

Managing climate and environment

Dairy sector food waste action plan

June 2023



Australian Dairy Products
Federation Inc.



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The following dairy companies were involved in the development of the Action Plan and are committed to working collaboratively to reduce food waste across the dairy supply chain



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Disclaimer

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Executive summary

This Dairy Sector Food Waste Action Plan is the Australian dairy industry's response to the Australian Federal Government's goal of halving food waste by 2030. Food waste from the dairy supply chain has previously been identified as one of the six highest Australian food waste sources. This Sector Action Plan reflects the Australian dairy industry's commitment to sustainable practices, including reducing waste, which is highlighted in the 2021 Australian Dairy Sustainability Framework report.

There are a range of initiatives and practices currently implemented by dairy farmers, individual dairy manufacturers, and retailers that contribute to reducing dairy food waste across the supply chain. However, further opportunities to tackle dairy food waste exist. This has been recognised by the Dairy Manufacturers Sustainability Council and the Australian Dairy Products Federation and its members, who have identified a need for collective action across the industry.

The result of this collective action is the Dairy Food Waste Action Plan. This has been developed by Dairy Australia in partnership with the Australian Dairy Products Federation and Stop Food Waste Australia. There has

also been input from Dairy Manufacturers Sustainability Council members and other dairy companies, with support from Sustainability Victoria. Its development has increased transparency of dairy food waste across the supply chain, and it provides a pathway for the industry to collaboratively tackle this waste challenge.

Australian dairy industry and current dairy food waste

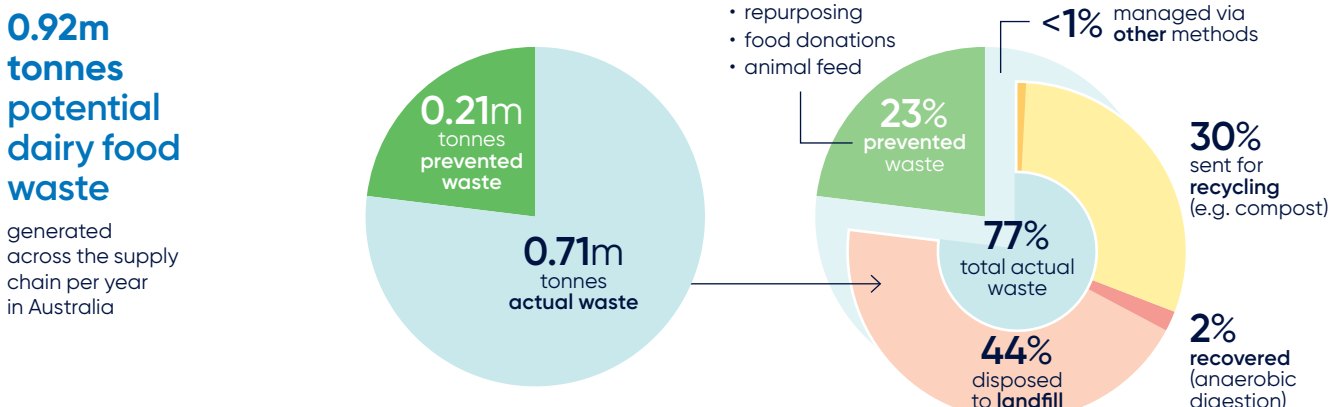
Dairy is Australia's third largest rural industry, featuring 4,420 dairy farms and 455 processing factories across the country. In 2021/22, the total annual milk production was 8,554 million litres, with 86 per cent produced in south-east Australia.

The Dairy Food Waste Account compiled as part of this Sector Action Plan reports that there are currently 0.71 million tonnes of actual dairy food waste being generated across the dairy supply chain. The by-products from cheese production (e.g. whey), process wastes associated with dairy product manufacturing, and the disposal of finished product to landfill, are key waste categories.

Figure ES-1 How much milk and dairy food products are produced in Australia?

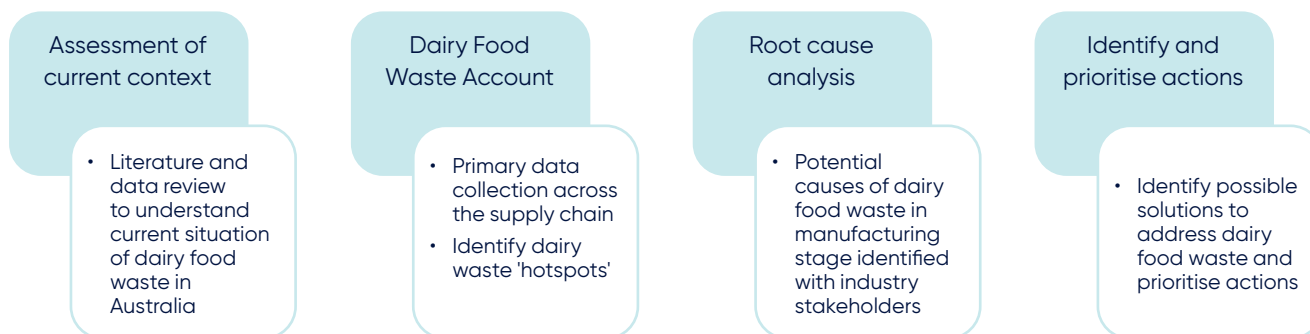


Figure ES-2 How much dairy food waste is there and where does it go?



Scope and methodology

Figure ES-3 Approach to developing the Sector Action Plan



Note: Project methodology aligned to the Waste and Resources Action Program UK's (WRAP UK) 'whole of supply waste mapping and resource efficiency process' which features problem definition, diagnostics/analysis, and solution generation phases.

The whole dairy supply chain was considered in this Sector Action Plan. While data collected as part of this study and recommended actions apply to the entire supply chain, a particular focus has been on the manufacturing/processing sector. This is due to:

- The influence of the project partners and ability to collect and analyse dairy food waste data for this stage of the supply chain.
- The volumes of dairy food waste at this stage of the supply chain, and the opportunity to identify and implement solutions that will maximise value (i.e. reduced dairy food waste).

The Dairy Food Waste Account estimates food loss and waste across the dairy supply chain using multiple data sources. It identifies the dairy food waste hotspots and the impact that can be achieved by either eliminating the dairy food waste from occurring or moving its management further up the dairy food waste hierarchy.

The account provides the richest data set of dairy food waste information available for the Australian dairy industry to date, and has been developed using the best available information from Australia and overseas. The data collected from the survey responses accounts for more than 80 per cent of Australia's total milk supply, with data collected from all eight of Australia's dairy regions.

Information in the Dairy Food Waste Account has been supplemented by the review of over 100 published reports. There have been more than 20 interviews with Australia's major dairy manufacturers, leading supermarkets and wholesale distribution businesses, consultants to the industry and technology providers, and food rescue organisations.

These interviews were used to undertake a 'deep dive' into potential root causes and drivers of dairy food waste (particularly hotspots) and were supplemented with Dairy Manufacturers Sustainability Council and project partner workshops, which also helped to identify solutions to dairy food waste.

Dairy Food Waste Account

Tables ES-1 and ES-2 (page 3) summarise the relative percentage of actual dairy food waste across the supply chain and show that:

- Significant volumes of dairy food waste are being generated at the manufacturing, food service and household stages.
- The highest proportion of dairy food loss is in those states that process the highest volumes of milk (i.e. Victoria, Tasmania and New South Wales).
- Cheese production is responsible for the largest dairy food waste volumes. It is predominantly the result of whey (a by-product of cheese production) being discharged to sewer and land.
- Milk processing is responsible for significant dairy food waste volumes, with the majority of this waste stream from finished product not being consumed, and then losses due to process wastes (predominantly dissolved air flotation [DAF] sludge and clean-in-place [CIP] operations).
- Raw milk losses on farm are low compared to the rest of the supply chain.

Table ES-1 Actual dairy food waste across the supply chain – percentage of total food waste

Dairy food waste types	Farmers	Manufacturing	Retail/ distribution	Food service	Household	Total tonnes	% of total
Total of actual dairy food waste (tonnes)	6,634	506,878	5,073	103,293	86,225	708,104	
By-product	0	50	0	0	0	354,949	50
Process wastes	0	15	0	0	0	105,867	15
Finished product	1	3	1	15	12	225,435	32
Unfinished product	0	3	0	0	0	21,707	3
Other	0	0	0	0	0	146	0
% of total	1	72	1	15	12		100

Table ES-2 Actual dairy food waste by product type and state

Category	Vic	NSW/ACT	Tas	SA	Qld	WA	NT	Total
Milk	9	12	1	2	4	2	0	30
Cheese	24	3	14	5	2	2	0	50
Fresh dairy	5	2	1	1	2	1	0	11
Frozen	0	0	0	0	4	0	0	4
Powders	3	0	1	0	0	0	0	4
Other/mixed	1	0	0	0	0	0	0	1
Total	42	17	17	7	11	5	0	100 or 708,104 t

Hotspot analysis for the manufacturing sector regarding whey and DAF sludge volumes have also been undertaken and are illustrated in Figures ES-4 and ES-5 (page 4).

This analysis has shown:

- Greater Melbourne (35 per cent of the total whey volume) and Tasmania (31 per cent) are key whey hot spot zones.
- The Greater Melbourne whey data reflects the whey produced by Melbourne's 60+ speciality cheese and yoghurt businesses that currently don't have the capital, footprint and/or scale to value add to their whey production and therefore discharge to sewer.
- Extent of whey disposal to land occurring in Tasmania.
- Approximately half of the total DAF sludge volume is being produced in the Murray Dairy region.

The Dairy Waste Account also highlights that it currently costs dairy manufacturers approximately \$700m/year to manage all potential food waste, with an additional \$120m of revenue lost from wasted finished products.

Table ES-3 Cost to manufacturers for managing food waste

Australia-wide	Total (\$)
Milk	89,760,000
Cheese	578,020,000
Fresh dairy	16,810,000
Frozen	1,770,000
Powders	12,060,000
Other	9,710,000
Total cost to manage all dairy food waste	708,130,000

Figure ES-4 Total whey by dairy region

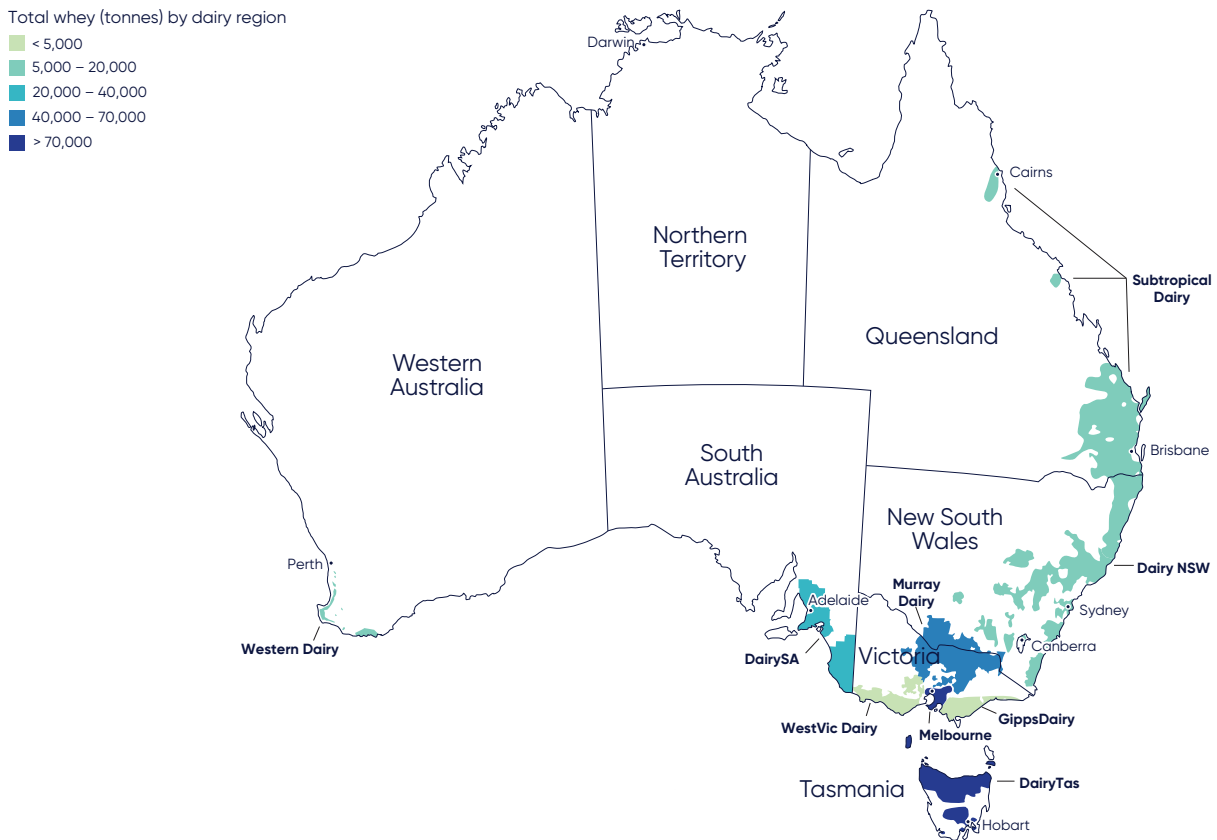
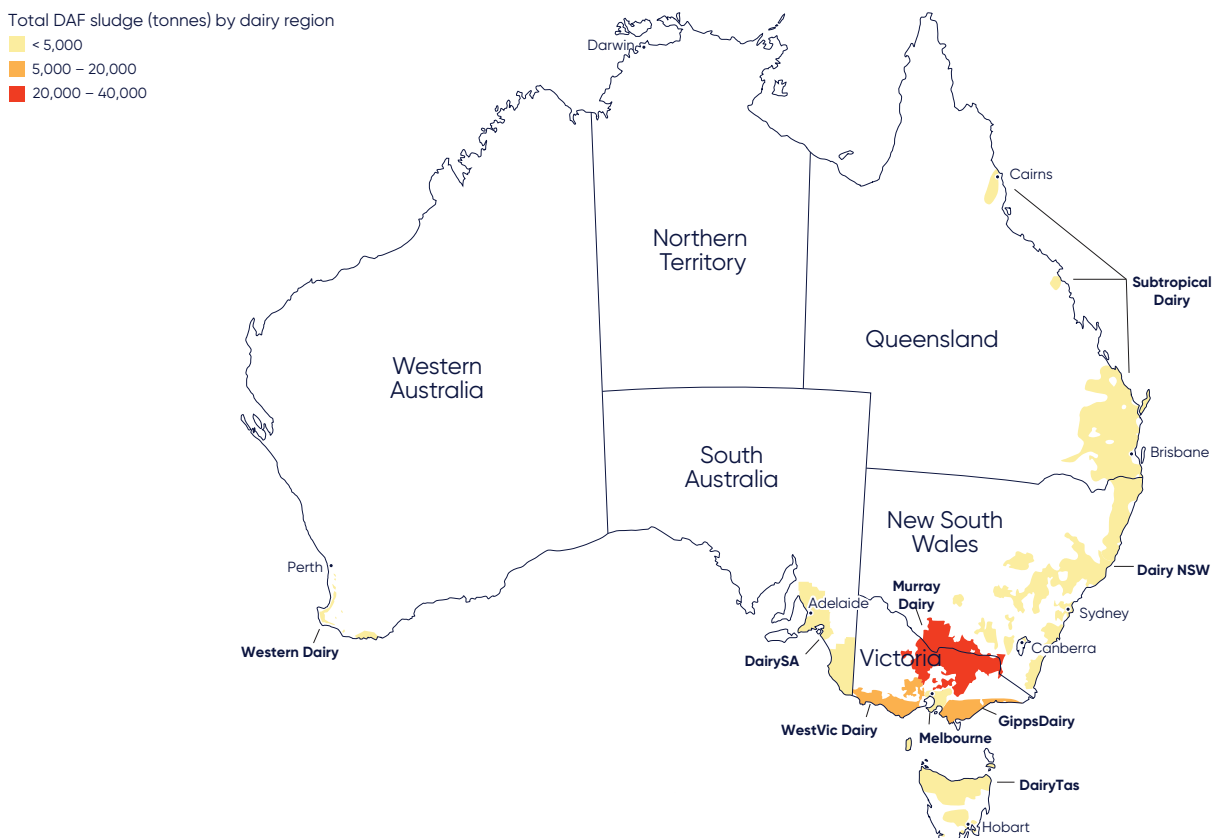


Figure ES-5 Total DAF sludge by dairy region



The key root causes for dairy food waste across the supply chain were explored through interviews with key stakeholders representing each sector and summarised in Table ES-4.

Table ES-4 Key root causes of dairy food waste across the supply chain

Stage	Key root causes
Farms	<ul style="list-style-type: none"> • Power outage/faulty equipment/disrupted or poorly coordinated milk collection routes leading to unsuitable milk temperature • Inappropriate antibiotic use • Human error leading to washdown water mixed with milk
Manufacturing	<ul style="list-style-type: none"> • Lack of understanding of extent of food waste being generated at the site or true scale of impact • High number of products produced with inefficient coordination between planning and production leading to high frequency cleaning • External forecasting demands for short runs of multiple products leading to high frequency cleaning • Antiquated or out dated methods (e.g. timed or manual) used to control cleaning processes • Competing demands for capital for identified upgrades • Lack of availability of adequately trained staff • Unavailable capital, scale and/or land to value-add by-products • High transportation costs for composting/value-add options • Uncertainty regarding potential to donate products to food rescue
Distribution and retail	<ul style="list-style-type: none"> • Rotation of products with short shelf life to meet consumer expectations • Packaging breakages or failures • Transportation breakdowns • Poor sales forecasting, promotions management, product inventory management
Food service and households	<ul style="list-style-type: none"> • Disposal is easy with little understanding of the impact/consequences • Over purchase of food due to poor planning • Inappropriate food storage • Uncertainty regarding safe use of leftovers/offcuts/excess products • Lack of clarity regarding best before/use by/expiry dates and how to apply them



Actions to reduce dairy food waste

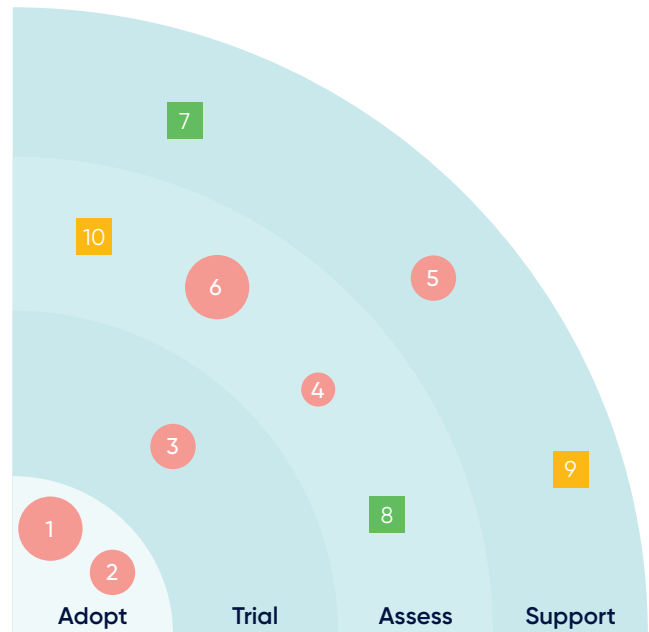
Figure ES-6 provides a summary of the recommended actions to be implemented by the dairy industry in response to the key dairy food wastes identified by the Dairy Food Waste Account and associated industry consultation. The figure highlights actions that target specific parts of the supply chain, the scale of each actions impact in reducing food waste, and the level of implementation (i.e. adopt through to support) required.

Figure ES-6 Summary of identified actions to reduce dairy food waste

Supply chain area

Manufacturing	
1	Monitor dairy food waste across the supply chain and establish industry working group
2	Implement practices that prevent process wastes
3	Investigate technology solutions that turn processing waste and packaged goods into animal feed
4	Increase options for more DAF sludge to be composted
5	Increase awareness for more edible dairy food to go to food rescue sector
6	Assess commercial feasibility of diverting excess whey to third-party processors in regional networks for conversion to value-added products
Distribution/retail	
7	Promote value of improving product labelling and storage advice of dairy food products
8	Investigate technology platforms that can help reduce dairy food waste
Food service/households	
9	Behaviour change programs to support households minimise dairy food waste
10	R&D on potential use of micro-filtration and super chilling technologies to extend shelf life of milk and other dairy products

Level of implementation



Scale of dairy food reduction impact



The relative impact of each action in terms of reduced dairy food waste volumes, saved management costs, and reduced greenhouse gas emissions (GHG) are listed below.

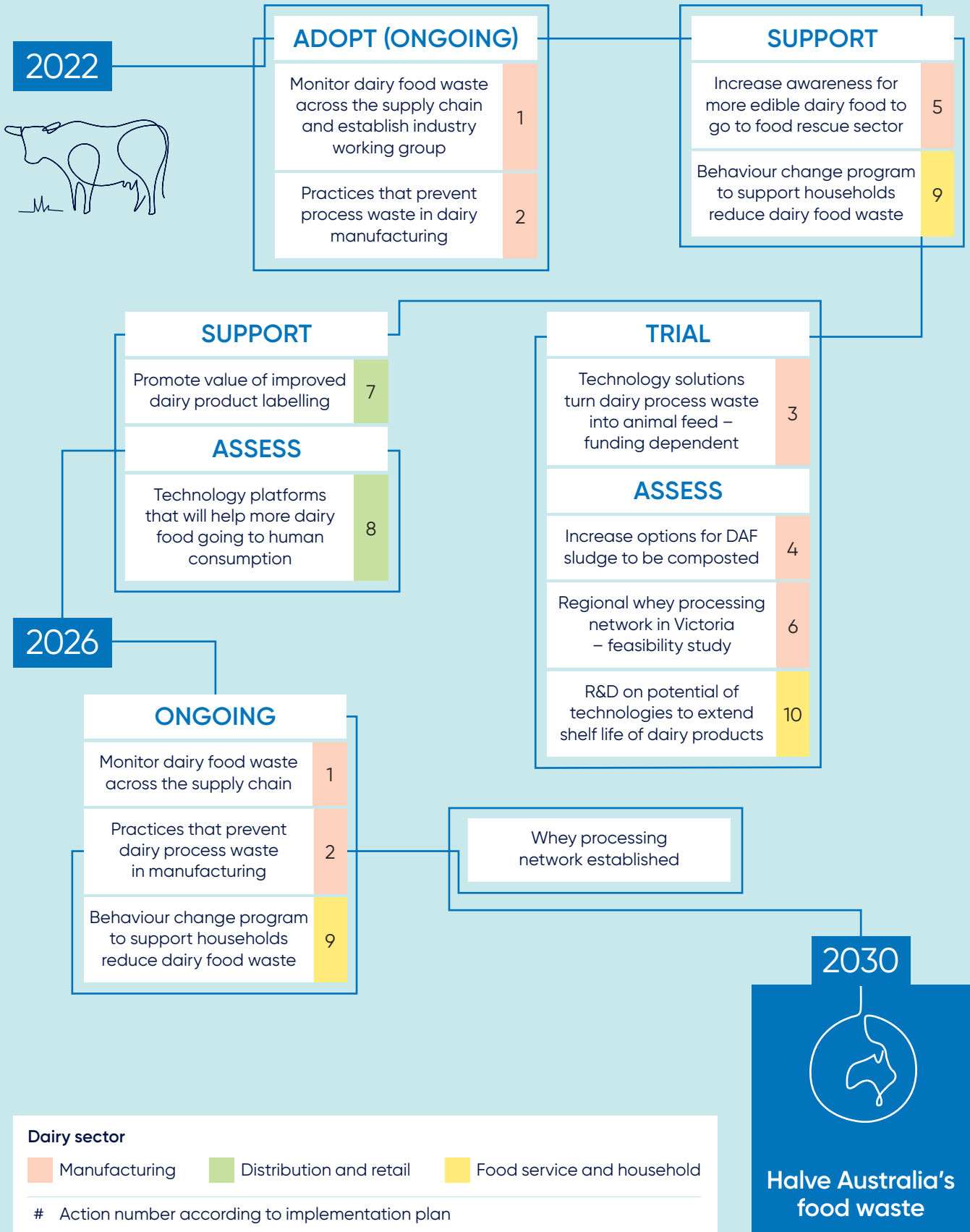
Table ES-5 Recommended actions and their estimated impact

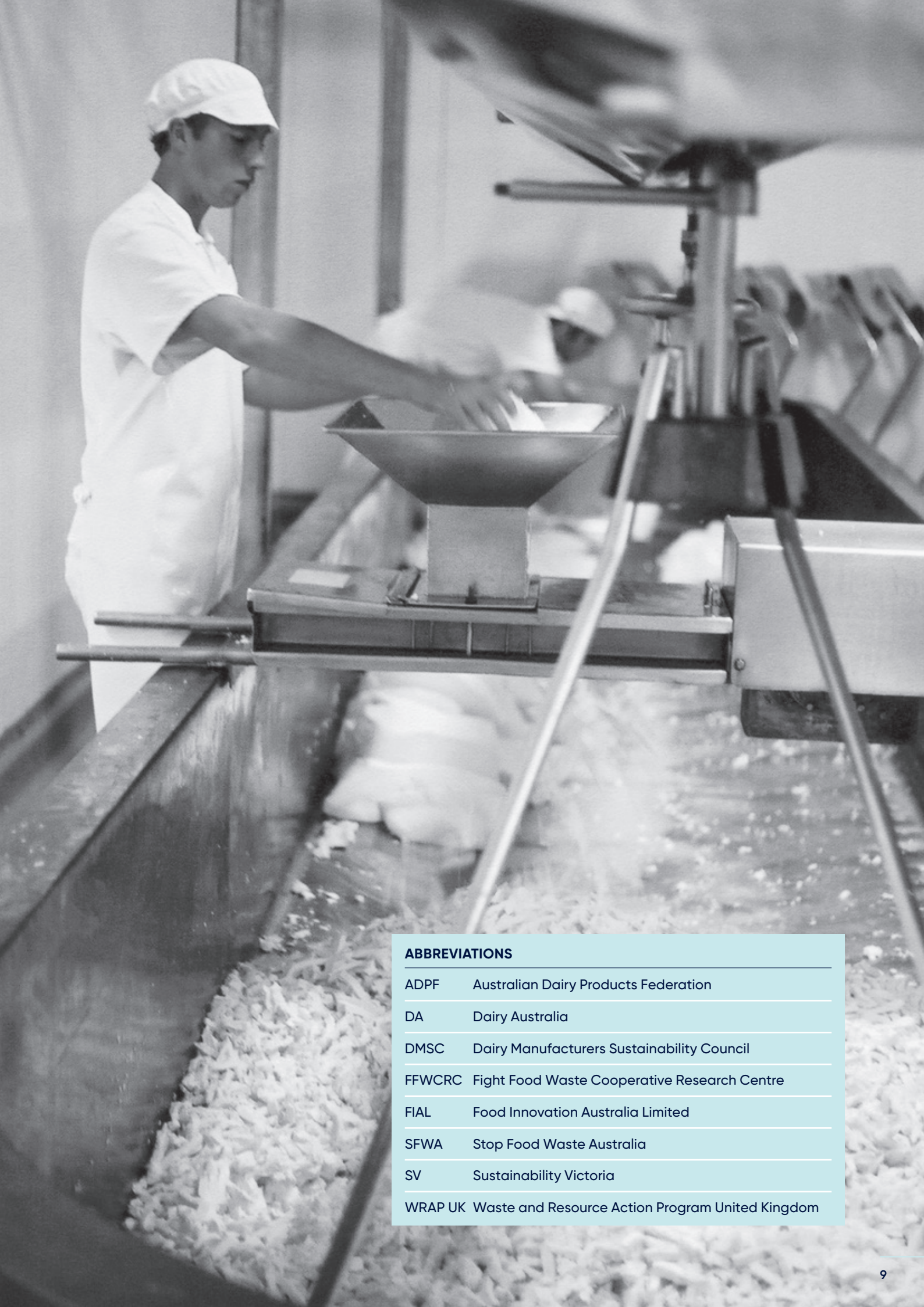
Action	Waste reduction (t/yr)	Reduced management costs (\$m)	GHG savings (t CO ₂ e/yr)
1. Monitoring	Supply chain 70,000 – 105,000 Manufacturing 50,000 – 75,000	Manufacturing \$70 – 105m	Supply chain 190,000 Manufacturing 110,000
2. Process wastes	5,000 – 10,000	\$3.6 – 9.2m	13,335
3. Animal feed	10,000 – 25,000	\$3.5 – 9.0m	40,000
4. DAF sludge composting	2,500 – 7,500	\$0.9 – 2.7m	7,500
5. Food rescue	Manufacturing 2,400 – 6,000 Distribution/retail 500 – 1,250 Food service 10,000 – 25,000	\$0.6 – 1.5m	70,000
6. Regional whey processing	55,000 – 85,000	\$170 – 260m	115,000
7. Product labelling and storage	Unquantified but potential for 20,000 tonnes of milk from correct milk storage, or approximately 15 to 20% of the total milk wastage volume		
8. Technology platforms	Unquantified, but Foodbank Australia's Y Waste app alone has the potential to divert 104 tonnes/annum of food from landfill		
9. Behaviour change program	Unquantified, but significant potential across all dairy food products, e.g. 4,000 tonnes of milk or approximately 10% of the total household milk waste volume		
10. R&D micro-filtration and super chilling	Unquantified, but potentially 8,000 tonnes of milk or approximately 4% of the total milk waste volume		



Roadmap for Dairy Sector Action Plan

The following roadmap highlights the potential journey for the dairy industry to reach the 2030 target of halving Australia's food waste. Ongoing communication and support from all dairy industry organisations, the food rescue sector, not-for-profit organisations (e.g. Stop Food Waste Australia) and government will ensure effective delivery of solutions to meet the 2030 target.





ABBREVIATIONS

ADPF Australian Dairy Products Federation

DA Dairy Australia

DMSC Dairy Manufacturers Sustainability Council

FFWCRC Fight Food Waste Cooperative Research Centre

FIAL Food Innovation Australia Limited

SFWA Stop Food Waste Australia

SV Sustainability Victoria

WRAP UK Waste and Resource Action Program United Kingdom

Glossary

Term	Definition
Actual dairy food waste	Dairy materials that are sent to the following destinations which are lower on the dairy food waste hierarchy and therefore are technically classified as food waste: <ul style="list-style-type: none"> • bio-based materials/biochemical processing • composting • applied to land • anaerobic digestion/co-digestion • sewer • landfill • other.
All potential dairy food waste	Dairy materials that are sent to the following destinations which sit under the 'Prevention' category of the dairy food waste hierarchy and therefore are not considered food waste: <ul style="list-style-type: none"> • repurposing • donate or sell to people • animal feed.
By-products	Any secondary substance/product that is produced during manufacturing of the primary food product. By-products generated in production of dairy food products includes: <ul style="list-style-type: none"> • whey (acid, salty, sweet) • mother liquor • lactose concentrate.
CIP processes	Clean-in-place (CIP) is a method of automated cleaning the interior surfaces of pipes, vessels, equipment, filters and fittings, without the need for major disassembly. CIP is commonly used for equipment such as piping, tanks and fillers.
CO ₂ e	Metric measure used to compare the emissions from various greenhouse gasses on the basis of their global warming potential, by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential.
DAF sludge	Dissolved air flotation (DAF) is a wastewater treatment process designed to remove suspended solids by floating them to the surface of the unit operation and then skimming off the concentrated material. DAF sludge is this concentrated material. When used in dairy processing, it is typically made up of small bits of proteins, fats and fibrous material.
Dairy regions	Australia's dairy industry is split into eight dairy regions that cater to local needs and provide regional development programs for dairying operations within that region. The regions are: <ul style="list-style-type: none"> • Murray Dairy: Murray region, northern Victoria and southern NSW • WestVic Dairy: western Victoria • GippsDairy: Gippsland region, Victoria • DairyTas: Tasmania • Dairy NSW: New South Wales • DairySA: South Australia • Subtropical Dairy: subtropical region, Queensland and NSW • Western Dairy: Western Australia.
Finished product	Any manufactured product that is suitable and intended to be sold
Fresh dairy	Fresh dairy products such as butter, yoghurts, dairy desserts, chilled custards and creams, dairy dips etc. Excludes cheese, milk, frozen dairy and powders.
Hotspot	Identified areas of the manufacturing process and/or supply chain where there is notable losses or waste of dairy food product based on data collection activities
Milk equivalent	A measure of the quantity of fluid milk used in a processed dairy product.
Process wastes	Materials generated during the manufacturing process of dairy products (e.g. liquid waste from cleaning processes, dissolved air flotation sludge).
Unfinished product	Any product that has not passed through the complete manufacturing process and is not suitable to be sold in its current form.

Section 1

Introduction and background

The Australian dairy industry is committed to sustainable practices – including reducing waste – which is highlighted in the 2021 Australian Dairy Sustainability Framework report. Currently, there are a range of initiatives and practices implemented by dairy farmers, individual dairy manufacturers and retailers that contribute to reducing dairy food waste across the supply chain.

However, further opportunities to tackle dairy food waste exist and this has been recognised by the Dairy Manufacturers Sustainability Council (DMSC) and the Australian Dairy Products Federation, who have identified a need for collective action across the industry. This Sector Action Plan addresses this need, which has been developed by Dairy Australia in partnership with the Australian Dairy Products Federation, Stop Food Waste Australia, input from DMSC members and other dairy companies, with support from Sustainability Victoria.

1.1 About this sector plan

This Sector Action Plan is the Australian dairy industry's commitment to supporting Australia's target to halve its food waste by 2030. Its development has increased transparency of dairy food waste across the supply chain and it provides a pathway for the industry to collaboratively tackle this waste. The plan features a range of feasible solutions that, when implemented, can provide value back to dairy businesses and the wider community, including:

- increase in dairy products available for human consumption
- waste management cost savings
- reduced environmental impacts associated with food waste
- operational savings (e.g. reduction in water and energy use).

Implementation of this plan will support the dairy industry to meet its goal of reducing food waste and contribute to Australia's target to halve food waste by 2030.



1.2 Australian dairy industry

Dairy is Australia's third largest rural industry and has a farmgate value of production of \$4.7 billion, featuring 4,420, dairy farms and 455 processing factories across the country. In 2021/22, the total annual milk production was 8,858 million litres, with 86 per cent produced in south-east Australia.

Cheese production uses the largest proportion of Australia's milk production, with approximately 39 per cent (Figure 1) of Australia's fresh milk used to produce a range of bulk and speciality cheese products, predominantly across south-east Australia. Beyond the production of cheese, drinking milk and butter/skim/whole milk powder production also utilise significant proportions of Australia's milk supply.

The Dairy Food Waste Account (section 3) that has been compiled as part of this Sector Action Plan reports that there are currently 0.71 million tonnes of actual dairy food waste being generated across the dairy supply chain, with by-products from cheese production (e.g. whey), process wastes associated with dairy product manufacturing, and the disposal of finished product to landfill, key waste categories. These dairy food waste categories are therefore important focuses for this Sector Action Plan.

While the industry is undertaking a range of initiatives to reduce the volume of dairy food waste being generated (Figure 2, page 13), there remains significant opportunity to reduce dairy food waste via prevention, reuse/repurpose, and diversion activities. The dairy industry's aim is to prevent the food waste from occurring in the first place or moving the management of the food waste further up the waste hierarchy.

Figure 1 How much milk and dairy food products are produced in Australia?

8,554 million litres of milk produced annually

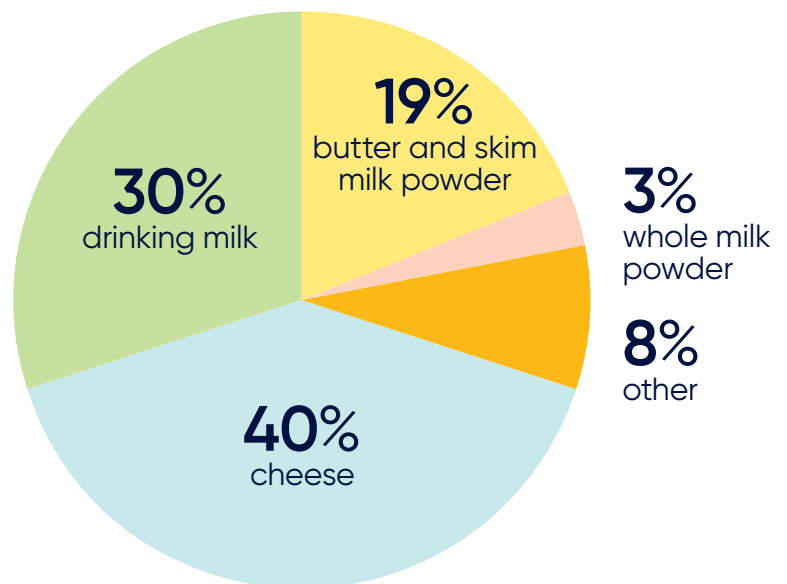
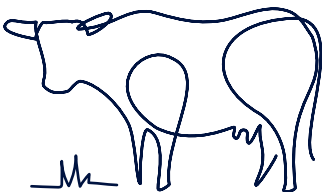
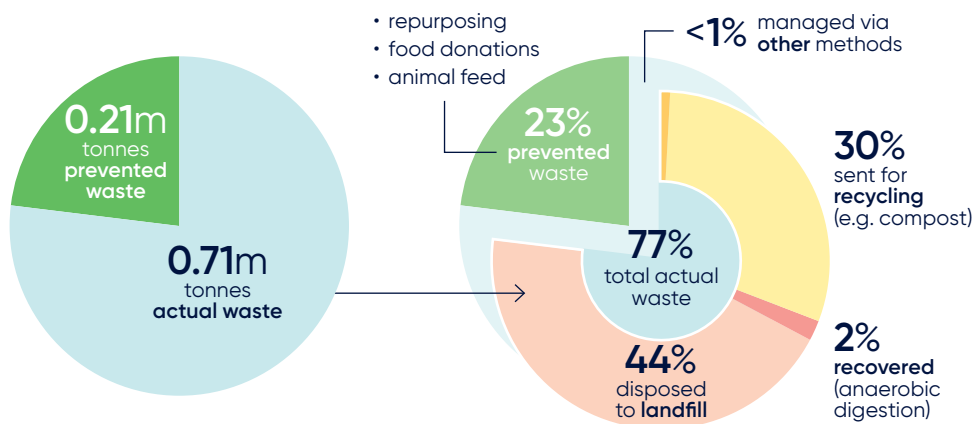


Figure 2 How much dairy food waste is there and where does it go?

0.92m tonnes potential dairy food waste

generated across the supply chain per year in Australia



Key organisations

Australia's dairy industry is supported by a number of key organisations that help drive sustainable and profitable operations across the sector. They and have been instrumental in the development of this Dairy Food Waste Sector Action Plan. The following information provides a snapshot of these key organisations and helps to identify the roles that each organisation can play in implementing and supporting the actions detailed in this action plan.

In addition to the organisations discussed below, there are a range of government initiatives and organisations that will support the dairy industry to reduce its food waste, and implement this Sector Action Plan. Detail regarding these initiatives and organisations is provided in the following sections and helps to provide the context for this action plan in the broader Australian food waste reduction landscape, and ongoing support that may exist for the delivery of the actions.

Dairy Australia

Dairy Australia is the national services body for the Australian dairy industry that delivers eligible research and development (R&D) activities. These activities are funded by dairy farmers' paid levies and matching payments from the Commonwealth Government. Dairy Australia's purpose is to support the profitability and sustainability of dairy farming and undertake investments in innovations that focus on increasing farm productivity and the global competitiveness of the Australian dairy industry. It also provides practical tools, services, and advice to assist farming operations and the dairy supply chain.

Dairy Australia contributes funding, planning, and management to eight Regional Development Programs and works closely with state and national representational bodies to deliver the dairy industry's goals.

Australian Dairy Products Federation

ADPF is the national peak policy and advocacy body representing commercial, post farm-gate members of the Australian dairy industry, including processors, traders and marketers of Australian dairy products. For the past 30 years, The ADPF has worked to represent the interests of its members in promoting and protecting dairy products through advocating for improvements in the manufacturing, marketing and trading of dairy. ADPF members process more than 90 per cent of Australian milk volumes and provide dairy products for both the domestic and export markets.

ADPF and its members are committed to a thriving, profitable and sustainable dairy industry, valued by the wider community.

Dairy Manufacturers Sustainability Council

The DMSC is a community of practice whose membership is comprised of the environmental and sustainability group managers from Australian dairy manufacturing companies. It has an industry-wide focus that assists company members to improve environmental compliance and the sustainability of their operations. In 2020/21, company members were estimated to be processing more than 85 per cent of the national milk supply.

Dairy Australia provides the secretariat for the DMSC as part of a larger program designed to support the sustainability of the Australian dairy manufacturing industry.

1.3 Government initiatives to tackle food waste

Australia has set a target to halve its food waste by 2030, aligning with the United Nation's Sustainable Development Goal (SDG) 12.3:

“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.”

In 2017, the Australian Federal Government published the National Food Waste Strategy to provide a framework to support collective action towards reducing food waste and achieving SDG 12.3. Several state governments have also declared their commitment to help deliver this national target.

Below is a summary of relevant initiatives and some of the key organisations responsible for acting to reduce food waste in Australia.

National Food Waste Strategy

A definition of food waste for the Australian context has been provided in the National Food Waste Strategy. It promotes a food recovery hierarchy (Figure 5, page 19) where management practices that support food waste avoidance are preferred over resource reuse, recycling, reprocessing, energy recovery and disposal. The Strategy also highlights the shared responsibility in reducing food waste and has identified four priority areas for action: *Policy Support, Business Improvements, Market Development and Behaviour Change*.

In 2020, Food Innovation Australia Limited (FIAL) developed a roadmap for reducing Australia's food waste by half by 2030 to support implementation of the National Food Waste Strategy. The establishment of Stop Food Waste Australia and its voluntary agreement program, the Australian Food Pact, and Sector Action Plans are key steps in the delivery of this roadmap.

Recently, FIAL (2021) has investigated the feasibility of halving Australia's food waste by 2030. This study has included updating the National Food Waste Baseline, identifying hotspots for waste and environmental impacts, testing and costing scenarios. It notes that industry led initiatives provide the most cost-effective approach to reducing food waste, once a supportive policy framework is in place.

This Sector Action Plan has adopted the food waste definitions and identified actions that align to priority areas for actions as outlined in the Strategy and subsequent reports.

Path to Half Report – Sustainability Victoria

Sustainability Victoria released the *Path to Half: Solutions to halve Victoria's food waste by 2030* in 2021, which provided insights into food waste in Victoria, its wider impacts on climate change, water loss and economic cost, as well as an overview of food waste solutions. The report identified six foods with the highest waste volume, climate, water and cost impacts with milk and cheese being significant contributors.

Subsequently, Sustainability Victoria awarded a grant to Dairy Australia and its project partners Stop Food Waste Australia and the Australian Dairy Products Federation to:

- Quantify volumes and composition of dairy waste.
- Develop and assess solutions to reduce dairy waste in processing and households.
- Identify new products, services, and business models to establish a circular dairy sector.

Delivery of this Sector Action Plan is a key outcome of this grant.

Stop Food Waste Australia and Sector Action Plans

Stop Food Waste Australia (SFWA) is an independent long-term partnership which was established with funding from the Australian Government Department of Climate Change, Energy, the Environment and Water to lead the delivery of the National Food Waste Strategy. SFWA is part of Fight Food Waste Limited an independent not-for-profit company and charity.

SFWA is driving the development of Sector Action Plans to address major food waste 'hotspots' in Australia's food system. By taking a sector-based approach, multiple stakeholders can come together in pre-competitive collaborations to address specific food waste challenges that are too significant for individual organisations to solve alone.

Hotspots in the food system are where several factors combine to create situations where there is:

- High amounts of food loss or wastage
- High environmental impact from the wasted food.
- High value foods are wasted.

Sector Action Plans provide an opportunity to prioritise actions and develop a workable plan to reduce food waste in the food system.

Other key priorities of SFWA include implementation of the Australian Food Pact. SFWA works closely with partners and the Fight Food Waste Cooperative Research Centre (FFWCRC), which is also part of Fight Food Waste Limited, to reduce food waste and drive innovation, productivity, and sustainability of Australia's food systems.

Section 2

Developing the Sector Action Plan

This Sector Action Plan draws on the existing knowledge and insights of people from within the dairy industry, in partnership with those from SFWA. The shared understanding of existing dairy food waste management, both in Australia and overseas, has informed the recommended actions detailed in Section 4 of this report.

The plan builds upon, and is informed by, existing approaches and strategies to tackle food waste, including the:

- National Food Waste Strategy
- Food Loss and Waste Accounting and Reporting Standard
- Whole Chain Food Waste Reduction Plan **Toolkit** developed by the Waste and Resources Action Programme (WRAP), United Kingdom (UK) as this supersedes the WCRE Toolkit
- SFWA Sector Action Plan process.

The whole dairy supply chain was considered in this Sector Action Plan (i.e. full 'farm-to-fork' product supply chain), including dairy farms, manufacturing sector, distribution, retail sector, food service and households (Figure 3). While the Dairy Waste Account has collected and estimated dairy food waste data for the entire supply chain, and the actions recommended by this plan apply to the entire sector, a particular focus has been on the manufacturing/processing sector, given:

- the influence of the project partners and therefore the ability to collect and analyse dairy food waste data for this stage of the supply chain
- the volumes of dairy food waste at this stage of the supply chain and therefore the opportunity to identify and implement solutions that will maximise value (i.e. reduced dairy food waste).

The system boundaries for each stage of the dairy supply chain (Figure 4, (page 16), have been adopted from Arcadis (2019) to assist in the collection of dairy food waste data and development of this Sector Action Plan. It shows in a simplified form, the key destinations of dairy food waste as currently exists, and helps to identify solutions that can be implemented to prevent/minimise dairy food waste from occurring.

2.1 Scope

Figure 3 Australian dairy supply chain



The colour coding aligns with the Dairy Food Waste Hierarchy presented in Figure 6 (page 19), with a preference for management actions that prevent dairy food waste from occurring in the first instance (green shaded cells), as opposed to those practices that result in recycling (yellow), recovery (orange) and disposal (red). These system boundaries and definitions have been used to define what is considered 'actual dairy food waste' by the project, with dairy materials that fall into this category defined as shown in the adjacent box.

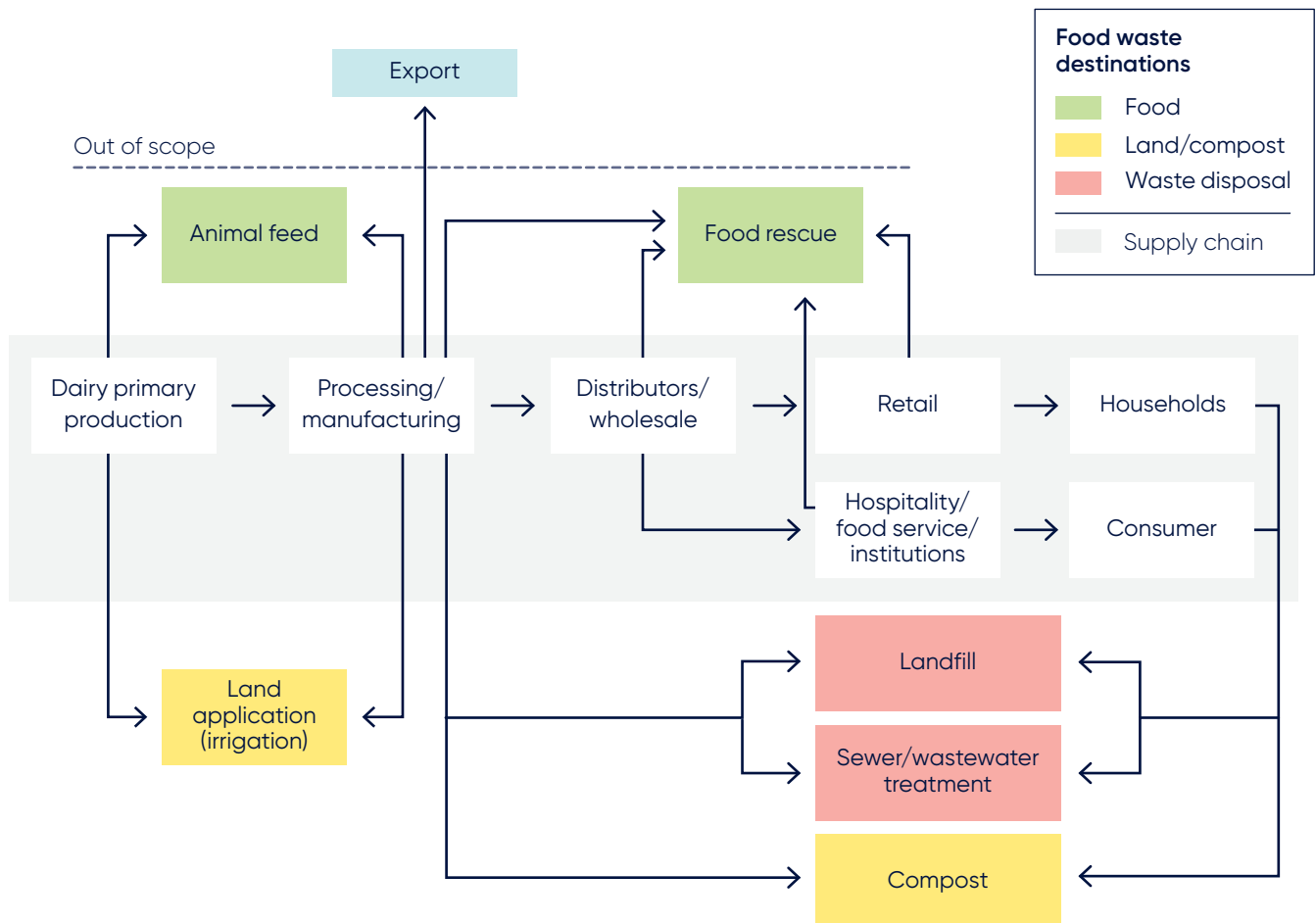
The aim is to move dairy food waste that falls into these categories up the food waste hierarchy, with the ultimate aim being food waste prevention.

WHAT IS ACTUAL DAIRY FOOD WASTE?

Dairy materials that are sent to the following destinations which are lower on the dairy food waste hierarchy and therefore are technically classified as food waste:

- Bio-based materials/biochemical processing
- Composting
- Applied to land
- Anaerobic digestion/co-digestion
- Sewer
- Landfill

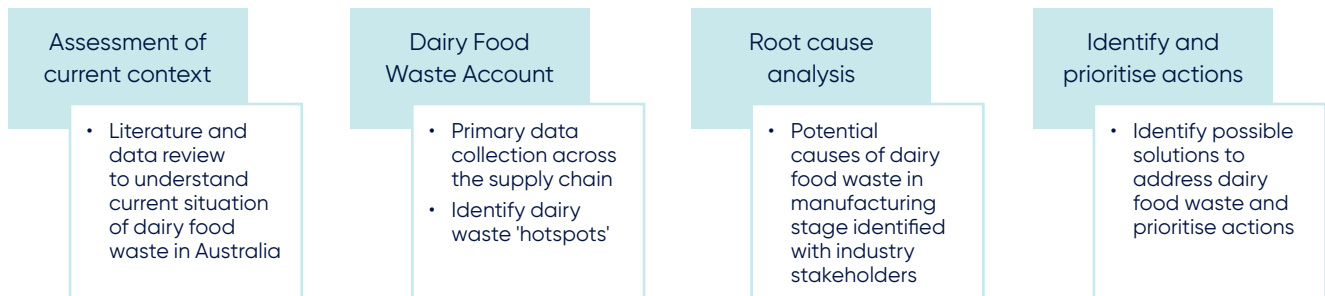
Figure 4 Dairy sector supply chain – system boundaries and food waste destinations



2.2 Key steps

The key steps to developing this Sector Action Plan are summarised in Figure 5 and further details provided below. The approach was mainly based on the Waste and Resource Action Program UK's (Wrap UK) 'whole of supply chain waste mapping and resource efficiency' process, and featured problem definition, diagnostics/analysis, and solution generation phases.

Figure 5 Approach to developing the Sector Action Plan



Understanding current context

A detailed literature review was undertaken based on resources from DA, SFWA (and their partners e.g. WRAP UK), the ADPF, and those that are publicly available, to outline what is currently known about dairy food waste in Australia. This review also included an overview of current standards for accounting and reporting food waste.

The literature and data review involved the assessment of over 100 published reports and data sources and was instrumental in the development of the data collection surveys and resources that have culminated in the Dairy Food Waste Account (following section).

Significant value from this stage of the project has also been gained during the identification and prioritisation of actions, with published reports and data from Australia and overseas (particularly the UK) used to validate the potential impact of the nominated actions.

Dairy Food Waste Account

The Dairy Food Waste Account estimates food loss and waste across the dairy supply chain using multiple data sources. Its main purpose has been to identify the dairy food waste hotspots and the impact that can be achieved by either eliminating the dairy food waste from occurring, or moving its management further up the dairy food waste hierarchy (Figure 6, page 19).

Development of the Account included a detailed data survey and follow up consultation with dairy manufacturers, retailers and food rescue organisations. Pre-gate milk loss data for dairy farms was provided by Dairy Australia, while dairy food waste estimates for food

service and households were developed using secondary sources (e.g. the National Food Waste Baseline, surveys, previous audits). Existing data held by DA on whey production volumes by Melbourne's small- to medium-sized speciality cheese and yoghurt production businesses was also used to build the account.

The Account provides the richest data set of dairy food waste information available for the Australian Dairy Industry, and has been developed using the best available information from Australia and overseas, as informed by the project investigations and input by subject matter experts (e.g. the project team). Further information about the data collection method and sources is provided in Appendix 1.

For the manufacturing sector, a data survey was developed to collect the following information:

- Incoming volumes of raw milk.
- Outgoing products (e.g. milk, yoghurt, cheese, cream, powders, etc.).
- By-products (e.g. whey).
- Volumes of wastewater disposed to sewer.
- Food waste volumes avoided or managed through various methods including food waste prevention, recycling, recovery, and disposal.
- Current dairy food waste management costs.

Details regarding the type of dairy food waste generated in the manufacturing stage and current practices (or destinations) to manage this waste is provided in Appendix 2.

The data collection has been supplemented with direct interviews and discussions with all of Australia's major dairy manufacturers and covers more than 13 manufacturers in total. The interviews and discussions were used to clarify their waste management practices and explore the root cause of dairy food waste at their manufacturing sites. These interviews and discussions were conducted individually and in group settings, to identify current management practices, dairy food waste hotspots, and possible interventions that were applicable to the entire industry and not just isolated occurrences.

An additional four interviews were undertaken with consultants and technology providers to the dairy industry, and provided an independent assessment of dairy food waste trends across the industry and potential mitigation actions that could feasibly reduce dairy food waste.

Considerable time was also spent engaging with, and learning from, Australia's food rescue organisations, as they are recipients of edible dairy products that would otherwise go to landfill and have significant potential for expanded intake. Input from these organisations – combined with the data collection from the manufacturers/processors – has been instrumental in identifying opportunities for more finished product to be made available for human consumption and the ways that this can be achieved. This engagement involved individual and joint discussions with Foodbank, SecondBite, Ozharvest, FareShare and Yume.

Two interviews were also conducted with one of Australia's leading supermarket companies and a leading wholesale distribution business to investigate dairy food loss across their businesses and root causes. Repeated attempts were also made to try and engage with a second leading supermarket company but they were unavailable across the course of the project.

Root cause analysis

A 'deep dive' to understand the potential root causes and drivers of dairy food waste – particularly the hotspots – was completed through interviews with representatives from across the dairy supply chain, including the food rescue organisations listed above.

This was supplemented with DMSC and project partner workshops to explore possible causes of dairy food waste in the manufacturing stage and considerations to other parts of the supply chain. In particular, a cause and effect' activity was run in these workshops using the 'five whys' technique and mapping root causes in a Ishikawa (or fishbone) diagram to clearly highlight the issues in manufacturing driving dairy food waste and losses.

The most significant of these root causes are discussed in the later section outlining recommended actions, with these identified actions directly addressing the key root causes of dairy food waste.

Identify and prioritise actions

Possible solutions to address the root cause and issues of dairy food waste were scoped with the DMSC and project partners via workshops. From these solutions, actions were identified and prioritised based on a set of key principles (see Actions to Reduce Dairy Food Waste section).

Consideration to how identified actions can be implemented are based on:

- Ease of implementing the actions.
- Responsible organisation to lead implementation of actions and other enabling factors (e.g. supporting agencies, existing programs and available funding).

A high-level roadmap has been provided to guide implementation of actions to support the dairy industry's goal of helping Australia to halve its food waste by 2030. The road map is presented in the final section.



2.3 Principles for targeting food waste

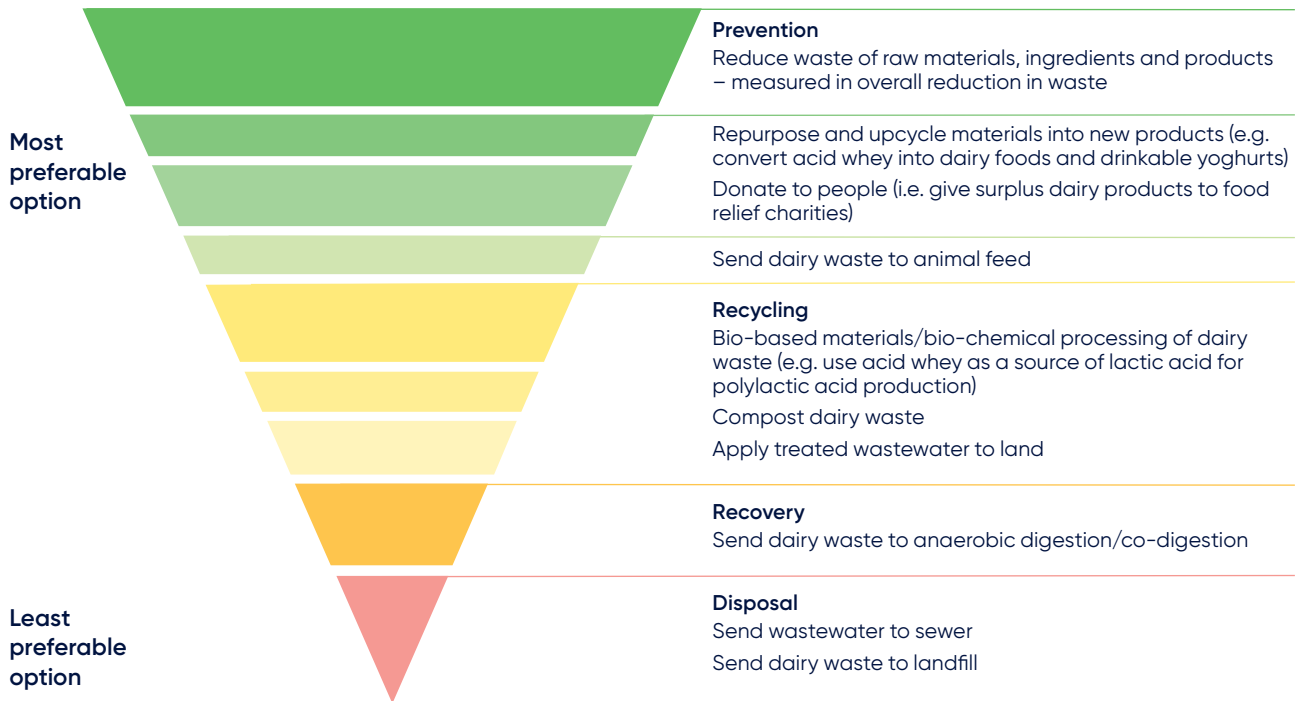
The food recovery hierarchy presented in the National Food Waste Strategy Feasibility Study – Final Report has been adapted for this Sector Action Plan and has been used to classify current practices in preventing and managing dairy food waste. It has also been used to identify and assess commercially viable and responsible solutions to reduce dairy food waste.

A key principle for this Sector Action Plan has been to focus on identifying those actions that can assist moving

dairy food waste ‘up’ the hierarchy (Figure 6), aiming for further prevention of food waste across the supply chain. Those actions categorised in ‘green’ will contribute to Australia’s commitment of halving food waste by 2030. These include:

- Preventing food waste and loss.
- Reuse/repurpose, such as food rescue or for the creation of new ‘upcycling’ food products.
- Diversion of food waste to animal feed.

Figure 6 Food waste hierarchy adapted for Dairy Sector Waste Action Plan



Section 3

Dairy Food Waste Account

The Dairy Food Waste Account identifies current food waste practices and hotspots across the Australian dairy supply chain. Its development is described in the previous section, Developing the Sector Action Plan with further detailed advice regarding its development provided in Appendix 1.

The significant primary data collected for the manufacturing sector provides a more detailed and accurate picture of the type and amount of dairy food waste generated at this stage, compared to previous food waste studies. For the other stages of the supply chain, it's expected that dairy food waste would be higher than reported figures given less accessible primary data. Furthermore, it can be difficult to estimate dairy food loss at the retail and household stages due to behavioural practices such as milk, yoghurt and dairy desserts being disposed down the sink.

Regardless, consolidation of data and information for the Dairy Food Waste Account has identified the hotspots of dairy food waste and where opportunities to improve dairy food waste management exist across the supply chain. It also highlights and confirms noteworthy practices currently being implemented by individual businesses that avoid food waste and support donations, repurposing and recycling.

3.1 Overview of dairy food waste

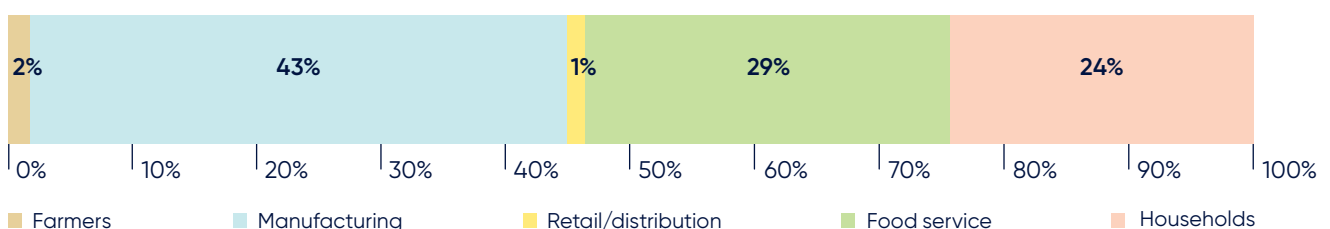
Across the dairy supply chain

Figure 7 summarises the relative percentage of actual dairy food waste across the supply chain, highlighting where most of this waste is likely to be generated. This figure excludes by-products (e.g. whey) that are produced in the manufacturing stage, acknowledging it is mainly an unavoidable 'material' in the processing of milk into other dairy products, particularly for cheese.

Figure 7 indicates that significant volumes of dairy food waste are being generated at the manufacturing, food service and household stages of the supply chain and that dairy food waste at the farm and retail/distribution stages is small and insignificant in comparison. The farm dairy food loss data is considered to be an accurate

representation of the potential losses at the farm end of the supply chain and recognises the significant work done by the dairy industry to keep farm milk losses low. However, the retail/distribution estimates are likely to be underestimated and more significant than reported, particularly for the retail component of this category. One per cent of total food losses at the distribution stage is consistent with data from other similar exercises both within Australia and overseas (e.g. cold chain sector reports). However, it is considered that this value is underestimated for retail. Ongoing monitoring led by SFWA has the potential to provide greater insight into the actual dairy food loss that is occurring at this stage of the supply chain, and is featured in the actions recommended in Section 4 of this report.

Figure 7 Actual dairy food waste source by sector, Australia wide (tonnes, excluding by-products)



While it is technically accurate that by-products, and in particular, whey, are unavoidable due to the production of cheeses and yoghurts, their management can be sources of significant dairy food loss, particularly where whey is discharged to sewer or applied to land.

Table 1 provides further detail of the total amount of actual dairy food waste for each component of the supply chain and a breakdown of the type of dairy food waste (i.e. by-product, process waste, finished products, unfinished products), and this time includes by-products. As seen, by-products and process wastes at the manufacturing stage, and finished product at the food service and household stages of the supply chain, remain significant – and therefore are a focus of this action plan.

To provide further detail on the process waste data at the manufacturing stage, this category of dairy food waste can be broken down into the following components.

PROCESS WASTE ARE APPROXIMATELY (on a per tonnes of total process wastes basis)
48% DAF sludge
16% cleaning
25% start-up/shut down
9% product loss
2% testing

The combination of DAF sludge and Clean in Place (CIP) operations (i.e. cleaning; start up/shut down) accounts for approximately 89 per cent of the manufacturing process wastes and have been a key focus for the root cause analysis investigations completed with the DMSC, and the actions presented in Section 4.

Key insights

Key insights from the data presented above can be summarised as follows:

- Dairy food waste hotspots across the supply chain are highlighted in Table 1, with manufacturing contributing the highest proportion.
- By-products (at 50 per cent) are the largest dairy food waste stream. Of this material, most is whey from cheese manufacturing.
- Other notable dairy food waste hotspots are process wastes (15 per cent) and finished products in the food service (15 per cent) and household (12 per cent) sectors.
- Proportionally, milk losses on farm (prior to manufacturing) and losses due to distribution are low compared to the rest of the supply chain (one per cent).

Table 1 Actual dairy food waste across the supply chain – percentage of total food waste

Dairy food waste types	Farmers	Manufacturing	Retail/ distribution	Food service	Household	Total tonnes	% of total
Total of actual dairy food waste (tonnes)	6,634	506,878	5,073	103,293	86,225	708,104	
By-product	0	50	0	0	0	354,949	50
Process wastes	0	15	0	0	0	105,867	15
Finished product	1	3	1	15	12	225,435	32
Unfinished product	0	3	0	0	0	21,707	3
Other	0	0	0	0	0	146	0
% of total	1	72	1	15	12		100

Across the states and territories

Dairy food waste data is also presented according to the amount generated on a state/territory basis and the type of dairy product (Table 2).

Table 2 Actual dairy food waste by product type and state (percentage)

Category	Vic	NSW/ACT	Tas	SA	Qld	WA	NT	Total
Milk	9	12	1	2	4	2	0	30
Cheese	24	3	14	5	2	2	0	50
Fresh dairy	5	2	1	1	2	1	0	11
Frozen	0	0	0	0	4	0	0	4
Powders	3	0	1	0	0	0	0	4
Other/mixed	1	0	0	0	0	0	0	1
Total	42	17	17	7	11	5	0	100 or 708,104 t

A number of insights can be drawn from this information and the data from the Dairy Food Waste Account that underpins it:

- The highest proportion of dairy food loss is in those states that process the highest volumes of milk i.e. Victoria, Tasmania and New South Wales.
- Cheese production is responsible for the largest dairy food waste volumes and is dominated by the generation of by-products (whey), with by-products comprising over 90 per cent of the total cheese food waste volume.
- Milk processing is responsible for significant dairy food waste volumes, with 30 per cent of the overall volume. The majority of these wastes are from finished product not being consumed (i.e. 60 per cent of the total milk production food wastage volume) and then due to losses that occur due to process wastes (32 per cent).
- Across all states, dairy food waste associated with the production of fresh dairy is relatively significant, with by-product (whey – 47 per cent) and finished products not being consumed (48 per cent) virtually comprising this entire segment.



Manufacturing hotspot analysis

The data presented in Tables 1 and 2 (page 21 and page 22 and associated discussions shows that there are significant volumes of dairy food waste occurring during manufacturing due to the generation of by-products (whey) from the production of cheese and yoghurt, and also due to process wastes from the processing of raw milk and cream etc.

While neither of these dairy food waste categories can be completely eliminated, there is opportunity to reduce how much of these food wastes are managed via recycling, recovery and disposal management practices. In some cases, the industry will benefit from improved management options that can serve multiple manufacturing sites rather than individual actions that are focused on individual sites. To help assess the potential for this, hotspot analysis has been undertaken for the whey (by-products) and DAF sludge volumes. Heat maps for these waste streams are presented in Figures 8 and 9 respectively (page 24). The mapping uses Dairy Australia's Dairy Region's to combine and assess the data and highlights:

- Greater Melbourne (35 per cent of the total whey volume) and Tasmania (31 per cent) are key whey hotspot zones, followed by Murray Dairy (15 per cent) and then SA (9 per cent).
 - The Greater Melbourne whey volume is coming from the 60+ (see Appendix 1) small- to medium-sized speciality cheese and yoghurt businesses that don't have the capital, footprint or scale of production to value add their operations by installing a dryer to further process their whey into products like whey protein concentrate (WPC). This practice has been common over the years for many of the larger Victorian cheese production sites as they do have

the capital, footprint and scale necessary to invest in this type of production. It remains however out of reach from the small- to medium-sized operators and therefore, they discharge their whey to sewer.

- The Tasmanian volume is due to the land application of whey, which is a form of disposal/recycling as per the dairy food waste hierarchy and therefore recorded as dairy food waste.
- The Murray Dairy region is responsible for approximately half of the DAF sludge volume recorded by the Dairy Food Waste Account, with WestVic Dairy (13 per cent) and GippsDairy (12 per cent) the next significant regions.
 - Reductions in DAF sludge will ultimately be achieved by cleaner production techniques and reduced product losses during the manufacturing of the dairy products and developing an overall culture across the manufacturing sites of dairy food waste avoidance. In some instances, manufacturing sites with significant DAF sludge volumes have benefited from being able to send their DAF sludge to compost facilities. This has largely been opportunistic however, with the manufacturing site fortuitously located near a suitable compost operation.
 - Transportation costs are a key barrier to DAF sludge being composted or used for animal feed, so access to nearby operations or ways to overcome the transportation costs are important when considering DAF sludge management options.

The actions presented in the following section have been informed by this hotspot analysis. Proposed regional solutions will have benefit for individual businesses who are currently reliant on whey and DAF sludge management practices that constitute dairy food waste.



The Greater Melbourne whey volume is coming from the 60+ small- to medium-sized speciality cheese and yoghurt businesses that don't have the capital, footprint or scale of production to value add their operations by installing a dryer to further process their whey.

Figure 8 Total whey by dairy region

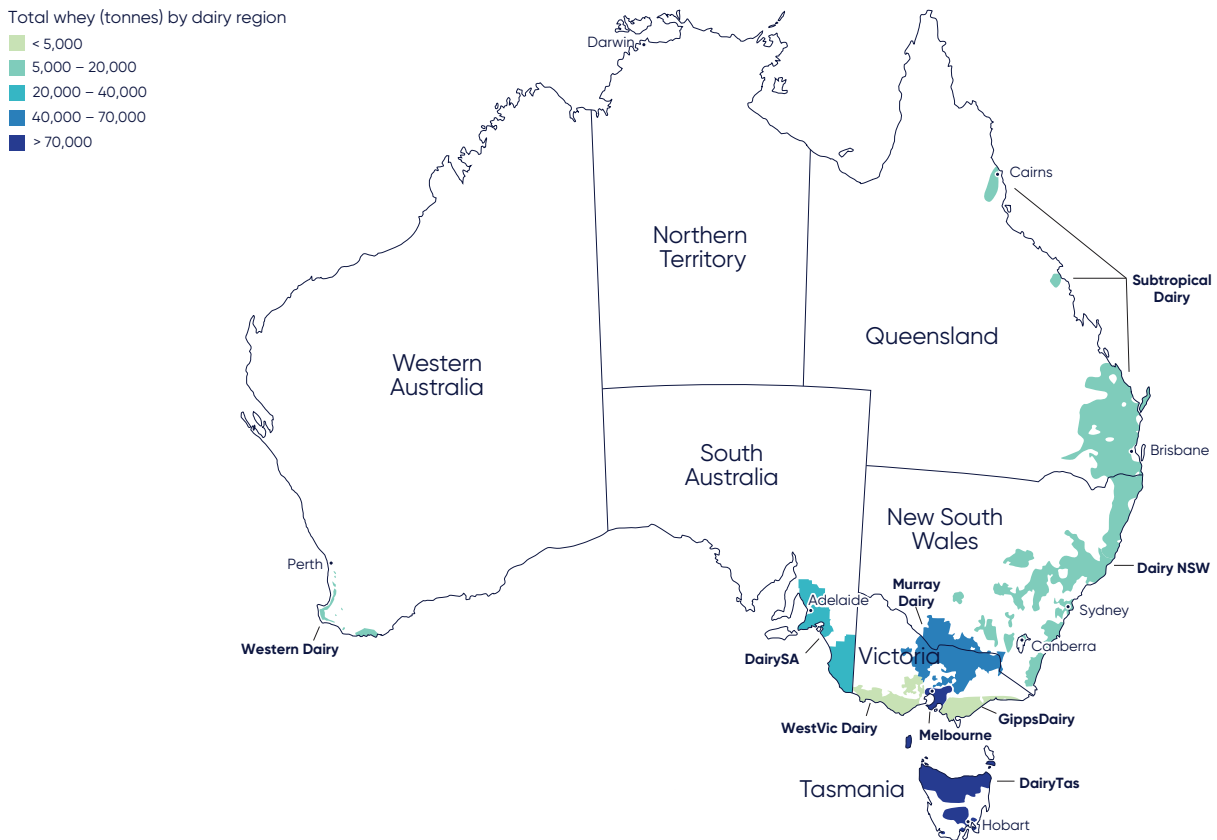
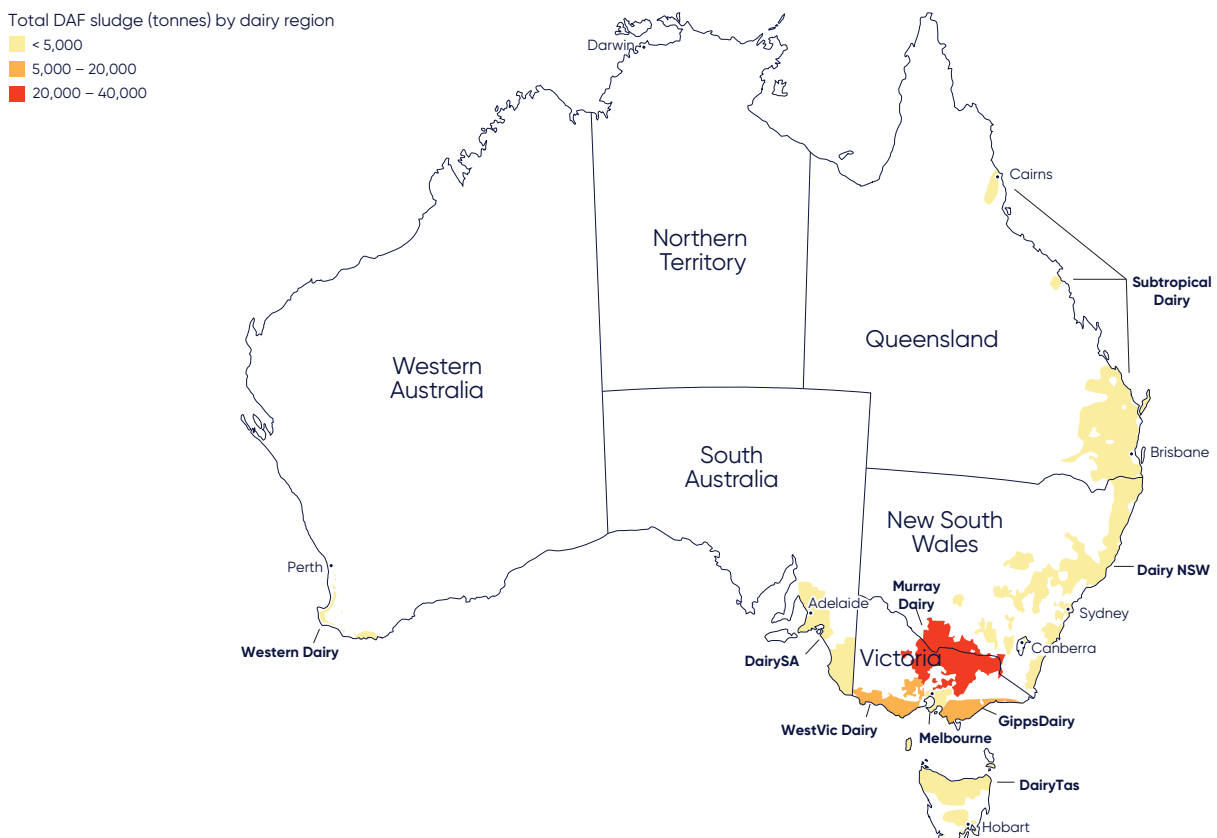


Figure 9 Total DAF sludge by dairy region



Management and disposal costs

The dairy waste account also records the cost to manufacturers for managing the dairy food waste generated, with this information presented in Table 3 below.

It currently costs dairy manufacturers approximately \$700 million per year to manage all potential food waste, with an additional \$120 million of revenue lost from wasted finished products (Table 4).

These cost estimates have been used to determine the reduction in food waste management costs that can be achieved by implementation of the recommended actions (see Section 4.)

Table 3 Cost to manufacturers for managing food waste

Australia-wide	Total (\$)
Milk	89,760,000
Cheese	578,020,000
Fresh Dairy	16,810,000
Frozen	1,770,000
Powders	12,060,000
Other	9,710,000
Total cost to manage all dairy food waste	\$708,130,000



Table 4 Estimated wholesale market value of wasted finished product*

Australia-wide	Manufacturing (\$)	Retail/distribution (\$)	Food service (\$)	Households (\$)	Total (\$)
Milk	6,126,000	2,031,000	34,142,000	19,896,000	62,195,000
Cheese	8,592,000	3,757,000	71,228,000	93,974,000	177,551,000
Fresh dairy	101,491,000	4,841,000	138,958,000	183,334,000	428,624,000
Frozen	140,000	–	–	–	140,000
Powders	266,000	–	–	–	266,000
Other	3,162,000	–	5,916,000	7,805,000	16,883,000
Total	\$119,777,000	\$10,629,000	\$250,244,000	\$305,009,000	\$685,659,000

*Excludes value of other dairy waste streams that didn't become finished product

3.2 Dairy food waste by supply chain sector and the root causes

Dairy farms

Key data insights

One per cent of raw milk loss occurs on-farm (Table 1, page 21).

Causes of dairy food waste

Compared to the total dairy food waste occurring across the supply chain, only a small amount of raw milk loss occurs on-farm. Where milk losses do occur on farm, it's generally due to an 'event' (e.g. power outage in the milking shed, antibiotic treatment of dairy cows with mastitis) rather than an ongoing issue. In such cases, the milk may not meet required specifications and may be fed to livestock, applied to land, or managed through the dairy effluent system.

Dairy manufacturing

Key data insights

- 506,878 tonnes of total actual dairy food waste are generated at the manufacturing stage, showing it is clearly an important hotspot in the supply chain (Table 1, page 21).
- By-products and process wastes are the most substantial dairy food waste in manufacturing (Table 1, page 21).
- Victoria processes significant volumes of raw milk and manufactures large volume of dairy products and therefore has the highest amount of actual dairy food waste, whey by-product, and management/disposal costs (Table 2, page 22; Figures 8 and 9, page 24).
- The amount of whey by-product is highest in those dairy regions (i.e. Victoria and Tasmania) with substantial cheese manufacturing (Table 2, page 22; Figure 8, page 22).
- Costs associated with dairy food waste management and disposal can be attributed to cheese manufacturing and is primarily due to whey by-products (Table 3, page 25).

The manufacturing stage is a notable hotspot for the generation of dairy food waste. This is not surprising given raw milk processing is complex with multiple products (e.g. yoghurt, cheese, milk powder, ice cream, dairy desserts) being produced from the initial intake of raw milk, or in some cases, the intake of other milk-derived products like cream.

Throughout the production cycles there are various occasions for dairy losses and waste streams to be generated, with the identified waste categories including:

Process waste

- Processes involved in the start-up and shut down of processing equipment.
- Inefficient or incorrectly calibrated cleaning equipment and processes (e.g. CIP systems).
- Cleaning between changeover of product runs or different flavours, including the frequency of changeover. Product changeovers are influenced by SKU proliferation which also result from retailer NPD demands for small volumes of new products. These demands can also lead to waste of finished products when order volumes for new products are below the minimum volume batch runs at a processor/manufacturer.
- Materials (i.e. DAF sludge) from wastewater treatment processes associated with dairy manufacturing.

Unfinished products

Testing procedures for quality control and food safety purposes.

Finished products

Products not meeting specifications (e.g. weight, labelling) or not having sufficient shelf life for retail.

By-products created in the manufacturing of various dairy products, particularly whey from cheese production.

Causes of dairy food waste

The root causes to these waste streams being generated are complex and vary at each manufacturing site. However, they can be grouped into the following categories:

- Equipment (e.g. aging or out of date, replacement costs, lack of automation).
- People (e.g. staff shortages, human error, need for training and procedures, lack of awareness of waste issue).
- Management (e.g. competing priorities, reduced focus on minimising dairy food waste and continuous improvement).
- Process (e.g. high number of products manufactured, inefficient coordination between planning and production departments).
- Measurement (e.g. KPIs or benchmarks not defined, waste data not fully captured or costed).
- External drivers (e.g. inaccurate retailers' product forecasting, demand for new dairy products).

As noted previously, Australia's dairy industry has approximately 455 processing factories that vary considerably in terms of scale, complexity, variety of products produced etc. The engagement undertaken with the DMSC throughout this project has found that a number of sites do not have a detailed understanding of the food waste they are generating and why it is being generated. They also don't know the true cost to their business from these food wastes. This is in terms of management costs, lost revenue and environmental factors (e.g. water, energy, CO₂e). The root cause as to why these losses are occurring are likely to come from the list of dot points above. However, each site will benefit from a detailed understanding of the factors leading to their dairy food waste, the true cost of these losses to their business, and the mitigation actions that can be implemented by reduce the losses.

Distribution and retail

Key data insights

- One per cent of actual dairy food waste is finished products in this part of the supply chain (Table 1, page 21).

Dairy food waste data for this sector was supplemented with five interviews with retailers and food rescue organisations. Data was extrapolated to cover data gaps, with dairy food waste estimates based on population size of each state and territory. As discussed previously, it is likely that more dairy food waste is generated at the retail stage than what is reported.



Causes of dairy food waste

Insights from interviews with sector representatives indicate that practices of rotating out products with short shelf life to meet consumer expectations is the main reason for dairy food waste in the retail sector. This is supported with evidence from previous studies in Australia and overseas. Packaging breakages or failures and transportation issues are also responsible for losses.

Issues such as poor sales forecasting and promotions management and product inventory management can also be key reasons for food waste at the distribution and retail stages.

Food service and households

Key data insight

- Twenty-seven per cent (i.e. 15 per cent in food service and 12 per cent in households) of actual dairy food waste is finished products (Table 1, page 21)
- This is the highest proportion of finished dairy food product loss across the whole supply chain.

Data for this stage of the supply chain was based on previous studies and waste audits as outlined in Appendix 1. Dairy food waste is likely to be under reported for this part of the supply chain, noting challenges in estimating volumes wasted of varying product types and disposal methods (e.g. sink disposal, bin, home compost).

Causes of dairy food waste

The National Food Waste Baseline report notes the food service and hospitality sector is complex featuring many businesses of varying size and number of employees. Given this diversity, there is a wide range of waste types generated, including damaged or spoiled food due to poor stock rotation, storage or transportation, unprepared food or ingredients past their use-by date, food preparation offcuts, unsold meals and customers purchasing more foods than they need. The sector is also a significant contributor of liquid waste, particularly grease trap waste.

Food waste generated in households consists of unconsumed food that has perished and the edible and inedible scraps from food preparation and consumption. Some of the reasons for why this food waste is being generated. This includes too much food being purchased, food not being stored properly, food preparation waste, cooking and serving too much, concerns regarding the safety of leftovers or not knowing what to do with them, lack of clarity regarding best before/use by/expiry dates and lack of knowledge in how to use the food (Fight Food Waste CRC, 2019).

Section 4

Actions to reduce dairy food waste

Various initiatives are already being implemented by the dairy industry to tackle dairy food waste across the supply chain. These activities are often at individual processing site within a dairy manufacturing company or at the store level within the retail segment. However, there are further opportunities for the dairy industry to work collectively to address sector-specific food waste challenges, as highlighted in the Waste Account. Building upon these existing initiatives and sector wide knowledge is a key feature of this Sector Action Plan.

The agility of the dairy industry to adapt to a range of competing demands depends upon current and future infrastructure, business strategies, policy settings and available investment. Solutions that can be implemented to minimise dairy food waste across the supply chain need to be balanced with risk (e.g. food safety) and other commercial considerations (e.g. implementation costs, feasibility).

Identifying actions

The possible solutions to reducing dairy food waste – and where interventions are needed most across the supply chain – is based on identifying the hotspots and understanding the potential root causes

Representatives from the dairy manufacturing sector have worked together to share their insights about these root causes. They are helping to explore solutions and identify those actions and other initiatives that have potential to be the most effective in reducing dairy food waste.

The following principles were used to assess and identify actions suitable for implementation.

Principles for identifying actions

Criteria	Description
Prevention	Actions that focus on prevention of food waste, before recycling and recovery
Food waste hierarchy	Actions that contribute to more dairy food waste 'moving up' the food recovery hierarchy.
Specific	Actions that specifically target dairy waste hotspots
Evidence	Actions where there is available evidence that shows the potential benefits of implementation
Feasible	Actions that are technically feasible, commercially viable and practical to implement
Co-benefits	Actions that have may provide additional benefits other than dairy food waste reduction (e.g. reduction in use of water, energy, packaging and cost savings)

The identified actions are presented according to the stage of the supply chain, the dairy food waste hotspot they are targeting, an estimate of the dairy waste reduction potential and other benefits (e.g. reduction in management costs and greenhouse gas (GHG) emissions).

Reduced GHG emissions from the recommended actions have been estimated using the US EPA Waste Reduction Model (WARM) and other published data. Additional detail is provided in the background report to this Sector Action Plan.

4.1 Whole of dairy industry/supply chain

A key finding from developing this Sector Action Plan has been the importance and ongoing need to consistently monitor dairy food waste and loss across the supply chain. A current challenge for the dairy industry is having a common metric for measuring and monitoring this dairy food waste, given the variability and range of dairy food products.

For the Dairy Food Waste Account, dairy food waste was also calculated on a 'milk equivalents' basis to enable more accurate comparison of dairy waste across the supply chain. These milk equivalents figures were consistent with the dairy food waste data (tonnage) reported in the Waste Account, with key hotspots identified as by-products (whey) and process wastes in manufacturing and finished product losses at the food service and household stages. However, development of a more sophisticated and consistent milk equivalents

calculator that can assess all dairy products and their ingredients is required to ensure confidence and accuracy in the data collection, and to allow for discreet comparison of data between products, manufacturing sites, stages in the supply chain etc.

Solutions

The dairy industry and broader supply chain require a standardised monitoring tool to support consistent and ongoing monitoring of dairy food waste and enable tracking of industry progress against dairy food waste reduction initiatives. Experience from the United Kingdom indicates that initiatives focused on regular food waste monitoring can result in more than a 15 per cent reduction in food waste (WRAP 2021), with 140 businesses in the UK that have year-on-year data reporting a 17 per cent overall reduction in food waste.

ACTION 1

Monitor dairy food waste across the supply chain and establish industry working group

Target Actual dairy food waste

Amount 708,104 tonnes/annum (total across dairy supply chain)
~ 500,000 tonnes/annum (total for manufacturing sector)

Objective **To help drive and track progress against dairy food waste reduction initiatives by developing a standardised monitoring tool. This will provide ongoing clarity as to actual dairy food waste and loss occurring across the supply chain and effectively communicate the true cost of that waste stream and value of lost product. A further objective of this tool would be to support internal company reporting on processing efficiency and potentially determination of Scope 3 emissions.**

DESCRIPTION	ESTIMATED WASTE REDUCTION tonnes/annum	OTHER BENEFITS
This action features the following activities	10 – 15%	Reduced cost of dairy waste management
Develop a milk equivalents calculator that can convert all forms of dairy products and their ingredients into a common metric (milk equivalents).	Across dairy supply chain 70,000 – 105,000	\$70 – 105m (manufacturing sector)
Include this calculator in a standardised monitoring template, similar to that used for the Dairy Food Waste Account data collection process.	For manufacturing stage ~ 50,000 – 75,000	Reduced GHG emissions Across dairy supply chain 190,000 t CO₂e
Monitoring is to occur at least every second year using the above template to support ease of data collection, consistent reporting across the supply chain, and monitoring the progress and impact of industry actions over time.		For manufacturing stage 110,000 t CO₂e
Monitoring template will enable individual sites to analyse their various waste streams in detail and provide a common metric for benchmarking. It will also enable the different stages of the supply chain to effectively communicate the value of loss product, as well as an internal reporting tool on efficiency (particularly for manufacturing).		
DA will be responsible for leading the monitoring and data collection/analysis at the manufacturing stages, with SFWA responsible for the retail, distribution, food service and household data collection.		
Ongoing monitoring led by SFWA will provide greater insight into actual dairy food waste occurring at retail and distribution stages.		

Note: Engagement with the DMSC during the root cause and solutions workshops identified the value that some members have received from the Piqet life cycle assessment tool that has been developed for the packaging industry. Consideration should be given to developing a similar tool that the dairy manufacturers can use to show the reduction in environmental impacts that can be achieved from changed dairy food waste management.

4.2 Manufacturing

Raw milk processing into various dairy food products is complex and, as expected, generates by-products and processing waste. As highlighted in the Dairy Food Waste Account, half of the actual dairy food waste generated in the manufacturing stage are by-products, with process wastes accounting for a further 15 per cent of the actual dairy food waste volume, with DAF sludge accounting for half of these process wastes and CIP operations a further 40 per cent (see Table 1, page 21).

Additionally, the dairy waste account reports that there is over 24,000 tonnes of finished product annually being wasted at the manufacturing stage, with an additional ~109,000 tonnes of finished product being wasted at the retail/distribution and food service stages.

Solutions

Given the complexity of processing milk into various dairy products and differences that exist between each processing site, there is a strong need for each manufacturer to measure the milk and other product losses generated at their sites and understand the causes for these losses. Following this, effective practices and systems can be implemented that drive change to minimise dairy food waste. Many of these practices such as root cause analysis, continuous improvement reporting and training are already being initiated by some of the more progressive manufacturers. However, there is opportunity for greater adoption across the sector.

Process wastes and DAF sludge

Reduced process wastes and ultimately a reduction in DAF sludge will come from a decrease of raw product loss (e.g. milk or cream) by the manufacturing sites. There are a range of interconnected activities at the manufacturing sites that will achieve this and can collectively be referred to as 'developing a culture of dairy food waste avoidance. Workplace safety programs are a good related example of how behaviour change programs have led to positive improvements within manufacturing environments in recent years. Workplace safety is now embedded into virtually all facets of manufacturing and the same opportunity exists for dairy food waste avoidance. Those manufacturing sites engaged through the development of this action plan who have a focus on continuous improvement regarding dairy food waste avoidance, rather than a culture of 'blame' when things go wrong, have reported significant reductions in dairy food wastage, improved morale and solutions generation by a greater cross-section of the manufacturing team.

Reduced process wastes will come from the combination of sub-actions listed below, and it is up to each manufacturing site to identify specifically for their operations which of these requires improvement and should be addressed:

- Internal reporting metrics and communication methods that clearly identifies the process wastes and how these can be prevented.
- Value stream mapping and detailed root cause analysis to determine why dairy food loss is occurring.
- Training programs that support skill development of dairy processing staff.
- Access to best practice CIP operation information and regular training.

The implementation of these sub-actions will reduce the volume of DAF sludge being produced by each manufacturing site, but will not eliminate it. The sites generating high volumes of DAF sludge (see Figure 8, page 24) will benefit from access to more cost effective DAF sludge management options. Such options may take the form of:

- Composting facilities with the scale and demand for DAF sludge as a feedstock.
- New technologies that can make use of the calorific value of the milk solids as animal feed.

Compost facilities need to be close enough to the processing sites to overcome high transportation costs, which can make the composting of DAF sludge unviable.

Jet Technology is an example of new technology that can potentially make use of DAF sludge in the production of animal feed. It's based on an in-vessel aerobic fermentation process (ERS) that can convert DAF sludge and other dairy food waste organics (e.g. packaged food products, whey, unfinished products etc.) into shelf-stable animal feed. The feedstocks are pasteurised resulting in pathogen destruction, and the recovery rates for a variety of dairy food products are reported by JET Technology to be approximately:

- 14 per cent for packaged milk
- 50 per cent for packaged cheeses/yoghurts/dairy desserts
- 35 per cent for DAF sludge
- less than 5 per cent for whey.

The technology is scalable with processing capacity ranging from 2 t/day to 25 t/day in a single unit. JET's largest processing operation at present, is overseas and processes 75 t/day of dairy cow manure.

JET Technology is an established business internationally and it's currently working with Deakin University in Geelong to finalise the project plan for the Trailblazer Program. The Trailblazer Program is a group of R&D projects invested by the Australian Federal Government. JET was selected by Deakin University to partner in the program focusing on developing organic recycling solutions and is considered one of the largest government investments in organics recycling. JET appears to have several attractive features, including the potential to deal with a range of dairy waste feedstocks, including packaged dairy food waste.

By-product (whey)

The key focus is for whey that is currently being discharged to sewer or land, to be further processed into value-add whey products, and/or provided to pig farmers for animal feed. There are two key opportunities to achieve this.

- 1 The JET Technology discussed above is a potential option for whey processing, and whey should be considered as part of the Jet Technology investigations to see if it can yield a viable end-product. The issue with whey is its high water content, which can create challenges with cost-effective transportation of whey to processing sites. (Note, this has implications for the small- to medium-sized (SME) producers in Melbourne as well discussed below). This could be overcome by the technology being established at the processing site. However, it is unlikely that the dairy manufacturers will want to invest in such technology themselves and will likely prefer 'off-take' agreements to supply their waste streams for processing. On-site thermalisation and de-watering of the whey may offer a potential solution to this, but it requires exploration as part of the larger JET Technology investigations.
- 2 Investigate the feasibility of establishing a regional whey processing facility within suitable proximity to Melbourne's small- to medium-sized speciality cheese and yoghurt producers. Preliminary assessment suggests that there is spare processing capacity at existing facilities within 100km of Melbourne to process up to two-thirds of the 110,000kL/annum of liquid whey being discharged to sewer by SME producers in Melbourne. Use of existing spare capacity is more attractive than a purpose-built facility due to cost savings and potential to generate a return on capital from the existing underutilised asset(s). As discussed above, the key barriers to be overcome are the logistics/ transportation issues, plus developing a commercial model that adequately rewards all stakeholders. If these can be overcome, there is potential for more than 50 per cent of the current whey volume being discharged to sewer in and around Melbourne to be used to develop whey-based products.

There is significant opportunity for more finished product to be sent to food rescue organisations for human consumption.

The industry should also support the ongoing supply of whey for pig feed by connecting manufacturing sites with excess whey to pig producers who have demand for whey in their feed rotations. Preparation of a risk mitigation strategy for if whey can no longer be supplied to piggeries due to biosecurity reasons, should also be considered by the industry.

DA should also communicate the outcomes of whey valorisation projects (e.g. fermented beverages project) to the SME producers in Melbourne, as well as outcomes of whey valorisation projects undertaken by WRAP UK (i.e. whey management from production without acid whey residues, conversion of acid whey to dairy foods, the use of acid whey for nutritional beverages applications).

Finished product

There is significant opportunity for more finished product to be sent to food rescue organisations for human consumption. While many of the manufacturing sites already do this via donations and/or the supply of product that are close to expiry, the Dairy Food Waste Account shows there are still relatively significant volumes of finished product going to landfill. Consultation undertaken in developing this action plan has highlighted that confusion still exists regarding the management of supermarket branded products, i.e. there have been instances where supermarket-branded products have been disposed to landfill due to uncertainty regarding whether they can be sent for food rescue.

SFWA's Food Rescue Sector Action Plan will provide significant opportunity to increase the amount of edible dairy food that is sent to the food rescue organisations.

The Foodbank Hunger Report 2019 states that five million people in Australia are food insecure and almost three in five Australians experiencing food insecurity (58 per cent) have sought assistance from a charity at least once in the last 12 months. Only 37 per cent of the charities are meeting the full needs of the people that they assist, with Foodbank itself providing more than 815,000 people with food relief every month by working with over 2,400 charities across Australia. One hundred per cent of edible dairy products that have two days' of shelf life left can be provided as a meal to someone in need. Australia's food rescue organisations have significant demand for increased protein.

ACTION 2

Implement practices that prevent process wastes

Target Processing wastes

Amount ~ 105,000 tonnes (including 41% of CIP waste)

Objective For each dairy manufacturing site to develop and maintain a clear understanding of the milk and/or other dairy product losses they are generating, the possible root causes, and to then, using existing or newly developed resources, implement effective systems that drive change. The following actions are intended to minimise process wastes generated during manufacturing.

DESCRIPTION	ESTIMATED WASTE REDUCTION tonnes/annum	OTHER BENEFITS
<p>This action outlines a suite of practices and activities for both individual dairy manufacturers and the whole sector to consider, including:</p> <p>Review and develop, in consultation with company management, internal reporting metrics (e.g. value of lost product, labour costs, 'environmental footprint') and communication methods that clearly identifies the process wastes and how these can be prevented.</p> <hr/> <p>Implement value stream mapping and detailed root cause analysis to determine why dairy food loss is occurring.</p> <hr/> <p>Promote benefits of cultivating a 'dairy food waste avoidance culture' at manufacturing sites – one that focuses on continuous improvement rather than 'blame'.</p> <hr/> <p>Review existing training and develop targeted programs if required, such as micro-credentials, that support skill development of dairy processing staff. Two courses to be prioritised include:</p> <ul style="list-style-type: none"> • Basics on effective dairy food processing (including cleaner production and lean manufacturing practices). • Advanced training for key dairy processing staff (including above topics plus reporting and communication for change and leadership skills to support dairy food waste avoidance culture). <hr/> <p>Ensure manufacturers have access to best practice CIP operation information and regular training. Focus would include regular review, auditing, calibration and optimisation activities of CIP processes and equipment.</p>	<p>5 – 10%</p> <p>5,000 – 10,500</p>	<p>Reduced dairy waste management cost \$3.6m – 9.2m</p> <p>Reduced GHG emissions 13,335 t CO₂e</p>



ACTION 3

Investigate available technology solutions that can turn processing waste and packaged goods into shelf stable animal feed

Target DAF sludge – processing waste

Amount ~ 50,000 tonnes (approximately 48% of the total process waste tonnes)

Objective **To reduce the amount of DAF sludge produced from wastewater management at processing sites via prevention activities (see Target 2), or to be recycled, rather than landfill, sewer or land application methods of disposal.**

(Note: the following would also have applicability for finished products and other dairy food waste organics e.g. whey).

DESCRIPTION	ESTIMATED WASTE REDUCTION tonnes/annum	OTHER BENEFITS
This would include exploring potential for Jet technology to convert DAF sludge and other dairy food waste feed stocks (e.g. whey; packaged finished products) into cost effective animal feed.	20 – 50% 10,000 – 25,000	Reduced dairy waste management cost \$3.5m – 9m Reduced GHG emissions 40,000 t CO₂e

ACTION 4

Increase options for more DAF sludge to be composted

Target DAF sludge – processing waste

Amount ~ 50,000 tonnes (approximately 48% of the total process waste tonnes)

Objective **To reduce the amount of DAF sludge produced from wastewater management at processing sites via prevention activities (see Target 2), or to be recycled, rather than landfill, sewer or land application methods of disposal.**

(Note: the following would also have applicability for finished products and other dairy food waste organics e.g. whey).

DESCRIPTION	ESTIMATED WASTE REDUCTION tonnes/annum	OTHER BENEFITS
Dairy manufacturers to work with State and Federal Governments to support increased composting opportunities for DAF sludge	5 – 15% 2,500 – 7,500	Reduced dairy waste management cost \$0.9m – 2.7m Reduced GHG emissions 7,500 t CO₂e

ACTION 5**Increase awareness about need for more edible dairy food to go to food rescue organisations**

Target Finished products

Amount 24,000 tonnes (manufacturing)

Objective **Increase the volume of edible dairy food going to human consumption and reducing volume going to landfill.**

DESCRIPTION	ESTIMATED WASTE REDUCTION tonnes/annum	OTHER BENEFITS
<p>Create opportunities for dairy manufacturers, retailers and food rescue organisations to increase awareness regarding the need for more edible food to be provided to the food rescue sector rather than disposed to landfill. This will be done through:</p> <ul style="list-style-type: none"> • A forum for DMSC, ADPF and food rescue organisations to come together and promote the value of the food rescue groups in reducing finished products going to waste. • Development of best practice guidance for food donation • Utilise existing technology (e.g. Yume) to support efficient movement of product from manufacturing to food rescue. 	<p>10 – 25%</p> <p>2,400 – 6,000 (manufacturing)</p> <p>500 – 1,250 (distribution/retail)</p> <p>10,000 – 25,000 (food service)</p>	<p>Reduced dairy waste management \$0.6m – 1.5m</p> <p>Reduced GHG emissions 70,000 t CO₂e</p>

ACTION 6**Assess commercial feasibility of diverting excess whey from small- to medium- dairy businesses to third-party processors in regional networks for conversion to value-added products**

Target Whey

Amount 170,000 tonnes (Australia-wide)

Objective **Reduce the volume of whey being disposed to sewer and land.**

DESCRIPTION	ESTIMATED WASTE REDUCTION tonnes/annum	OTHER BENEFITS
<p>Undertake a detailed feasibility study to evaluate the viability of potential regional (communal) whey processing options in Victoria.</p> <p>This study would consider the following aspects:</p> <ul style="list-style-type: none"> • Potential for thermalisation and then de-watering of whey at the SME sites first to overcome transportation issues. • Cost benefit of processing at an existing site with spare capacity compared to purpose-built facility. • Development of a suitable business model for the whey processing facilities/network. 	<p>50 – 75%</p> <p>55,000 – 85,000 (Victorian SME)</p>	<p>Reduced dairy waste management cost \$170m – 260m (manufacturing)</p> <p>Reduced GHG emissions 115,000 t CO₂e</p>

4.3 Distribution and retail

The Dairy Food Waste Account identified only a small proportion of dairy food waste generated at these points in the dairy supply chain. However, it is notable that the waste at this point is all finished product that has incurred the full measure of input costs to make it available for human consumption. These costs include transportation and packaging and have also accumulated their highest environmental footprint by this stage.

A reduction of 20,000 tonnes of milk waste may be possible by reducing average household fridge temperatures to 5°C.

Solutions

Solutions considered focused on those that the dairy industry and other project partners, such as SFWA, can influence to reduce the amount of finished dairy products becoming waste and more going to human consumption. This includes changes to dairy food product labelling and supporting technology that can connect edible dairy food products with potentially more end consumers. Action 5 also has significant potential to help with reduced dairy food waste for distribution and retail, with increased collaboration with the food rescue sector and more edible food being donated for human consumption.

WRAP UK have undertaken significant research on the value of improved labelling and storage advice for dairy products (their research is featured in Action 7 below). There are also a variety of technology platforms in Australia and overseas that have the potential to help ensure edible food is consumed by humans. Examples of these platforms include:

- Gander is an electronic platform that integrates with point of sale software and alerts consumers when reduced price quality food is available for purchase. The initiative makes a profit by charging a small fee per product advertised (10 cents per ticket).

- Foodbank Australia are working with Y Waste, an app that facilitates the discounted sale of end-of-day food from quick-service restaurants to consumers, rather than the food going to landfill. The app was expanded to include the option of restaurants offering free meals to people in need in the community. Now in stage two, the NSW EPA, Foodbank Australia, Y Waste and RMIT are undertaking a NSW pilot study for the rollout of the app in the community. Through this project, the aim is to have 1,000 quick-service restaurants register with the Y Waste app and offering 4,000 meals per week. This is estimated to equal 2000 kilograms of food per week (or 104 tonnes per annum – based on average meal size of 500g) redirected from landfill.
- Food Rescue Hero is a USA technology platform and mobile app that mobilises volunteers to transport surplus food to those who can use it. The app addresses the logistical challenges of food rescue through community-powered networks. Volunteer drivers are alerted when surplus food is available to be picked up near them. Since its launch in 2016, the app has redirected more than 35 million kilograms of perfectly good food from landfills to the people who need it.

WRAP UK reports indicate that it has not been possible to quantify the potential consumer food waste reductions of a switch from use by to best before/best within date on milk. However, the research does show that more than 50,000 tonnes of milk waste reduction per annum (UK data) may be possible with a reduction to an average temperature of 5°C in household fridges. Converted to Australian figures, this may be in the order of 20,000 tonnes of milk, or approximately 15 to 20 per cent of the total milk wastage volume (~110,000 tonnes/annum) across these sections of the supply chains.

ACTION 7

Promote value of improved labelling and storage advice of dairy food products

Target	Finished products
Amount	195,000 tonnes (across all sectors of the supply chain) ~ 86,000 tonnes (estimate of all dairy food waste in households) ~ 40,000 (estimate of wasted milk in households)
Objective	Increase the volume of edible dairy food going to human consumption and reducing volume going to landfill.

DESCRIPTION	ESTIMATED WASTE REDUCTION tonnes/annum	OTHER BENEFITS
<p>Promote value of improvements to product labelling requirements based on successful overseas experience. For example:</p> <ul style="list-style-type: none"> • Changing from use by to best before dates. • Removing expiry dates from some products completely (e.g. yoghurt) and provide alternative advice, such as 'use your senses'. • Ensuring the same dairy product groups are using the same type of expiry date to avoid confusion. • Correct labelling where 'open life' is used: <ul style="list-style-type: none"> – Once opened, 'best within X days' (where its important for food quality, such as bags of grated hard cheese). – Once opened, use within X days' (only when required for food safety reasons). • Use of bar codes (or similar) for dates other than Best Before information to avoid consumer confusion. • Providing storage advice (e.g. 'keep in the fridge below 5°C') or symbols for visual information (e.g. 'blue fridge 5°C'). 	Unquantified but estimated as 20,000 t of milk	Unquantified

ACTION 8

Investigate technology platforms that can help reduce dairy food waste

Target	Finished products
Amount	195,000 tonnes (across all sectors of the supply chain) ~ 86,000 tonnes (estimate of all dairy food waste in households) ~ 40,000 (estimate of wasted milk in households)
Objective	Increase the volume of edible dairy food going to human consumption and reducing volume going to landfill.

DESCRIPTION	ESTIMATED WASTE REDUCTION tonnes/annum	OTHER BENEFITS
Investigate and where viable, promote the value of platforms (e.g. Gander, Too Good To Go, the Y Waste App, Food Rescue Hero app – USA) to reduce dairy food loss and increase edible dairy food being purchased and consumed by food service and households.	Unquantified	Unquantified

4.4 Food service and households

It is perhaps not surprising that the highest proportion of wasted finished dairy food products are generated in these sectors. There are a range of complex reasons why this is the case which are outlined below but also include issues with stock management and over production in the food service sector.

Solutions

To reduce dairy food waste in both food service and households, solutions need to address some of the key drivers for this waste that include: appropriate storage of dairy food products, confusion regarding 'use by'

labels, lack of knowledge regarding food safety and various ways to use the food products.

Many households are 'time poor' so solutions that can support easy decision making around product storage and food safety guidance provided through labelling and targeted behaviour change programs are useful. This would also apply to food service business who have the added complexity of different employees of varying product and food safety knowledge and practices. There is further opportunity for the food service sector to increase the amount of edible dairy food that may otherwise be wasted via donations to food rescue organisations or other charities.

ACTION 9

Implement behaviour change programs to support households minimise dairy food waste

Target Finished products

Amount 195,000 tonnes (across all sectors of the supply chain)
 ~ 100,000 tonnes (estimate for food service)
 ~ 86,000 tonnes (estimate for households)

Objective **To reduce the amount of edible finished dairy products being wasted in food service and the home and going to landfill, given the highest percentage of wasted finished products occurs in this part of the supply chain.**

DESCRIPTION	ESTIMATED WASTE REDUCTION tonnes/annum	OTHER BENEFITS
This may include messaging around better cold storage at home, encouraging freezing of milk (before it goes off) and using 'all your senses' before discarding dairy food products.	Unquantified but estimated as 4,000 t of milk (see note)	Unquantified

Note: Data suggests a potential saving of 10,000 tonnes (UK data) of milk waste reduction per annum for households with a 10% increase in freezing rate. Converted to Australia figures, this may be in order of 4,000 tonnes of milk, or approximately 10% of the total household milk waste volume (~40,000 tonnes/annum).

ACTION 10

Research and development (R&D) to understand the commercial and food waste reduction benefits of extending the shelf life of milk in domestic retail supply chains versus export supply chains

Target Finished products

Amount 195,000 tonnes (across all sectors of the supply chain)
 ~ 100,000 tonnes (estimate for food service)
 ~ 86,000 tonnes (estimate for households)

Objective **To reduce the amount of edible finished dairy products being wasted in food service and the home and going to landfill, given the highest percentage of wasted finished products occurs in this part of the supply chain.**

DESCRIPTION	ESTIMATED WASTE REDUCTION tonnes/annum	OTHER BENEFITS
This R&D would focus on the potential to use micro-filtration and super chilling technologies to extend the shelf life of liquid milk and other dairy products.	4% (milk) 8,000 (milk)	Unquantified

Note: Data suggests a potential saving of 20,000 tonnes of milk savings per annum (UK data) for householders for a one-day increase in shelf life. Converted to Australian figures, this may be in the order of 8,000 tonnes of milk, or approximately 4% of the total liquid milk wastage volume (~205,000 tonnes/annum).

4.5 Dairy farms

Background

The milk losses on farms are relatively low, reflecting industry investment in programs such as 'Cups On Cups Off'. These support dairy farmers to detect, treat, and prevent mastitis. Another resource is the 'Early Milk Collection Index tool', which is designed to quickly and simply determine whether milk picked up early (at above 5°C) will meet Food Standards Code and/or EU requirements. These programs are ongoing and will continue to have support from the industry, ensuring milk losses on farm remain low. The industry also maintains a strong focus on milk quality – which is often measured via bulk milk cell count (BMCC). Dairy companies have incentives for low BMCC and this helps ensure the milk can be used for a variety of products while also seeking to optimise shelf life.

Solutions

This Sector Action Plan reiterates the need for continued support for the initiatives noted above, while also highlighting the value of helping farmers ensure they consistently have their milk cooled at the correct temperature. For example, installing temperature sensors on milk vats, having back-up generators to maintain power during power outages.

In summary, the dairy industry will continue to support dairy farmers maintain low levels of milk losses via the following existing activities:

- 'Cups On Cups Off' program.
- Early Milk Collection Index.
- Targeted antibiotic use for dairy cows.
- Milk vat temperature sensors.
- Generators to manage power outages.

Additional actions are not warranted for this section of the supply chain given milk losses are low relative to other sections.



Section 5

Implementation plan

A summary of the identified actions for implementation is represented in Figure 10, highlighting for each action:

- Scale of dairy food waste reduction impact (low, medium, high).
- What part of the supply chain it's targeting (manufacturing, distribution and retail, food services and households).
- Level of implementation (adopt, trial, assess, support).

Figure 10 Summary of identified actions to reduce dairy food waste

Supply chain area

Manufacturing	
1	Monitor dairy food waste across the supply chain and establish industry working group
2	Implement practices that prevent process wastes
3	Investigate technology solutions that turn processing waste and packaged goods into animal feed
4	Increase options for more DAF sludge to be composted
5	Increase awareness for more edible dairy food to go to food rescue sector
6	Assess commercial feasibility of diverting excess whey to third-party processors in regional networks for conversion to value-added products

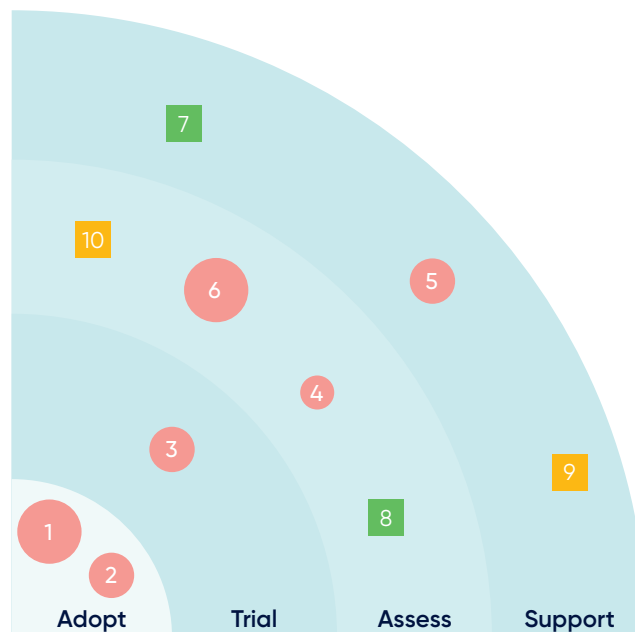
Distribution/retail

7	Promote value of improving product labelling and storage advice of dairy food products
8	Investigate technology platforms that can help reduce dairy food waste

Food service/households

9	Behaviour change programs to support households minimise dairy food waste
10	R&D on potential use of micro-filtration and super chilling technologies to extend shelf life of milk and other dairy products

Level of implementation



Scale of dairy food reduction impact



To support implementation of the actions, further detail is provided in Table 5 with the following information:

Pillars – covers different areas of activity (i.e. monitoring and reporting, technology communication and education, research and development, business practices and policy).

Food waste hierarchy – what category of the hierarchy does the action represent.





Responsibility – who should lead implementation of the action and other enabling factors needed to support implementation.







Level of implementation – indicates the 'readiness' (i.e. technical and financial feasibility) of the action to be implemented in the Australian dairy supply chain context.

Impact – level of impact the action is likely to have including reducing dairy food waste volumes, GHG emissions and food waste disposal costs, if implemented.

A roadmap supplements this plan to highlight the potential journey for the dairy industry to reach the 2030 target of halving Australia's food waste. Many of these actions will also reduce waste management costs for dairy manufacturers, reduce other environmental impacts and ensure more dairy food products are available for human consumption. Ongoing communication and support from all dairy industry organisations, the food rescue sector, not for profit's (e.g. Stop Food Waste Australia) and government will ensure effective delivery of solutions to meet the 2030 target.

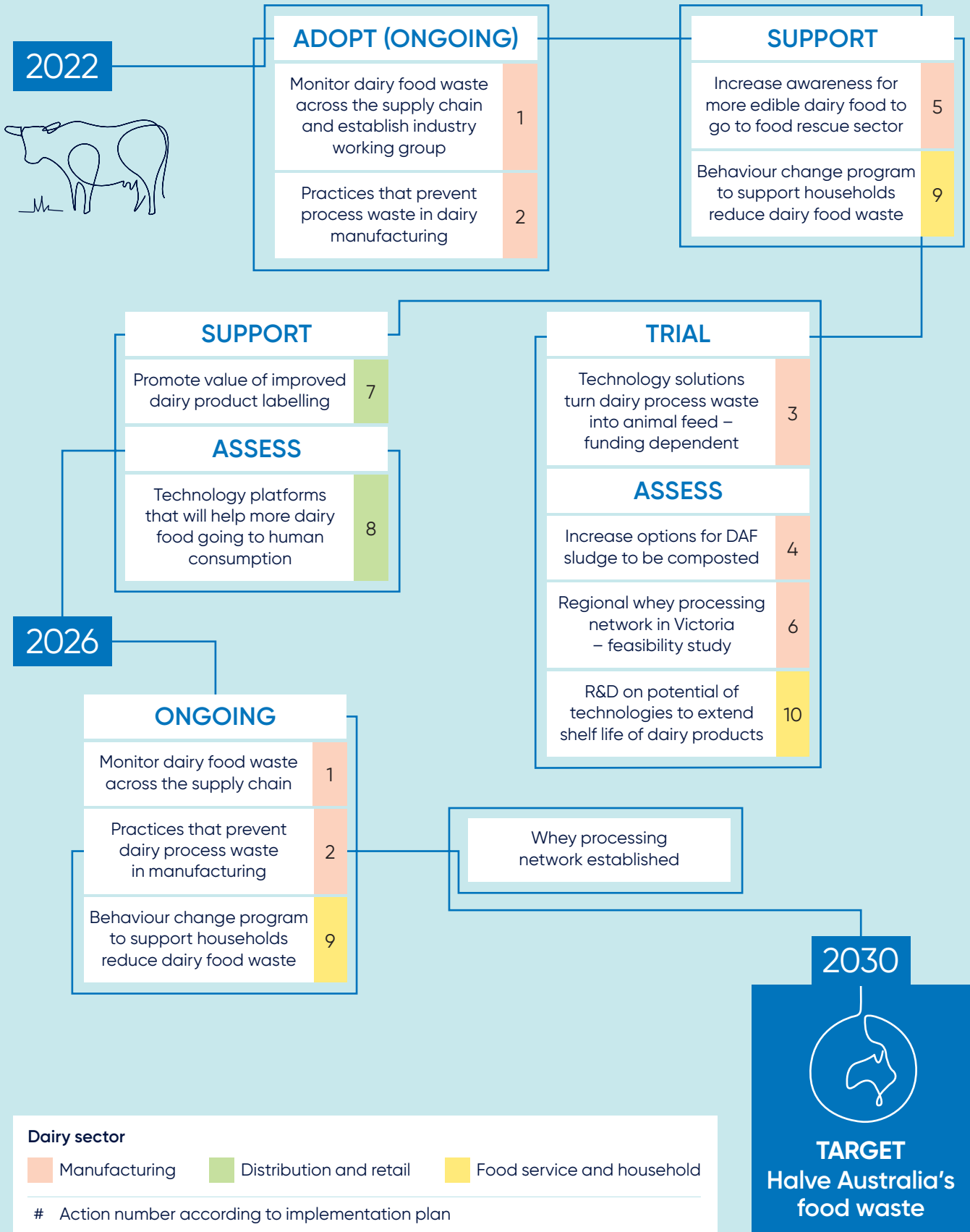
Table 5 Actions for implementation

No.	Action	Pillar	Food waste hierarchy category	Responsibility Enablers	Implementation levels	Start	Impact
Manufacturing sector							
1	Monitoring of dairy food waste across the supply chain	Monitoring and reporting		<ul style="list-style-type: none"> DA – farm and manufacturing sectors SFWA – distribution, retail and household sectors 	Adopt	Immediate/ ongoing Supply chain wide monitoring every second year	Highest
2	Implement practices that prevent process wastes	Business practices		<ul style="list-style-type: none"> ADPF, DA and individual manufacturers DMSC – Community of Practice Existing training providers, Fight Food Waste CRC: Australian Industry Food Waste Training Needs Analysis 2020 Linkages to Dairy Manufacturing Webinar program SFWA 	Adopt	Immediate (building on existing best practice across the sector)	Medium
3	Investigate available technology solutions that can turn processing waste and packaged goods into shelf stable animal feed	Technology		<ul style="list-style-type: none"> DA Funding to implement pilots 	Total	End of 2023 to establish pilot (funding dependent)	Medium
4	Increase options for more DAF sludge to be composted	Policy		<ul style="list-style-type: none"> State and Federal Governments DA 	Assess	Potential for initial opportunities to be scoped by end of 2023 (government policy dependent)	Lowest

No.	Action	Pillar	Food waste hierarchy category	Responsibility Enablers	Implementation levels	Start	Impact
Manufacturing sector							
5	Increase awareness for more edible dairy food to go to food rescue sector	Communication and education		SFWA (via Food Rescue Sector Action Plan and Australian Food Pact Food Rescue Working Group) • DMSC • Food rescue organisations	Support	Immediate	Medium
6	Assess commercial feasibility of diverting excess whey to third-party processors in regional networks for conversion to value-added products	R&D		DA Government funding to support feasibility study and potentially infrastructure	Assess	Staged approach: • Initial scoping study by mid 2023 • Establish processing partnerships by end of 2023 or new infrastructure by 2025 (funding dependent)	Highest
Distribution and retail sector							
7	Promote value of improving product labelling and storage advice of dairy food products	Policy/business practices		SFWA Case studies, information and experience from overseas (e.g. WRAP 2018)	Support	Begin by mid-2023	Unquantified in Australian context but potentially lowest
8	Investigate technology platforms that can help reduce dairy food waste	Technology		SFWA • DMSC • Food rescue organisations	Assess	By end of 2023 (depending on current pilots with technology apps e.g. Y Waste)	Unquantified in Australian context but potentially lowest
Food service and household sectors							
9	Implement behaviour change programs to support households minimise dairy food waste	Communication and education		SFWA, SV • ADPF, DA • Linkages with other Sector Action Plans that have identified behaviour change programs	Support	Ongoing (building upon existing behaviour change campaigns where they exist in states and opportunity for a national campaign)	Unquantified but potentially highest if delivered with general Australia-wide program to minimise all food waste
10	R&D on potential of use micro-filtration and super chilling technologies to extend shelf life of milk and other dairy products	R&D		Manufacturing companies, ADPF R&D funding	Assess	By end of 2023 (for initial scoping of options)	Unquantified in Australian context but potentially lowest

Roadmap for Dairy Sector Action Plan

The following roadmap highlights the potential journey for the dairy industry to reach the 2030 target of halving Australia's food waste. Ongoing communication and support from all dairy industry organisations, the food rescue sector, not for profit organisations (e.g. Stop Food Waste Australia) and government will ensure effective delivery of solutions to meet the 2030 target.



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Appendices

Appendix 1 Methodology for dairy food waste account

Data collection for the following section of the dairy supply chain is outlined below.

Farmers

- Based on estimates provided by Dairy Australia on pre-farmgate milk losses and applied to volumes of unprocessed milk produced in each state.
- Sustained effort by the dairy industry to minimise on-farm milk losses.

Dairy manufacturers

- Primary data reported by dairy manufacturers of all product categories. Responses capture and estimate more than 80 per cent of Australia's milk production.
- Data not provided from more than 20 per cent of manufacturing sites and some of the survey returns were missing data and may have been excluded from average values for the industry.
- Whey production from the small/medium cheese producers calculated by RMCg and based on cheese production data from Dairy Australia for small/medium speciality cheese producers (i.e. annual production by 69 manufacturers producing less than 5,000 tonnes of cheese per year for a period of five years from 2014/15 – 2018/19). It assumes regional manufacturing sites that fall within this category manage whey via land application and metropolitan sites via sewer, as validated by the project's stakeholder interviews.
- The data is extrapolated to generate Australia-wide waste volumes assuming the same ratios for waste streams and management methods (excluding cheese where primary data and the small cheese volumes estimates are used).
- 'Other' has been used when there is mixed dairy waste (e.g. manufacturers with multiple product lines and waste is aggregated and can't be individually reported).

Retailers

Based on data reported by retailers. Volumes were extrapolated to consider data gaps and Australia-wide volumes are estimated to state/territory level relative to population.

Food service

- Data from the National Food Waste Baseline report for total food waste in the food service industry was analysed in similar way to the households data.
- Additional data provided by NSW EPA to help estimate milk volumes disposed to sewer. The volumes were adjusted to consider the dairy product type assuming similar percentage splits as household WRAP data.
- The data is based on a range of assumptions and is an estimate.

Households

- Data from the National Food Waste Baseline report for total food waste was combined with data from FFW Australia study into household food waste to determine the proportion of dairy food waste and how it is managed (landfill, composting, sewer).
- This was cross-checked against Rawtec kerbside audits and an adopted value was selected based on these. A reality check based on various other sources was completed to avoid over/underestimating the total volume.
- The volumes were then adjusted to consider dairy product type from dairy food waste research completed by WRAP (e.g. milk, cheese, fresh dairy).
- The data is based on a range of assumptions and is an estimate.

Appendix 2 Dairy food waste types and destinations

Identified dairy food waste in manufacturing and management or disposal options currently used by manufacturers

Dairy food waste	Description	Current destinations
By-products		
Mother liquor	From lactose production	Animal feed (cows), compost, land application
Acid whey	From yoghurt and certain soft cheese manufacturing	Further processing for protein and other nutrients, animal feed, land application
Salty whey	From salted cheese manufacturing process	Animal feed, trade waste
Brine	From some cheese manufacturing	Trade waste
Permeate	Created when UF milk made from skim milk	Landfill, compost
DAF (dissolved air flotation) sludge	Material (protein, fat etc.) skimmed from DAF process	Compost, trade waste, land application, landfill
Unfinished product – intermediates		
Raw milk, cream (milk fat, protein, lactose)	Products lost due to spills, during cleaning processes and start-ups and shut down processes	Trade waste Treated wastewater discharged to waterways or irrigated/applied to land Animal feed
Unfinished product		
Products not meeting quality parameters for food safety	Plant failure/shutdowns may cause products to not meet specifications Products being contaminated	Trade waste (e.g. skim milk) Landfill (e.g. yoghurt bases)
Products from sampling procedures for quality control purposes	Examples include UHT milk, powdered milk	Animal feed Landfill
Finished products		
Over production/products with shorter shelf life than required		Animal feed (e.g. ice cream mixes) Food rescue companies Landfill
Unpackaged product – possible quality (food safety) concerns	Equipment failure, contamination Out of date, short date	Animal feed (e.g. cheese, milk) Landfill
Unpackaged product not meeting other specifications (i.e. weight)		Compost (e.g. icy poles) Landfill
Packaged products – possible quality (food safety) concerns	Passed use by date	Animal feed (de-packaging required) Compost (de-packaging required) Landfill (e.g. packaged desserts, cheeses)
Packaged products not meeting other specifications (e.g. labelling)	Labelling or packaging issues, such as incorrect date on label or placement of label	Animal feed (de-packaging required) Compost (de-packaging required) Landfill
Packaged products that is damaged	Damaged products Sampled products for quality control purpose	Animal feed (e.g. milk powder), composting/anaerobic digestion, landfill



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