new packaging designs

Stage 12 consisted of five consumer focus groups in which the final packaging designs from Stage 11 were discussed and concept-tested. The five online focus groups of 5-6 people represented a cross-section of regular consumers for each of the five main food waste categories under consideration (27 people in total). An external research supplier conducted the focus groups and provided transcripts to the investigatory team. Participants for this stage, located in various Australian states, were sampled under the same conditions as the other consumer research stages (particularly the other qualitative consumer stages—Stages 3 and 7).

The focus group methodology allowed for collective assessment and socio-cultural nuances to be explored beyond the more individualised approaches of earlier consumer research stages. The focus group facilitated open conversations and provided a cross-section of opinions on the packaging solutions designed in Stage 11.

More detail on the methodology used for Stage 12 can be found in the Focus Group Concept Testing of Packaging Solutions (Topline Report).

Stage 13 Methods:

Report to industry and academy

The final stage of the research involved consolidating the research project into this Final Report. A co-authorship model based on the Committee on Publication Ethics (COPE) Authorship Guidelines was developed and adhered to, prioritising collaboration and drawing on insights from the entire multidisciplinary research team (see Contributors section below).

03

SUMMARY OF RESEARCH FINDINGS

Stage 1:

Background Literature review

Relevant report/document: Baseline literature review – Industry report (Full).

Consumers' understanding, perceptions, and uses of packaging play a significant role in household food waste generation, but the respective elements of food waste within households are not clearly understood. This research stage investigated existing knowledge about consumers' understanding of the relationship between food waste and packaging. Using a systematic literature review, we reviewed both scholarly literature in the fields of consumer perception and packaging design, as well as grey (non-academic) literature.

This stage began the process of uncovering insights that could be used to inform food producers, packaging designers, and retailers in their strategies and educational campaigns, to identify and develop food-saving packaging solutions in collaboration with food retail industry and government partners.

The existing knowledge found in the review identified four broad categories that drive food waste in households:

- Consumer values (e.g., commitment to environment, concern for food safety).
- The challenges of everyday life.
- Managing stock in households.
- Material factors of food and packaging.

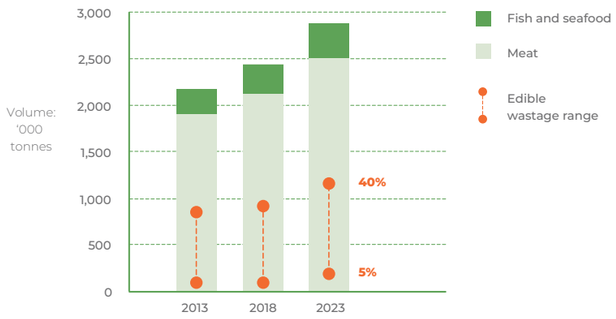
The review also identified existing functional packaging features that already work to save food waste and the reasons for food waste that could be overcome by packaging design. In particular, studies have identified emerging packaging technologies known as 'active packaging', 'smart packaging' or 'intelligent packaging' that are currently underutilised in Australia. Active packaging relates to packages that have a more active role than simply containing and protecting foods. In contrast, smart or intelligent packaging senses information about the food it contains and communicates that information to suppliers, retailers, or consumers. This report finds that while there is some existing research about consumer attitudes towards these technologies, it is sparse.

Identification of five main food categories

The review also investigated the five main categories of household food waste that would be used as the focus for the remainder of the project: meat and seafood, bakery, packaged and processed foods, dairy and eggs, and fresh fruit and vegetables. The literature surveys in this model quantified the sales volumes in Australia of the five different food categories and collated this data with estimates of food waste in each of the categories (see Figure 6) and with findings that show the global warming potential of these foods based on Life Cycle Assessments.

FIGURE 6A

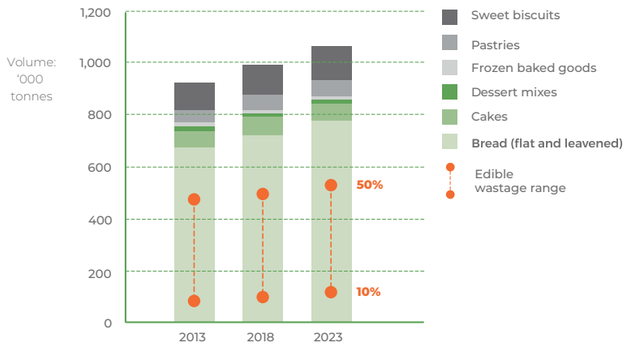
Rates of food waste in Australia in the fish, meat and seafood category



(Data adapted from Euromonitor (2019, 2018a, 2018b); Reutter et al 2017)

FIGURE 6B

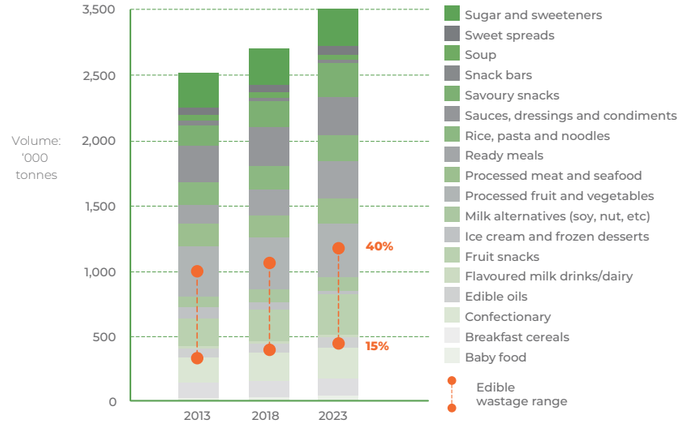
Rates of food waste in Australia in the bakery category



(Data adapted from Euromonitor (2019, 2018a, 2018b); Reutter et al 2017)

FIGURE 6C

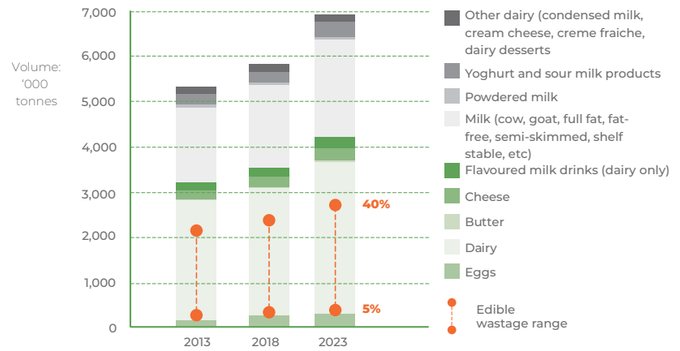
Rates of food waste in Australia in the packaged and processed category



(Data adapted from Euromonitor (2019, 2018a, 2018b); Reutter et al 2017)

FIGURE 6D

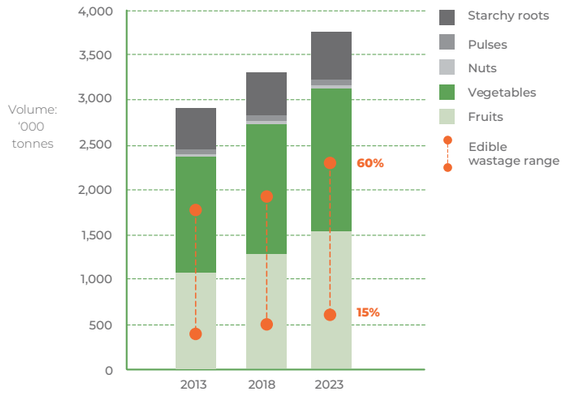
Rates of food waste in Australia in the fresh fruit and vegetables category



(Data adapted from Euromonitor (2019, 2018a, 2018b); Reutter et al 2017)

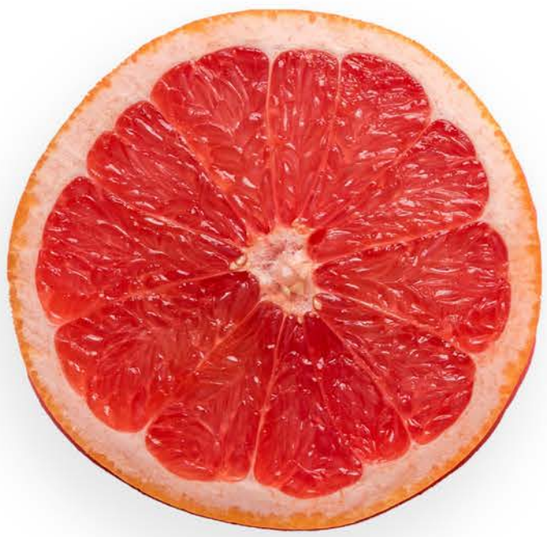
FIGURE 6E

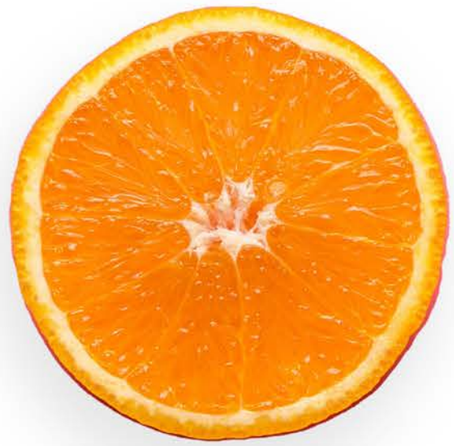
Rates of food waste in Australia in the dairy and eggs category

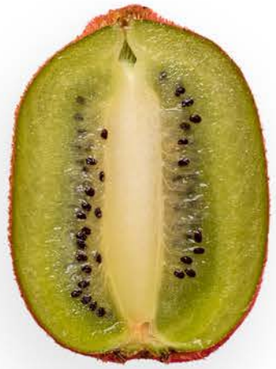


(Data adapted from Euromonitor (2019, 2018a, 2018b); Reutter et al 2017)

Key insights based on this research stage can be found in the 'Conclusions and Insights' section below.







Stage 2:

Baseline conceptual model of food waste in Australia

Relevant report/document:
Conceptual model (video).

This project stage developed a baseline model estimate of food loss and waste in Australia. The model's findings were summarised in an infographic (found here). Key findings are summarised below:

- Australian households were found to waste 46% of their food when audited at a local level versus 34% when audited at the national level, indicating a 12% difference.
- The food industry had a 57% adoption rate of save food packaging features.
- 42% of consumers agree that "packaging helps reduce food waste", but only 13% could be considered "Promoters" of food waste saving activities.

Stage 3:

Journey mapping

Relevant report/document: Journey mapping (full report).

This project stage used a qualitative journey mapping methodology to gain insight into consumers' experiences and understanding of food and packaging from purchase to consumption and disposal. This stage aimed to answer the following research question:

> *What are the parameters (contributors, barriers, facilitators, etc.) for the most wasted foods (i.e., why, who, when, how packaged or not, how much is wasted/how much could be saved)?*

Journey maps were built with users to explore the sorts of things users consider in their food purchases and food consumption journeys, including any emotional, social, and technical issues they face when understanding food consumption and waste. Thirty-seven consumer journeys were mapped across the five main food categories identified earlier.

The journey mapping found various behaviours, motivations, practices, and obstacles for consumers across different food categories.

The key insights are:

- A range of planning and purchasing behaviours were observed across product categories. Some consumers purchase food based on price, others on portion size. People's values appeared to influence their choices about what to buy and whether they planned their shopping.
- The relationships between values and food behaviour were not always clear-cut. For example, for some consumers for whom the price was a consideration and who have economic or financial matters in mind when they are shopping, the effect of economic values meant having a list and only buying what they needed. For others, shopping according to economic values meant shopping based on what food items were on special. Though they have a similar motivation, these two approaches could lead to vastly different outcomes in terms of food wastage.
- Household demographics and dynamics were substantive influences on when shopping happens, what is purchased, how it is stored, and what is wasted. Consumers often felt that waste was more influenced by the rest of the food chain than choices in the home.
- Packaging was essential to the purchase and often the storage of food. Consumers recognised a tension between the positives and negatives of packaging regarding food purchase, storage, and consumption. This tension was not necessarily linked to the function of reducing food waste, especially when it came to fresh produce.

The journey mapping found various behaviours, motivations, practices, and obstacles for consumers across different food categories.

- There was an interrelation between packaging and storage issues in consumers' homes. Consideration of packaging was related to the size of the food product available, the consumers' available storage space, and food quality. There was also some confusion about how best to store food, i.e., whether to keep food in its packaging or other storage containers. The ability to reseal food was seen as a way packaging might reduce waste, but there was a recognised trade-off between the price and quality of resealable packaging.

- Packaging materials mattered to consumers, who overall felt that if a material is recyclable, then it is a net benefit for the environment, as is food and packaging that is readily composted (or biodegradable over time, rather than compostable at home). Despite some recognised trade-offs between the suitability of different materials for storage and purchase, anti-plastic sentiment remained high. However, plastic was still used by consumers to a large extent.

- Consumers expressed a complex relationship with date labels: confusion, distrust, or a lack of concern. This led to participants ignoring the labels altogether and relying on their senses instead.

Key insights based on this research stage can be found in the 'Conclusions and Insights' section below.

Stage 4:

Existing perceptions of packaging survey

Relevant report/documents: Consumer survey analysis (summary); Consumer survey results (full dataset).

This stage evaluated Australian consumers' perceptions of the role of packaging in reducing food waste via an online survey.

The key research question underpinning this stage of the research was as follows:

> *Could packaging play a role in decreasing food waste, and if yes, how much, and what sort?*

After analysis, key findings of Stage 4 include:

- Consumers perceive packaging waste as a more serious environmental issue than food waste.

- Most consumers do not consider food waste as an extreme environmental issue.

- Consumers' perceptions of the seriousness of food waste also influence their perceptions of packaging that can reduce food waste.

- Significant differences between men and women and older and younger consumers were found regarding the relationship between packaging and food waste, and food waste as an environmental issue.
- Consumers found these four aspects of food to be most important:
  - The price of food.
  - The quality of food.
  - The taste of food.
  - How long fresh food lasts.
- Most consumers are worried about the impact of food packaging on general waste. However, they agreed that packaging serves the purpose of food preservation. Consumers do not believe packaging is necessary for fresh food, although they continue to buy packaged fresh food. Many people (35%) are indifferent to the issue of food packaging, believing that suppliers and retailers are in control of how food arrives in consumers' baskets.
- 30-50% claim that they 'never' waste or dispose of unplanned leftovers, including feeding to pets.
- 29% of consumers save leftovers in the fridge/ freezer 'every time' & 36% do so 'most times'.
- Most consumers (58%) understand that 'best before' means 'food is still safe to eat after this date as long as it is not damaged, deteriorated or perished'.

- 25% believe food is unsafe after the best before date.
- 59% understand 'use by' relates to food safety & freshness.
- 21% believe 'use by' determines food's saleability. 15% believe 'food is still safe to eat after this date as long as it is not damaged, deteriorated or perished'.

Stage 5:

Industry think tank online survey

Relevant report/document: Industry Think Tank Results.

This study stage conducted think tanks to garner industry representatives' understanding of and ability to respond to consumer perceptions. The think tanks included an online survey and an online seminar. Both offered opportunities for industry representatives to discuss the findings of the research project's earlier stages: the baseline literature review, the journey mapping study, the existing perceptions of packaging survey, and the packaging design interviews.

Following the think tanks, we synthesised industry feedback on consumer research regarding food waste into seven categories:

1. Consumer education and awareness of save food packaging (SFP).
2. On-pack communication.
3. Understanding consumer behaviours.
4. Packaging design.
5. Recycling & disposal.
6. Supply chain systems and their role in reducing consumer food waste.
7. Government actions to help industry reduce consumer food waste.

Overall, industry participants were not fully cognisant of consumer perspectives on food packaging. Participants also felt that consumers needed more education about how to save food. This is in direct contrast to the consumer results, which suggest that consumers buy what is available to them rather than making demands of retailers or producers.

Reconciling industry and consumer expectations of food waste and the role of packaging in reducing food waste were identified as potential future research directions.

Stage 6:

Publications

Stage 6 allocated time and resources to producing a range of publications, including peer-reviewed articles, book chapters, industry reports, infographics, and audio-visual materials. The interim publication permitted consultation with industry partners during the project rather than waiting until the end of data collection and analysis. Please see the Project Publications section below for a complete list of publications associated with this project.

Stage 7:

Packaging impact interviews

Relevant document: Packaging interview insights – Insights Report.

This stage explored the ways consumers use (or do not use) date labelling, storage labelling, and other labels to make decisions about purchasing and using food, and how these decisions might contribute to or reduce food waste.

The key research question for this stage of research was as follows:

> *What are the labelling and on-pack impacts on consumer decision-making? Does on-pack information help/hinder? What/sort/how/why? What is the role of date labelling?*

This stage was conducted via online interviews in households. Overall, we found that improved packaging and labelling can play a role in reducing household food waste.

Key findings from this stage of the study include:

- Consumers conveyed that more on-pack information could be provided that allows consumers to make informed decisions on storage and reduce waste. However, as consumers become familiar with products, they rarely read the packaging.
- Date labelling is reasonably well understood, but consumers want to see consistency and certainty surrounding how it is implemented.
- People engage with on-pack information differently depending on the food category.
- Discounted fresh food is seen to be of lesser quality and more likely to expire quickly.
- Consumers seek out on-pack nutrition and allergen advice for new product purchases but not for subsequent purchases.
- Consumers use sensory testing (smell, look, feel) to assess food quality and make decisions about disposal.
- Consumers do not desire on-pack storage information as they believe they already know how to store food.
- There are conflicting messages between in-store storage and advice on packaging for some food types. This contributes to consumer confusion and poor storage decisions.

- Consumers have not made the conceptual link between food packaging and reducing food waste. The disposal of flexible packaging is an issue as it is a major contributor to household waste (not just food waste).
- Consumers want straightforward and easy-to-read information. They prefer colourful and visual information that communicates shelf life and storage conditions (e.g., refrigerate after opening).
- Portion control and serving size information are useful for consumers to decide what to buy. However, some of the serving information is 'unreasonable' in that consumers believe that serving size is kept deliberately small for the purposes of marketing energy-dense foods.
- The quality of packaging materials should match the storage and transportation requirements. Some packaging contributes to food waste as it is not fit for purpose. This is especially true in foods such as salads that use 'flimsy' plastics.

Solutions proposed by consumers:

In addition to these findings, several solutions were proposed by consumers for ways that packaging could contribute to reducing food waste:

- Provide education to consumers about:
  - Food storage, alternatives for leftovers and other food waste reduction.
  - How to 'read' labels and packages to best reduce food waste.

- Use packaging and labelling to build on existing consumer knowledge structures:
  - Provide 'sensory' testing information on pack, aiding decision-making about food safety. Provide simple visual storage prompts (e.g., a snowflake symbol for food that can be frozen). Standardise label format to make information (e.g., contents, nutrition, and allergens (CNA)) readily perceivable.
  - Add food waste reduction information to labels next to the CNA data. Find innovative ways to supplement existing knowledge and help consumers make decisions about food (e.g., QR codes, in-store notices – not ads).
- Consider the differences between food categories:
  - Consumers look for storage and food safety labels on dairy and meat but not on other products.
  - Use labels on products to advise consumers about food waste according to the category (e.g., letting people know that 50% of bread is wasted, so put it in the freezer if you are halfway through the loaf).
- Reduce cluttered labelling and difficult-to-read layout and fonts:
  - Reduce the number of marketing objects on the package and provide relevant decision-making information.

  - Develop standardised packaging and labelling guidelines that make decision-making easier for consumers.
  - Use visual imagery to convey ideas, so the message does not require English language skills or a magnifying glass to understand.
- Clearly communicate the serving and portion sizes (based on real-life eating patterns):
  - Clearly display the number of serves on the package to help consumers decide whether a product will be consumed entirely before its best-before or use-by date.

Key insights based on this research stage can be found in the ‘Conclusions and Insights’ section below.

Stage 8:

Design and developing packaging alternatives

This stage developed alternative designs that could minimise food waste, using a matrix of best practice packaging design ideas and drawing on findings from the previous stages. In this stage, we created packaging prototypes and prepared them to be tested in Stages 9, 10, and 12.

Using the double diamond design methodology described above, we developed 25 prototypes of packaging that might help reduce food waste by engaging consumers and their food waste behaviours and perceptions.

Food packaging prototypes:

Bakery

B.1 – Bread

Portioned half loaf size for small or single households, featuring easy-to-use clip and storage instructions on how to freeze, including recipe ideas when becoming stale.

B.2 – Cake

Ridged container protects the product during distribution and home storage, and the resealable lid extends shelf life. Recommended portions are suggested for planning meals. Recipe ideas advise consumers on how to refresh if they are going stale.

B.3 – Biscuits

This tightly wrapped plastic sleeve features an easy-to-open rip tab, including an adhesive reseal strip at the end of the pack to extend freshness.

B.4 – Donuts

Ridged plastic packaging keeps the donuts fresh for longer and can be stored upright to avoid being squished. Messaging on the label advises on how to refresh if the donuts are becoming stale.

B.5 – Tortilla Wraps

Scissor line is placed well above the easy-to-view reseal strip to avoid cutting off the feature. Packaging includes storage and recipe ideas to extend shelf life. Oxygen scavenger pad to remain in packaging to keep the wraps fresher for longer.

Dairy and Eggs

DE.1 – Brie Cheese

Split entertaining pack provides smaller servings of two types of cheese. Clear message to consume within four days of opening. Storage instructions advise consumers to store in the original wrapper and place back into the protective cardboard outer box for storage.

DE.2 – Cream Cheese

This pack design features a resealable lid with a large, easy-to-lift tab for easy opening. The shallow design and curved corners allow the contents to be completely emptied with a butter knife or spoon.

DE.3 – Eggs

This typical egg carton packaging focuses on how to assess freshness using the float test through images and instructive text. Appropriate recipe ideas accompany each stage of freshness. The overhang lid allows customers to easily open and close the packaging to check for un-broken eggs before purchase.

DE.4 – Shredded Cheese

Cutline encourages preferred opening to avoid spilling. The small portion size suits single households. Storing and freezing instructions included.

DE.5 – Sour Cream

Packaging is transparent, making leftovers visible, with a click-to-close resealable lid. Cup measurements are labelled to relate to recipe quantities easily. Callouts recommend how to use up the last scrapings on crackers, supported by the smooth easy-to-empty shape.

Meat and Seafood

MS.1 – Sliced Ham

Resealable tray allows for extended shelf life when stored in the fridge. Three recommended freshness checklists of sniff, see, and taste are designed for the user to sense check the use-by date to determine whether the ham is safe to eat. Use up recipes suggested on pack.

MS.2 – Frozen Calamari

This packaging design is split into three individually sealed servings, allowing easy storage in the freezer, and ensuring the perfect amount is thawed for cooking.

MS.3 – Minced Kangaroo

Easy to open and divided portion packs of 2 X 250g sizes, ideal for small households. This pack allows for separate storage options. Call out about removed oxygen to educate consumers on food saving packaging technology.

MS.4 – Beef Steak

Designed for protection, this packaging is vacuum-sealed, prolonging the steak's life, with a callout to justify why the meat may appear darker than usual. Vacuum packaging extends shelf life while tenderising meat for fresher and better-tasting steak. The temperature indicator shows safety, giving consumers the confidence to consume even if nearing the use-by date.

MS.5 – Salmon

Stand-up portion packaging allows easy viewing when stored in the fridge to remind consumers not to waste the premium product and protects the premium salmon steaks from being crushed in the back of the fridge.

Fruit and Vegetable

FV.1 – Cut Apples

This structural packaging design focuses on callouts to consumers to eat while fresh and on the go. Includes an idea to try in a smoothie if not eaten on the day of purchase.

FV.2 – Frozen Peas

This packaging uses a character to gamify and communicate how to store it in the freezer, including a sticker to re-seal the pack. Markings encourage consumers to cut the corner of the pack to create a spout for easy pouring.

FV.3 – Loose Apples

This design focuses on communicating how to store apples for extended freshness, i.e., in the fridge crisper drawer and includes messaging on the best time to consume for a crisp taste.

FV.4 – Packed Fruit

This design features an easy-to-read cut line for easy access. Familiar sayings communicate the portion of apples per week. The strong carry handle is intuitively designed for easy handling getting the product home undamaged.

FV.5 – Salad Bag

Featuring tips on how to keep spinach fresher for longer through callouts on pack. This design also demonstrates two options on where to cut open the pack and how to store it correctly using the resealable sticker, which is also a temperature indicator, to show freshness.

Packaged and Processed

PP.1 – Almonds

Zip lock packaging keeps almonds fresher for longer. Date language communicates in plain English when the product is freshest. Callouts on the back of the pack suggest recipe ideas for almonds passing their freshest date and the number of portions recommended.

PP.2 – Cornflakes

Internal plastic pouch features a clear-cutting to avoid spillage by opening by hand. Includes an adhesive strip to re-close the plastic bag to keep the cereal fresh and crisp, avoiding unnecessary spillage.

PP.3 – Chutney

High-quality reusable chutney with an easy-to-empty shape allows consumers to get all the last scrapings out of the jar and reuse. Messaging also recommends using a fresh knife to avoid contamination that may cause mould growth.

PP.4 – Pesto

Easy to use squeezy bottle to dispense pesto quickly and for no waste, supported by lid standing format, which allows all the product to fall to the opening.

PP.5 – Tinned Tuna

Typical shallow tinned format with an additional clear click-to-close lid to seal in smell and freshness, allowing easy viewing of how much tuna is left over.

These prototypes were then tested in the project's next stage, Stage 9.

Stage 9:

Consumer acceptance of packaging alternatives survey

Relevant report/document: Consumer acceptance of packaging design alternatives (industry report) and Consumer acceptance for packaging design alternatives (full data set).

The key research question posed in the survey was:

> *What is labelling and packaging design's impact on consumer decision-making?*

This stage used an online survey to determine consumers' acceptance of the packaging design alternative prototypes developed in Stage 8. The survey assessed the acceptability of packaging design features in terms of intentions to purchase, willingness to pay and perceived user-friendliness. The five key waste areas identified in earlier phases of this research were assessed. Findings are reported by food category and specific product packaging designs.

Although this analysis generated detailed insights regarding each specific package and label design characteristic, a general buying behaviour pattern could be observed across the range of products investigated.

Key findings include:

- Consumers are willing to pay a premium for selected design choices that emphasise the high quality of the product, extend the shelf life of the food, are easier to store, or identify the portion sizes (when applicable to the product).
- Consumers expect package designs to be functional, easy to open, and easy to use in general. Consumers will not necessarily pay more for such features.
- Consumers expect packaging and labels to be informative and describe their contents. Additionally, they want the packaging to be attractive, visually appealing, and functional.
- Consumers will search for packaging alternatives that are easy to open and use (i.e., they will go out of their way to find alternatives). Attractive designs that are easy to see through and identify the contents are also highly desirable.
- The more familiar they are with the product; the less likely consumers will pay more for innovation in package design.
- People want to see 'official' information on their packages, such as barcodes, as this reassures them that the product meets standards.
- Function is more important than form, and participants will pay more for packaging that saves waste and extends shelf life.
- Portion size information is important, and participants would search for types of package design that indicate portions that fit with family needs.

Stage 10:

Industry think tank sprint series

Stage 10 was the second iteration of the earlier industry think tanks in Stage 5 but with added capacity to drill down into insights raised by the design prototypes from Stage 8 and consumers' reactions to them gathered in Stage 9. Findings from Stage 9 were presented to several industry representatives for their input and assessment.

Questions asked in this stage covered two main topics: (1) the perceived barriers and opportunities for change within the industry sectors and (2) the feasibility and acceptability of the packaging designs.

The industry insights on the specific prototypes gathered from these sprint sessions are presented in the following sections with their corresponding design changes.

Stage 11:

Re-design and re-develop packaging alternatives

This stage ran concurrently with the industry think tank series of Stage 10. Insights gleaned from industry in the sprint series were incorporated into the re-design of the 25 prototypes of packaging alternatives that were developed in Stage 8.

Table 1 shows one example of the insights gathered from industry representatives against the packaging alternative prototypes for one category (Bakery) and the design changes made in light of these insights. These innovations were included in final designs and provided to industry through reports and further focus group discussions.

TABLE 1

Insights from industry think tank sprint series against design changes made in Stage 11 for the Bakery category

Bread half loaf

Industry Insights	Design Changes
	Remove nutrition reference
Best before date confusion	Change language, I am freshest before...
Most Aussies don't know how to return to store REDcycle	Add more instructions, words and/or icons (what the bin looks like)
"RED bins at the front of your store is for soft plastic"	
Use tag rather than tie (quicklock tag)	Replace tie with quicklock tag
Add toasting as food saving technique	Add toasting as food saving technique

Cake

Industry Insights	Design Changes
Lots of packaging	
How does the pack type reduce food waste? Heavy plastic	
Clam shell design, lightweight & protects product, especially for iced/decorated cakes	Change to clam shell format
Where does portioning info come from? standard size?	Research cake portioning
Cake pop, safety risk re storage	

Donuts

Industry Insights	Design Changes
4 not 2 pieces, 2 unnecessary in the Australian market	Change pack format to 4 donuts
PET cannot be recycled under a certain size	

Biscuits

Industry Insights	Design Changes
Once opened, no excess packaging to use sticker	
May need to eat 4 biscuits to then use the reseal feature	
Better to have this seal at end of pack then fold packaging over and stick down?	
Reusable sticker, prominent on front but consumers don't use this feature	Change pack format to reseal strip (like wraps) with easy to pull additional tabs?
Sticker can get crumbs and not reseal	
Resealable tab instead?	
Window may cause UV damage to product	Remove window
Cream can smear on window – unappealing	

Wraps

Industry Insights	Design Changes
"I'm at my freshest before" may be conflicting to freeze info	
Needs more freezing instructions (how long it can be stored in freezer) to give consumers more confidence when storing in freezer (avoid freezer burn etc)	
Consumers don't know when they put in the freezer	
Could add area on pack to write the date added to freezer	
Caramel layer cake not really used	Change recipe idea (tortilla chips, quesadilla etc)
Add REDcycle info	
Oxygen scavenger only works when pack is sealed, might as well discard when opened	Change callout?

Stage 12:

Focus group concept testing of packaging alternatives

Relevant report/document: Focus Group Concept Testing of Packaging Solutions (Topline Report).

This stage concept-tested the packaging prototypes developed in Stage 8 and re-designed in Stage 11 in focus groups with consumers. The key research question posed by this stage was:

> *What are the potential solutions?*

The key findings are in Table 2, which shows the designs that inspire further usage and target unmet needs that resonate most with consumers; Table 3, which shows designs that missed the mark and require further refinement; and Table 4, which shows the designs that failed to address a consumer need or reduce food waste.

TABLE 2

Packaging Designs that inspire further usage and target unmet needs that resonate most

Packaging Design	Ready, with minor tweaks	Needs further refinement	Requires a re-think	Rationale
DE5 – Sour Cream				Cup measurements and transparency help reduce waste and tap into unmet needs.
MS2 – Frozen Calamari				Splitting the pack into three helps reduce food waste and is highly unique.
DE3 – Eggs				The pack offers a number of helpful suggestions to reduce waste and looks strong and sturdy.
MS3 – Minced Kangaroo				Splitting the pack into two has the potential to reduce waste and is relatively unique.
B1 – Bread				Half size loaf appeals to small households as a way to manage portions and reduce waste.
B5 – Tortilla Wraps				Zip lock functionality is well designed and has potential to reduce food waste.
PP1 – Almonds				Claims and zip lock functionality have potential to reduce food waste.
MS4 – Beef Steak				Freshness indicator helps reassure consumers about the colour of the meat.
B3 – Biscuits				Adhesive strip has the potential to keep the biscuits fresher for longer.

TABLE 3

Packaging Designs that miss the mark on pack design or claims need further refinement

Packaging Design	Ready, with minor tweaks	Needs further refinement	Requires a re-think	Rationale
B4 – Donuts				Messaging on label provides helpful tips on how to refresh if the donuts are becoming stale.
PP3 – Chutney				Talks about repurposing the pack, but not about reducing the potential for food waste.
FV1 – Cut Apples				Delivers to a need for apples on the go, but misses the mark on recipe ideas.
MS1 – Sliced Ham				Provides useful info to prevent food waste but some claims are contradictory or unnecessary.
FV2 – Frozen Peas				Reseal functionality helps reduce potential for food waste but “Pea monster” is divisive.
DE1 – Brie Cheese				A thoughtful way to explore flavours and reduce waste but needs a redesign and new flavours.
FV5 – Salad Bag				Some good suggestions but too much info on front of pack, need to dial it back
PP2 – Cornflakes				Storage directions and recipe ideas appeal but adhesive strip and transparent window divisive.
B2 – Cake				Recipe suggestions lack relevance & packaging does not clearly communicate its benefit

TABLE 4

Packaging Designs that fail to address a consumer need or reduce food waste do not appeal

Packaging Design	Ready, with minor tweaks	Needs further refinement	Requires a re-think	Rationale
DE4 – Shredded Cheese				In lieu of a zip lock function or usage ideas, this pack may have limited impact on food waste.
DE2 – Cream Cheese				Concept has nice appeal but doesn’t do much to motivate consumers to reduce food waste.
FV4 – Packed Fruit				Concept has nice appeal but doesn’t do much to motivate consumers to reduce food waste.
PP4 – Pesto				Squeezy format less than ideal, offers very few benefits and increases potential for food waste.
MS5 – Salmon				Multipack has potential but in current format it’s not clear that it’s a multipack & it looks cheap.
FV3 – Loose Apples				Consumers are unclear as to how this concept works or is priced, more clarification is required.
PP5 – Tinned Tuna				Concept offers no clear benefit to the consumer and is largely considered “unsafe”.

Key findings across all food categories:

- The most impactful concepts are unique and deliver to a true consumer need.
- Recipe ideas and storage instructions are helpful, but only if they are thought-provoking.
- Best before is more consistent and easier to understand than eat me / freshest by.
- Australia logo doesn't work as a stand-alone, consumers need more info and context.

Stage 13:

Report to industry and academy

This stage of the research entailed collating all the insights from the entire research project into a report for both industry and academic audiences. This final report is the result of this stage.

04

Project publications

Industry reports and information

For all industry reports, infographics, and data sets, see the Project page on the Fight Food Waste CRC's website:

https://fightfoodwastecrc.com.au/project/consumer-perceptions-of-the-role-of-packaging-in-reducing-food-waste/.

Outline

- Consumer perceptions project outline.

Baselines

- Conceptual model (video).
- Industry report (Full).
- Food waste scenario (infographic).
- Consumer packaging perceptions (infographic).
- Consumer packaging perceptions (video).

Food Waste Journey Mapping

- Journey mapping (infographic).
- Journey mapping (full report).

Existing Packaging Perceptions Survey

- Consumer survey analysis (summary).
- Consumer survey results (full dataset).

Label and Packaging Design Consumer Survey

- Consumer acceptance of packaging design alternatives (industry report).
- Consumer acceptance of packaging design alternatives (full dataset).
- Packaging interview insights – Insights Report.
- Industry Think Tank Results.

Label and Packaging Design Consumer Focus Group

- Focus Group Concept Testing of Packaging Solutions (Topline Report).

Peer reviewed articles

Langley, S., Phan-Le, N. T., Brennan, L., Parker, L., Jackson, M., Francis, C., Lockrey, S., et al. (2021). The Good, the Bad, and the Ugly: Food Packaging and Consumers. *Sustainability, 13*(22), 12409. http://dx.doi.org/10.3390/su132212409

Abstract:

Food waste is a significant environmental, economic, and social issue. In many cases, packaging protects food and prolongs its shelf life, reducing the overall environmental impact by reducing food waste. This research focuses on consumer perceptions of the role of packaging and on-pack labelling in reducing household food waste. The following research questions provided the framework for the study: (1) could packaging play a role in decreasing food waste; (2) what are labelling and packaging designs' impacts on consumer decision-making about food waste? This research draws on two qualitative studies. Study One focuses on journey mapping—following food waste throughout the consumer's engagement with food 'journey' from planning to disposal. Study Two comprises a series of in-depth interviews in consumers' homes focusing on how consumers engage with food packaging and food waste. Results indicate that there are at least two streams of consumer perceptions to consider when determining the relationship between food packaging and reducing food waste: the first is how practically useful packaging is for consumer needs; the second is consumers' perceptions about food packaging itself. There are tensions and trade-offs between these two sets of considerations. The results of the studies show consumers are unlikely to consider food packaging or reducing food waste as a primary motivation in their food purchasing decisions. The studies also show reducing packaging, including plastic packaging, is seen as more important than reducing food waste. Our results also highlight important elements to consider when designing food packaging. These results suggest that a fundamental review is needed for many aspects of packaging and storage information and that this review should account for consumers' information needs at different points: purchase, storage, during consumption, and between instances of consumption. Furthermore, our results suggest packaging designs that provide clear information and instructions for consumers to reduce food waste are needed.

Brennan, L., Langley, S., Verghese, K., Lockrey, S., Ryder, M., Francis, C., ... & Hill, A. (2021). The role of packaging in fighting food waste: A systematised review of consumer perceptions of packaging. *Journal of Cleaner Production, 281, 125276.* https://doi.org/10.1016/j.jclepro.2020.125276

Abstract:

Food packaging is often viewed as having a negative impact on the environment. However, packaging can protect food, prolong shelf life, and reduce environmental impact by reducing food waste. Throughout the existing literature it is evident that consumer knowledge and levels of awareness, interest, and appreciation of these

functions of packaging are major factors in their refusal or acceptance of emerging packaging technologies, whether those technologies are specifically directed at reducing food waste or not. The complex relationship consumers have with food packaging creates a barrier to food saving practices. This paper presents a systematised literature review of the existing scholarly and industry discussion of consumer food waste in households, packaging technologies to reduce food waste, and consumer perceptions of packaging. It maps the shifting theoretical approaches to food waste, showing a move in the literature away from food waste being treated as a food-related issue and towards seeing food waste as a waste-related, sustainability, production, and environmental issue. The paper finds that there is very little research that examines consumers' perceptions of food packaging. In particular, there is little research on the role of consumers' perceptions in reducing food waste. Mapping the ways different types of consumers perceive this role and linking this with a life cycle assessment of the overall environmental impact of food waste in different food categories could help the development of focused strategies for packaging design to reduce food waste in households. This review shows that technologies directly addressing the reasons for household food waste are under researched, and more research is needed to explicitly explore consumer perceptions, understandings, and acceptance of these packaging technologies.

Nguyen, A. T., Parker, L., Brennan, L., & Lockrey, S. (2020). A consumer definition of eco-friendly packaging. *Journal of Cleaner Production,* 252, 119792.

Abstract:

Consumers are increasingly concerned about the environmental consequences of packaging. Businesses are under pressure not only from consumers but also from governments to use eco-friendly packaging for their products. However, what consumers perceive to be eco-friendly packaging is still unclear, especially in emerging markets. This study examines consumer perceptions of eco-friendly packaging in the context of packaged food products in Vietnam. The study involved a series of six focus group discussions conducted with a diverse range of consumers. The focus of the debate was consumer perceptions of eco-friendly packaging, particularly whether or not consumers would adjust their purchase behaviours to be more environmentally friendly. The data analysis procedure was undertaken using inductive manual coding principles associated with interpretivist research. The results indicate that consumer perceptions of eco-friendly packaging can be categorised along three key dimensions: packaging materials, manufacturing technology and market appeal. While consumers have diverse perceptions of eco-friendly packaging, their knowledge is limited and more related to packaging materials (such as biodegradability and recyclability), and market appeal (such as attractive graphic design and good price). Consumers show little knowledge about manufacturing technologies but still desire an eco-friendly manufacturing process.

Results also suggest that a consumer-defined eco-friendly package for food products should be visually appealing while satisfying consumers' environmental expectations relating to packaging materials and manufacturing process. We therefore propose a consumer-initiated development of eco-friendly packaging that can be applied for sustainable packaging strategies.

Book chapters

Brennan, L., Parker, L., Lockrey, S., Verghese, K., Chin, S., Langley, S., ... & Alessi, N. (2021). The Wicked Problem of Packaging and Consumers: Innovative Approaches for Sustainability Research. In *Sustainable Packaging* (pp. 137–176). Springer, Singapore.

Abstract:

This chapter presents the methodology and consumer insights from a highly impactful research and design project, conducted over two years by the Fight Food Waste Cooperative Research Centre and RMIT University. The project is designed to inform the Australian packaging industry about developing products and services that will reduce food waste. Food waste in Australia is a wicked problem, replete with paradoxes: people hate plastic, but plastic saves food. The deep insights gained from the project have already resulted in significant changes to industry practices and new guidelines for packaging design. The methodology developed especially for this project is based on design thinking and ethnographic approaches, combined with quantifiable validation procedures. The study ensures that industry actors have the right tools to make packaging decisions that reduce food waste.

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Conclusions and insights

Stage 1 Insights:

Systematised literature review

Based on this review, we were able to identify several key insights:

Understanding consumer households and their practices

- Despite the extent of this research, more research is required to understand household practices relating to food packaging and food waste and how these insights can be used to inform product-packaging design.
- Further research needs to understand how packaging and food waste issues might vary across diverse households. This research would aim to understand broad consumer perceptions of food packaging and its potential to reduce food waste, and whether and how different households engage with different pack sizes for foods in the five food categories.

Consumer education

Much of the existing literature recommends consumer education about the role of packaging in reducing food waste. Therefore:

- Testing should be undertaken with consumers to understand how they interact with and understand on-pack information and date labels.

- An investigation should be undertaken to understand what delivery method/s would be appropriate for consumer education campaigns about packaging features (e.g., social media, websites, short videos, infographics) and the level of detail required.
- The findings from the above investigations need to integrate into existing government education campaigns, such as WRAP UK's Love Food Hate Waste program.

Consumer insights should inform industry when developing packaging design

- There is a significant gap between developing packaging technologies that reduce food waste and insights into how consumers engage with food packaging.
- Consumer insights should inform industry when developing packaging design. More research is required on how industry can integrate these consumer insights.
- More research is required on who in the supply chain (consumers or otherwise) benefits from extended shelf life and how date labelling could be standardised so that communication about shelf life is clear across the supply chain and to consumers.

Requirements for end-of-life options

- Australia and the UK are focussed on increasing the recyclability of food packaging.
- Food waste should be considered in plans to increase the recyclability of food packaging.

- More research is required on consumer perceptions of packaging's reusability, recyclability, and/or compostability, and the likelihood of consumers accepting these packaging options should be further investigated.
- More research is required on the potential trade-offs between the negative environmental impacts (e.g., more food waste) of packaging material design decisions that compromise product shelf life.

Stage 3 Insights:

Journey mapping

The journey mapping found 14 key insights for industry to reduce food waste through its relationship with packaging:

1. Increase the visibility of food waste's impact along the supply chain.
2. Engage with households' needs.
3. Develop deep and nuanced consumer research.
4. Create action to reduce FLW up-stream in the supply chain.
5. Educate consumers on packaging's functions.
6. Educate consumers on FLW across key food categories.
7. Communicate how food interacts with its packaging.
8. Educate consumers on packaging waste vs. food waste.
9. Design packaging for home storage.
10. More packaging, rather than less.
11. Communication on packaging for optimal home storage.
12. Date label clarity and reform.
13. Deploy packaging with material benefits.
14. Communicate the material benefits of packaging.

These insights provide industry and government with foundational advice to pursue actions that may better inform and enable consumers to reduce food waste in the home in relation to packaging.

Stage 9 Insights:

Consumer acceptance of packaging alternatives survey

Provide information in short form

Consumers want ready access to 'official' information as it reassures them of quality, provenance, and safety. QR Codes could help provide complex information and food waste reduction ideas without taking up a lot of packaging space. It also saves the unreadable font size issue identified in earlier research.

People will pay to reduce waste

If people can be persuaded that innovative package design will reduce food waste and save the biosphere, they will pay more. The task is, therefore, one of persuasion that the product will be better than an alternative if it is purchased in a waste-saving package.

Treat categories differently

Each category has differing features desired by consumers. It will not be possible to develop one-size-fits-all solutions to reducing food waste. No packaging is seen as better than some packaging, but this will likely increase waste, especially in meat and seafood.

Repurpose and refresh fruit and vegetables

Food waste could be reduced in the fruit and vegetable category by providing point of sale information about how to repurpose or refresh produce.

Focus on safety cues for meat and seafood

The primary concerns were food safety and quality in the meat and seafood category. Use packaging and labelling to signal safety and quality over food waste. Consumers would prefer to waste food in this category.

Keep it simple

In categories where limited expertise is required or available to assess quality (e.g., Bakery, Packaged and Processed), keep the information on the package to a minimum; more information leads to negative evaluations of the product/package. Provide additional information via point of sale or communication alternatives.

'Eat immediately' is an issue for food waste

Where a product is likely to be eaten immediately, ideas for storage and refreshment are not desirable. Adjusting portion sizes would be the only way to reduce waste in these products.

It's not about the money

Reducing the cost of the average food bill is not a motivation to save food. People will pay for quality and safety, as well as to contribute to the biosphere. It must be more than greenwashing. It must genuinely save food.

The problem with unpackaged food

Unpackaged food is problematic because there is no provenance or indicators of authenticity. People do not buy it by preference in larger stores because they are reassured by packaging that the product has been through some type of quality control in the supply chain.

Indicate both portion size and serves

Portion sizes and serving sizes provide different information. One is about healthy eating and the other is about how many people the product will feed from the same packet. Consumers need both types of information to assess their needs and to reduce waste by not over-purchasing.

Stage 10 Insights:

Industry think tank

The following insights were uncovered after analysing the survey responses and the dominant themes of the think tanks.

More consumer education is required to build awareness of:

- Benefits of packaging aiming to reduce food waste (features, format, size, materials).
- Tips and tricks for product use, storage options to extend shelf life after a pack is open.
- Recycling of packaging after use.

Portion size

- Household food waste reduction needs better portion-controlled packaging.
- Portions should be based on household size and consumer use/behaviour research.

Cost (investment)

- Sustainable packaging options and new/alterations to existing machinery are considered too expensive.
- Support from government and retailers is required.

Recyclability

- Ensure all packaging is recyclable and do not use the recycling symbol on packaging that is not recyclable in Australia.
- Government targets are not feasible without a whole-of-system approach to reducing food waste.

Stage 12 Insights:

Focus group testing

The insights gathered from this project stage are broad-ranging and go beyond the insights relating to specific packaging designs.

Add contexts to the 'Australian' logo

The Australian logo on its own does not provide consumers with enough context behind whether the product was made, produced, or packaged in Australia and/or made from Australian ingredients. As a result, more information and clarity are required to address this.

Offer thoughtful recipe ideas

Recipe ideas and storage suggestions are a great way to inspire use and reduce the potential for food waste. However, ideas and suggestions must be relevant and thought-provoking (i.e., go beyond the obvious) to be noticed and make a true impact. If not, all they will do is take up space on the pack.

Stick with the term 'best before'

The term 'best before' feels relatively open to interpretation and is consistently well known across various products and categories. It appears that sticking with this terminology as compared to 'eat me' or 'freshest by' as it is easier to understand – especial for cultural and linguistically diverse (CALD) audiences.

Avoid using 'eat me' or 'freshest by'

The terms 'eat me by' or 'freshest by' are rather divisive. Some feel that they are slightly more positive and open than the term best before. Others, especially CALD audiences, find it more confusing, foreign and unclear.

Specify 'Eat within X number of days'

In addition to a 'use by' or 'best before' date, consumers find it highly useful for packaging to call out the number of days clearly and effectively after opening the pack the product should be consumed. This serves as a reminder of when to eat the food and is thought to play a key role in reducing potential food waste.

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Directions for future research

Directions for Future Research

This project developed broad and detailed insights into consumers' understanding of the relationship between food waste and food packaging. Further research should use these insights to develop policy and affect changes in packaging designers' and providers' approaches to reducing food waste.

The research showed that a significant reduction in food waste could be made by reforming the system of date mark labelling and storage information in Australia. By educating industry, reforming and standardising labelling processes, and educating consumers on the correct usage of these labels, packaging and food industry stakeholders could significantly reduce food waste caused in the home. The insights from this project should be included in further research and projects in this space.

Furthermore, further work is required to match consumer expectations of packaging with what industry expects regarding food waste. This research could also feed into consumer information or education campaigns about food waste and food packaging.

There is also a need to establish open access information about how people use food packaging in their homes. Videos would be helpful in this regard. While market research is available, it is currently in the hands of commercial interests and is not available for general use. This would be helpful for input into packaging designed to reduce food waste.

Finally, this research can influence policy and strategies by ensuring that communication campaigns can be effectively targeted toward these behaviours and intervening in these behaviours by providing behavioural infrastructures designed to help consumers reduce food waste.

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Brennan, L., Langley, S., Verghese, K., Lockrey, S., Ryder, M., Francis, C., ... & Hill, A. (2021b). The role of packaging in fighting food waste: A systematised review of consumer perceptions of packaging. Journal of Cleaner Production, 281, 125276. https://doi.org/10.1016/j.jclepro.2020.125276

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Peer review statement

All reports and publications from this project were peer-reviewed, including this final report. We appreciate the time and expertise of the reviewers in improving and building the outputs into high-quality publications.

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Dr Michaela Jackson is a member of the School of Media and Communication at RMIT University. A cross-disciplinary researcher, Michaela is drawn to complex social issues that implicate communication practices, organisations and the wider community. Particular interests include communication ethics, controversial communication in its form or application, and health communication. Michaela's research has been published in internationally recognised peer-reviewed journals, book chapters and presented at national and international conferences.

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Dr Bruno Schivinski is a statistician, behavioural researcher, and Senior Lecturer in Advertising at RMIT University, Australia. He consults for online service providers, websites, and scientific institutions such as the Polish Ministry of Science and Higher Education (MNiSW) and the National Science Centre (NCN). Schivinski specialises in problematic consumer behaviour, social-media engagement, online branding, and user-generated content. His research has received international coverage in *Forbes Magazine* and *Google News*. His latest work can be found in academic journals such as the *Journal of Business Research, Journal of Advertising Research*, *Industrial Marketing Management*, *Strategic Marketing, Journal of Marketing Communications*, and *Journal of Clinical Medicine*.

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