DAIRY AUSTRALIA
Delivering for the dairy industry

Australian Dairy Manufacturing Industry State of the Environment Report

A Dairy Australia report on behalf of the Dairy Manufacturers Sustainability Council

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State of the Environment Report

Dairy Australia

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How Australia's milk processors are looking after our natural resources

Mike Ginnivan
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As community concerns and expectations about looking after the environment grow, Australia's milk manufacturers are being asked to demonstrate greater environmental responsibility and transparency.

While the Australian dairy industry has always taken responsibility for its role in protecting our natural resources, until now there has not been an industry-wide picture of how manufacturers seek to reduce their impact on the environment and how well they are performing.

This report features the findings of the first survey of major milk processing companies throughout Australia. Conducted in late 2005, the survey set out to identify the environmental initiatives and practices being used by milk processors and the resources they were using. The findings are based on data gathered from 40 processing sites belonging to nine milk processing companies that collectively process 74% of Australia's raw milk.

Though it is clear from the survey that dairy processors are addressing the challenges of environmentally sustainable milk production, and have been doing so for many years, this report does not pass judgement on the industry's performance. It simply establishes some key environmental performance indicators and sets the baseline from which performance can be measured over time.

The report will give local and international investors confidence that Australia's milk processors are being environmentally responsible. It will also help to promote the multitude of environmental initiatives being carried out by milk processors and their partners.

This is the first benchmarking tool of its kind for monitoring and improving environmental performance in milk processing plants.

As you can appreciate, it could not have been produced without the valuable input of the milk processors who willingly participated in the survey: Burra Foods Australia; Bega Cheese; Bonlac Foods; Dairy Farmers; Murray Goulburn Co-operative; National Foods; Parmalat; Tatura Milk Industries; and Warrnambool Cheese and Butter Factory.

The intention is to repeat the survey every three years to track how Australian milk processors have further improved their environmental performance.

The *State of the Environment Report* is a welcome initiative that demonstrates the Australian dairy industry's commitment to protecting and sustaining the air, water, soils, and plant, animal and microbial systems in its care. These vital natural resources are the cornerstone of the industry's continued viability and are valuable assets for future generations.

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Executive summary

Purpose of the report

- *State of the Environment Report 2005* was commissioned by the Australian dairy industry to study the environmental impact of dairy manufacturing (milk, cheese, yogurt, ice-cream, butter, powders, extended shelf-life products and high-value, functional ingredients). The report was produced by Dairy Australia, the industry's services provider, on behalf of the Dairy Manufacturers Sustainability Council (DMSC).
- Australian milk manufacturers were surveyed for the first time in late 2005 to identify their environmental initiatives and practices, and the level of resources used.
- The findings are set out according to nine Environmental Performance Indicators that represent the baseline from which future environmental performance will be benchmarked.

Environment Performance Indicators

1. Raw materials

- Milk production and processed ingredients for 2004/05 included 10,124 million litres of raw milk, 15,000 tonnes of sugar and 10,000 tonnes of salt.

2. Water

- Water sources were mains (69%), recovered condensate (17%), river water (10%), and dams or bores (4%).
- The sites surveyed consumed 10,000 million litres of fresh water and recycled an additional 2,000 million litres of condensate. Water consumption ranged between 1.5 and 1.9 litres per litre of raw milk.
- The steps taken to reduce water demand included optimising boilers, cooling towers and clean-in-place systems. New equipment was bought on the basis of minimal cleaning needs. Adopting membrane technology has improved the recovery of water, chemical and by-products.

3. Energy

- The sources of energy were natural gas (68%) and grid electricity (28%). More than 90% of grid electricity is coal-based.
- The sites surveyed used 7.2 million gigajoules of energy for dairy manufacturing (excluding fuel for transport).
- Industry-wide upgrading of evaporators and dryers and the closure of smaller, less-efficient plants over the past 20 years has improved energy efficiency by as much as 50% for some manufacturers. Further energy reduction will come from optimising energy-consuming equipment, heat recovery, plant load matching with electricity supply demands, and alternative sources and the co-generation of energy.

4. Chemicals

- Chemicals were used in water and wastewater treatment, for maintaining boilers and cooling towers, and for cleaning processing equipment. Most chemicals were discharged in the wastewater stream and could present a significant environmental impact, depending on the disposal method.
- The sites surveyed reported the use of sodium hydroxide (4,713 tonnes), sodium hypochlorite (50 tonnes), nitric acid (2,582 tonnes), phosphoric acid (68 tonnes) and sulphuric acid (1,007 tonnes).
- Research is under way to determine the optimum chemical concentrations for cleaning and the suitability of sodium-reduced alternatives.

5. Packaging

- Dairy manufacturing uses three types of packaging: primary, which comes into direct contact with the product; secondary, which groups quantities of primary packaged goods; and tertiary, which facilitates the handling and distribution of dairy products.
- A complete data set showing the tonnes of packaging used and the percentage of recyclable packaging could not be obtained for this report. Of the nine companies surveyed, six were signatories to the National Packaging Covenant. The 2005 covenant committed signatories to a national recycling target of 65% for packaging and no further increases in packaging waste disposed to landfill by the end of 2010.
- Manufacturers are working with suppliers and industry networks (such as the Australian Food and Grocery Council, the Royal Melbourne Institute of Technology Sustainable Packaging Alliance and Polystyrene

Australia) to reduce the amount of packaging used and to ensure that the proportion of recyclable material increases. Larger processors are incorporating the National Packaging Covenant Environmental Code of Practice into their management plans.

6. Solid waste and by-products

- Solid waste is categorised as organic or non-organic. Organic wastes include reject or unsold product and sludge from waste treatment processes. Non-organic wastes include packaging materials, such as cardboard, paper, cartons and plastic.
- The availability of solid waste data for all dairy processors varied and the methods of measurement were inconsistent. Solid waste tonnages could not be reported for 2004/05, however manufacturers are working with service providers to gain more accurate data for future reports. The sites that could provide data (representing 54% of Australia's raw milk production) showed a combined generation of more than 11,000 tonnes of sludge and stock feed.
- The Dairy Australia-funded Closing the Loop project has made some important advances in understanding the composition of solid organic wastes and the options for reuse, such as compost or fertiliser, animal feed, anaerobic digestion and biofuel.

7. Wastewater

- Wastewater comes from cleaning processing equipment and generally contains product residue.
- The sites surveyed produced more than 11,000 million litres of wastewater during 2004/05 (70% representation). Wastewater discharge is closely monitored and regulated under Environmental Protection Authority (or Agency) or local water authority trade waste agreements.
- The range of ratios for wastewater to raw milk of 0.4-3.2 indicated that there was an opportunity for some factories to reduce the volume of wastewater generated. The sites surveyed also indicated the discharge of 10,700 tonnes of nutrients (e.g. product residue) measured as Biological Oxygen Demand (BOD) and 270 tonnes of phosphates. In addition, approximately 1,860 tonnes of sodium salt was discharged with irrigated water and 660 tonnes was discharged to sewers.
- High levels of nutrients and spent chemicals in wastewater represent a loss of valuable resources. Steps to reduce wastewater include segregating and/or separating waste streams and treating and reusing appropriate quality water and chemicals. Advanced technologies such as diversion and monitoring systems and membrane separation have been introduced to detect wastewater quality and prevent the loss of valuable resources.

8. Greenhouse gases

- Sources of greenhouse gases are the combustion of natural gas at the processing site and the generation of electricity at the location of power generation.
- At the sites surveyed, 954,000 tonnes of CO_2 equivalent were emitted or 94.3 tonnes per million litres of raw milk processed. Of the nine companies surveyed, eight were signatories to the Greenhouse Challenge.
- Initiatives to reduce greenhouse gas emissions are addressed under Energy (see page 5).

9. Complaints and incidents

- A total of 203 complaints and incidents were reported over 2001-05 or 0.02 per million litres of raw milk processed. The majority of complaints (59%) were about odour and noise, which affected local amenity. There were 42 reported incidents of spills to sewers, surface water or stormwater during the reporting period.
- Air emission complaints related mainly to the release of solid particles, such as soot from boilers or powder from milk dryers. Most of the complaints in this category (60%) were directed towards one processor that was forced to burn soot-producing black coal as a substitute for coal briquettes when a local briquette factory burnt down. Complaints due to air emissions are therefore expected to fall in the following years.

Future initiatives and reports

There were a number of areas where there was insufficient information available to report some Environmental Performance Indicators, i.e. quantities of solid waste and packaging. The industry will encourage the collection of this information for inclusion in future reports. It is the intention of the DMSC to develop this report into a holistic 'sustainability' report to be produced every three years.

Further initiatives supported by the DMSC include an industry social impact report, technical guidelines for water recycling and reuse, a review of energy consumption and greenhouse emissions, and ongoing research into the reuse of bio-solid waste.

The next *State of the Environment Report* will assess the environmental performance indicators for 2007/08.

Introduction

State of the Environment Report 2005 is the first survey of environmental practices by and for the dairy manufacturing industry.

This report describes the various initiatives the industry has undertaken to conserve the consumption of water, energy, chemicals and packaging materials, and to generate less wastewater, solid and liquid wastes, and greenhouse gases.

With Australia in the grip of the worst drought on record, water scarcity is arguably the most serious environmental issue facing the industry today. The fact that raw milk is 87% water presents an opportunity for innovative solutions for water efficiency, particularly for those factories producing concentrated or powdered milk products.

The salinity of wastewater is another challenge being addressed by the industry. Developments in the field of membrane technology and the use of low-sodium chemicals are a step in the right direction to addressing this issue.

As a result of the variety of research and industry projects that are highlighted in this report, the industry has identified its major environmental challenges and is well placed to make informed decisions on future investment to minimise environmental impacts.

It is intended that similar reports will be produced every three years and that their scope will be expanded to a broader sustainability report.

This report was commissioned by the Dairy Manufacturers Sustainability Council (DMSC), formerly know as the Dairy Manufacturers Environment Forum. The DMSC is an industry-recognised body that includes representatives of the major dairy processing companies. Its primary roles are to set benchmarks for environmental sustainability, influence the transference of key skills and knowledge, and guide research activities.

This report has been produced by Dairy Australia, the Australian dairy industry's services provider. Dairy Australia delivers the services needed by the Australian dairy industry for its ongoing and future development as a competitive, innovative and sustainable dairy industry that contributes to the overall prosperity of Australian and regional economies.

Dairy manufacturing profile

The Australian dairy industry is one of the country's most important food and export industries, valued at $3.2 billion at the farmgate in 2004/05. It is the largest value-added food industry, increasing values more than three-fold through processing, to contribute $9 billion to the nation's economy.[1]

The dairy processing industry employs about 16,000 people[2] at more than 70 manufacturing sites[3] producing milk, cheese, yogurt, ice-cream, butter, powders, and dairy and pharmaceutical ingredients.

Milk production in Australia is mostly concentrated in the south-east of the country, with the States of Victoria, Tasmania and South Australia accounting for 78% of the total output in 2005.[1] Milk is processed by both farmer-owned co-operatives, such as Murray Goulburn Co-operative and the Dairy Farmers Group, and public and private companies. There are also a number of multi-national dairy companies operating within the Australian dairy industry, including Fonterra (Bonlac Foods), San Miguel (National Foods), Parmalat, Nestlé Australia, Kraft and Snow Brand.

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Survey response

The information presented in this report was provided by the Australian dairy manufacturing industry for the financial year 2004/05. A survey was completed for 40 dairy sites from nine milk processors accounting for 74% of raw milk processed for the industry. The participating companies were Murray Goulburn Co-operative, Dairy Farmers, National Foods, Bonlac Foods, Bega Cheese, Parmalat, Tatura Milk Industries, Burra Foods, and Warrnambool Cheese and Butter Factory (Table 1).

As the first public environment report prepared by the dairy industry, *State of the Environment Report 2005* is an important starting point for establishing industry benchmarks and for future reports. Not all processors were able to provide a full set of environmental data. Where results are based on responses from less than the 40 sites, the amount of milk processed by the responding sites is provided, expressed as a percentage representation of total raw milk production for 2004/05. As data availability varies between indicators, so this percentage varies.

The survey information and data has been provided in good faith for individual company operations and, where possible, has been crosschecked to ensure it is a true representation of the industry.

Table 1

Participating companies and sites

Single Sites	Multiple Sites				
Tatura Milk Industries	Bonlac Foods	Dairy Farmers	National Foods	Murray Goulburn Co.	Parmalat
Bega Cheese	Spreyton, Tas.	Canberra, ACT	King Island Dairy, King Isle	Koroit, Vic.	South Brisbane, Qld
Warrnambool Cheese and Butter Factory	Wynyard, Tas.	Hexham, NSW	Penrith, NSW	Leitchville, Vic.	Rowville, Vic.
	Stanhope, Vic.	Lidcombe, NSW	Tilba, NSW	Cobram, Vic.	Bendigo, Vic.
Burra Foods	Cobden, Vic.	Toowoomba, Qld	Crestmead, Qld	Rochester, Vic.	
	Cororooke, Vic.	Malanda, Qld	Salisbury, SA	Kiewa, Vic.	
	Darnum Park, Vic.	Clarence Gardens, SA	Murray Bridge, SA		
		Jervois, SA	Hobart, Tas.		
		Allansford, Vic.	Bentley, WA		
		Shepparton, Vic.	Cambellfield, Vic.		
			Chelsea, Vic.		
			Cobden, Vic.		
			Morwell, Vic.		
			Timboon, Vic.		

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Environmental management

Responsibility for environmental management rests with dairy manufacturers. At a site level, personnel with joint responsibilities for the environment and other areas, such as occupational health and safety or process improvement, typically manage environmental programs.

Management systems play an important role in helping to ensure correct procedures are followed. Of the sites that responded, 15% were certified to the ISO 14001 environmental management standard, while 88% were certified to the ISO 9001 quality management standard.

The Dairy Manufacturers Environment Forum (DMEF) was formed in 1996 to help manufacturers share information and become proactive in managing environmental issues. In 2006, under the direction of Dairy Australia, DMEF members have expanded their focus and adopted a united vision and strategy for the launch of the Dairy Manufacturers Sustainability Council. The section starting on page 11 of this report discusses the range of environmental programs supported by the DMSC.

The members of the DMSC are:

Dairy Australia	Neil van Buuren
Dairy Innovation Australia (formerly Dairy Process Engineering Centre)	Michael Weeks
Murray Goulburn Co-operative	Michael Carroll, Danny Wilson
National Foods	Susan Blacklow
Dairy Farmers	Janis Cecins
Parmalat	Justine Young, Margaret Berbers
Tatura Milk Industries	Karin Harding
Bega Cheese	Elvis Amair
Fonterra	Jane Sugrue, Simone Fletcher-Wells
Warrnambool Cheese and Butter Factory	Maurice King
UNEP Working Group for Cleaner Production in the Food Industry	Penny Prasad (Co-ordinator)

Environmental impact of dairy manufacturing

Dairy products are an important part of the Australian diet, providing great nutritional benefits. It is an essential food group recommended for daily consumption to maintain a healthy lifestyle.

Australian raw milk production reached 10,124 million litres in 2004/05, an increase of 0.5% on the previous year. Of the milk produced, about 20% was used to produce milk for drinking, while 80% was further processed into other dairy products (Figure 1).[1]

Manufacturing dairy products requires valuable resources – water, energy, various product ingredients and chemicals for processes such as cleaning (Figure 2). Dairy manufacturing also generates outputs such as air emissions, solid and liquid wastes that must be properly managed and, where possible, prevented or minimised.

The industry has about 70 dairy manufacturing sites of various sizes located in both urban and regional areas across Australia.[3] The location of these factories presents specific environmental management issues. Processors, for example, cannot irrigate with wastewater in regional areas without first considering the impact on soil health and the potential for run-off to water courses. Factories in urban areas must consider the impact of any noise or odour on their neighbours. The industry aims for responsible management of all environmental impacts arising as a result of their operations.

Figure 1

Raw milk utilisation

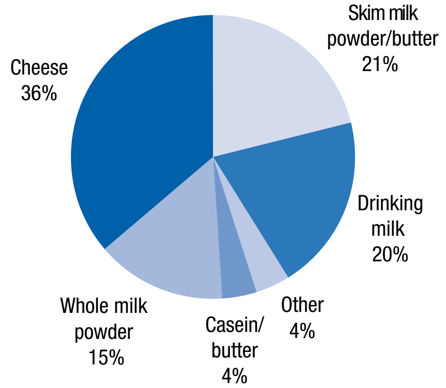


Figure 2

Process inputs/outputs of Australian dairy manufacturing

Process inputs →

Water

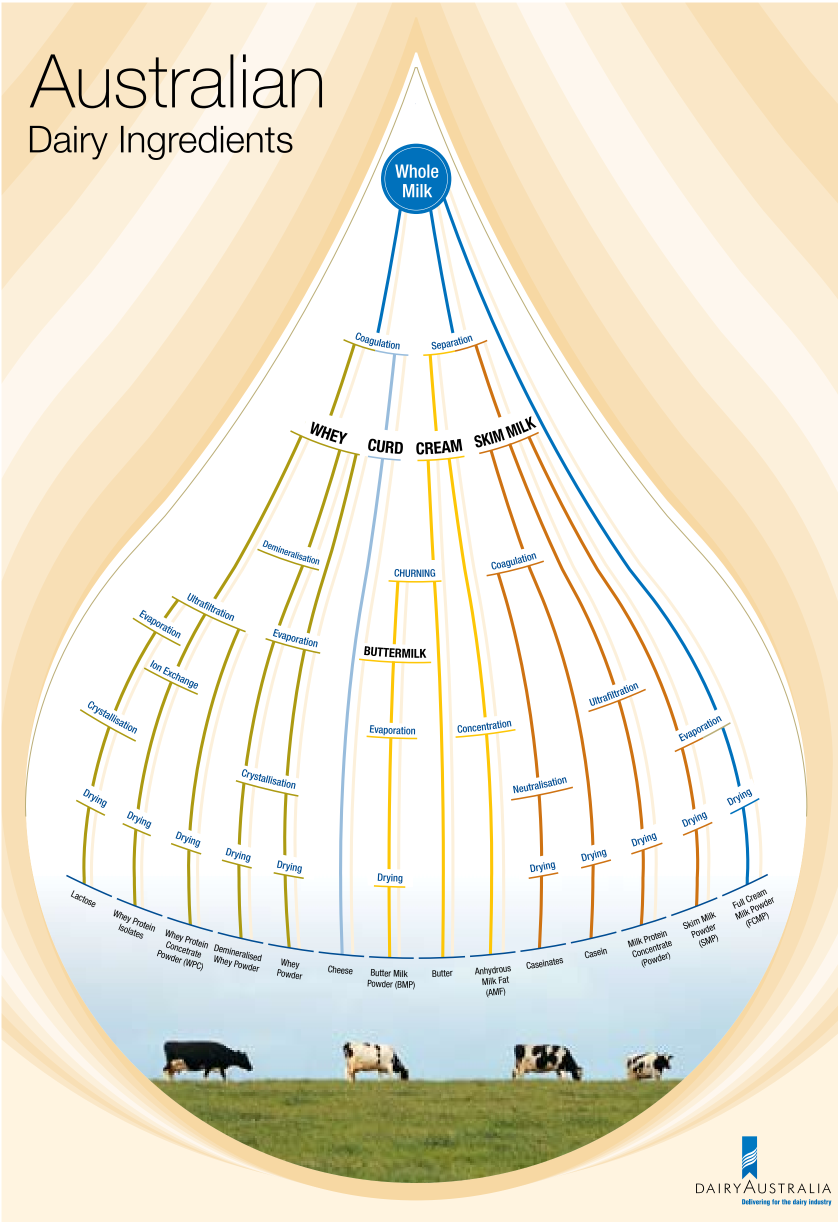
Energy

Packaging

Sugar

Salt

Chemicals



Process outputs →

Wastewater

Waste heat

Greenhouse gases

Waste packaging

Waste products

Spent chemicals

Noise

Odour

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Industry initiatives to reduce environmental impact

Australian dairy manufacturers are involved in numerous environmental programs through a combination of government, industry and research organisation partnerships. Programs are led in the main by Dairy Australia through the Dairy Processing Engineering Centre (DPEC) (now part of Dairy Innovation Australia) and/or the DMSC. Individual companies also run projects independent of these organisations.

DPEC focused on technological innovation for the dairy industry. It specialised in process and environmental technology evaluation, process optimisation, resource efficiency and training. Recent projects included involvement in the Closing the Loop project, the optimisation of automated cleaning systems and the development of engineering modules for students.

Each year, DPEC linked industry to research by one team-based project. In 2004/05, the Cleaning the Cleaning Solution project evaluated suitable technologies for chemical recovery from cleaning dairy manufacturing equipment and the evaluation of seven low or no-sodium cleaning-in-place (CIP) chemicals. The findings show the potential for factories to reduce or eliminate sodium discharges by using economically viable caustic substitutes without sacrificing cleaning power. The project found that the greatest benefit with the least cost came from the simple reuse of chemicals. Membrane filtration offers a greater benefit, but with substantially greater capital cost. Such research will help to reduce the industry's impact on the environment by minimising the 'salty' liquid wastes that are common to many dairy factories.

A Life Cycle Assessment (LCA) study for the dairy industry was completed in 2003 by the Centre for Water and Waste Technology at the University of New South Wales. The study, one of the first of its kind for an Australian food sector, evaluated the environmental impacts of the industry from on-farm and transport to processing and packaging. The study identified the 'hot spots' of dairy processing that have the biggest impact on the environment. The outcomes of this study are discussed on page 22 of this report.

The dairy processing industry has recognised the importance of being 'eco-efficient' – the idea of producing more with less. The *Eco-efficiency for the Dairy Processing Industry* manual and case studies was published by Dairy Australia in 2004 in conjunction with the United Nation Environment Program Working Group for Cleaner Production in the Food Industry. The manual is a collection of ideas and real case studies about how dairy processors can reduce resource use and the production of wastes. The project has also seen the publication of useful benchmark data for energy and water use. A copy of the manual and associated fact sheets can be downloaded from the DPEC (Dairy Innovation Australia) website – www.dairyinnovation.com.au

The Closing the Loop (CTL) project is an integrated and collaborative program between research providers and the dairy industry. Running from 2003 to 2007, the project aims to deliver practices and technologies that will reduce the volume and cost of waste disposal, develop integrated land-based reuse systems and develop regional options for waste treatment and reuse. A $4.4 million collaborative venture by the Victorian dairy industry, the project draws together scientific expertise from leading research organisations, including the Victorian Department of Primary Industries, Food Science Australia, Deakin University, Royal Melbourne Institute of Technology, DPEC and Victoria University. The CTL project is funded by the Geoffrey Gardiner Foundation, Victorian dairy manufacturers, the Department of Primary Industries Victoria and Dairy Australia. Specific projects undertaken by the CTL team are:

- a review of dairy factory solid and liquid waste management practices;
- research into the ultrasonic treatment of waste;
- establishing a flagship demonstration site and land application trials;
- identifying sustainable and cost-effective alternatives for dairy processing organic waste management in the Goulburn Valley and south-west Victoria;
- linking with DPEC to investigate alternative CIP chemicals and practices for reducing sodium in dairy processor waste streams; and
- evaluating technologies for removing salt from wastewater streams in dairy processing factories.

Research outcomes to date include:

- a detailed knowledge of the composition of a wide range of solid organic wastes and alternative reuse options;
- ultrasonics technology that improves the operational efficiency of waste treatment by up to 30%, although this improvement is at present considered too costly for most factories;
- a detailed knowledge of the performance of in-vessel composting systems and odour emissions during the composting of dairy factory organic wastes, bulked with green waste; and
- reverse osmosis technology that removes up to 97% of organic matter and up to 98% of salts from various dairy factory waste streams. However, ion-exchange and adsorption processes are not yet viable options for the removal of salt from dairy processing wastewater.

The CTL project has been an excellent example of industry collaboration. Project outcomes have been shared through presentations, field days, newsletters and project reports. Further information can be found at www.dpec.com.au/closingtheloop.php.

Dairy Australia drives the majority of new environmental research for the dairy industry. It also recently commissioned a new social impact assessment study of the Australian dairy industry from 2005 to 2007 to identify and quantify the social value of the industry and identify areas for improvement. Using a survey instrument developed by members of the DMSC and the Centre for Social Change Research at the Queensland University of Technology, the study will look into the impact on employees and local communities of the dairy industry and use its findings to help develop future strategies and measures for industry sustainability.

In addition to the programs described, individual companies have been involved in various government and research organisation programs:

- Dairy Farmers' Lidcombe site and National Foods' Penrith plant made substantial water savings through involvement in Sydney Water's Every Drop Counts program;
- Bonlac Victoria is looking to reduce environmental impacts through involvement with the Victorian Department of Sustainability and Environment South West Sustainable Settlements project;
- Tatura Milk Industries partnered with EPA Victoria, Goulburn Valley Water and DPEC to conduct a site salt and water audit;
- Parmalat Bendigo has also partnered with EPA Victoria and Coliban Water on a cleaner production project; and
- the Sustainable Packaging Alliance (SPA) has partnered with Nestlé Australia to develop environmental packaging guidelines. The SPA is also working with National Foods to optimise packaging supply chains.

Environmental Performance Indicators

Environmental Performance Indicators (EPIs) will be used to benchmark the future performance of the dairy industry. Given the wide variety of products produced by dairy manufacturers, the consumption of resources per kL of raw milk processed is the indicator most often used in this report. However, at a site level, resource consumption may be reported per tonne of product.

For this report, EPIs are reported for three factory types: sites that produce predominantly milk and dairy desserts, cheese and whey, or powdered products. These three types have significantly different processing steps that warrant the reporting of separate EPIs; for example, powder-producing factories generally use significantly more energy and less water due to the processes and equipment used to dry milk.

The following sections define the EPIs in terms of the main resources used in dairy manufacture, the emissions generated and how these indicators are managed to eliminate or minimise their environmental impact.

Raw materials

The dairy manufacturing industry processed 10,124 million litres of raw milk in 2004/05.[1] After milk-based ingredients such as raw milk, concentrates and powders, the next largest quantities of ingredients processed were 10,000 tonnes of salt and 15,000 tonnes of sugar. Salt is predominantly used in the manufacture of cheese and butter, while sugar is used in yogurts, dairy desserts and flavoured milk.

Water

Water is an essential part of dairy manufacturing. It is used for cleaning to ensure the highest levels of food safety and for general processing needs such as heating and cooling. Typical water use for a dairy processor producing mainly drinking milk (market milk) is shown in Figure 3.

Mains are the most common source of water (Figure 4). Water consumption by dairy manufacturers varies according to the products made. Milk is approximately 87% water and therefore factories producing powders potentially have an additional source of water, produced by removing water from milk in the drying process.

Figure 3

Typical water usage – market milk manufacturer[4]

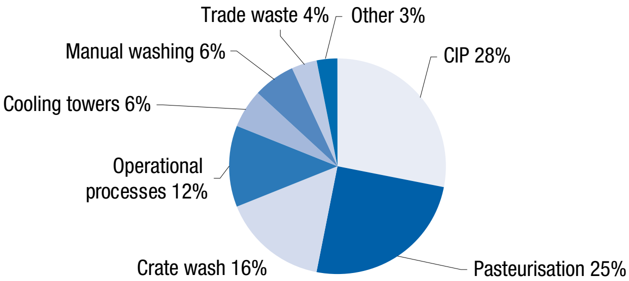
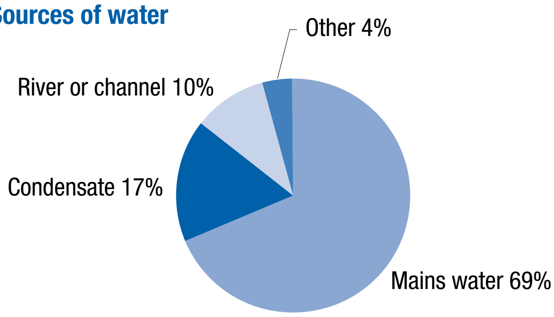


Figure 4

Sources of water



Some 17% of water is sourced from recycled condensate, produced during the drying process and by steam production. The quality of condensate varies depending on the state of the processing equipment and the potential for contamination with a product. As in all food factories, the water that is in contact with product must be of the highest quality. Therefore, the options for reusing condensate can be limited.

Some 36 of the 40 sites surveyed (73% representation) consumed 10 gigalitres of fresh water and recycled an additional two gigalitres of condensate. Average water consumption ranged between 1.5 L/L and 1.9 L/L raw milk (Table 2). However, for a factory producing mainly powdered products, water consumption can be as low as 0.1 L/L milk if much of the water is recovered during the drying process.

As with most food manufacturers, water conservation has become a higher priority in recent years. To reduce water usage, dairy manufacturers have sought to optimise the operation of equipment such as boilers, cooling towers and clean-in-place systems, which saves millions of litres of water each year (see case studies on next page). Many

Table 2

Fresh water use, L/L raw milk

	Min.	Max.	Av.	No. sites
Milk & dairy desserts	0.9	2.7	1.6	14
Cheese and whey	0.8	3.2	1.9	5
Powders	0.1	3.1	1.5	13
Representation: 73%				

sites also save water by designing or selecting equipment that minimises cleaning needs or enables water to be reused. Membrane technology has presented many opportunities for the recovery of water, chemicals and valuable product.

In addition to technological advancements, companies such as National Foods and Dairy Farmers have improved water management by participating in various government programs. As a result of National Foods Penrith's involvement in Sydney Water's Every Drop Counts program, the site reduced water consumption by 22%, saving 110 kL/day. There are also numerous examples of individual sites driving their own water conservation projects, including Murray Goulburn's Rochester facility detailed below.

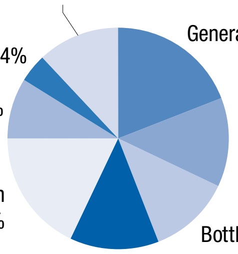
Energy

Energy is used in dairy manufacturing for refrigeration, air-conditioning, machinery operation (pumps, motors, fans, etc.) and lighting. Figure 5 shows a typical example of the energy consumption breakdown. Of the sites surveyed (70% representation), the main sources of energy were natural gas and grid electricity (Figure 6). Grid electricity is predominantly coal-based (93%), with the remainder produced by Tasmania's hydro-electricity scheme.

The mix of products produced by a factory has a bearing on the amount and type of energy consumed. For example, sites producing powdered products use significantly more

Figure 5

Typical energy cost breakdown – market milk[6]



Saving a precious resource: Murray Goulburn Rochester

Dairy processors understand that reducing water consumption not only helps to conserve a valuable resource, but that there are additional savings in energy, chemical and treatment costs. Recovering water for reuse not only helps to reduce a site's environmental impact, it also makes good business sense.

For example, Murray Goulburn's Rochester site recovers up to 190 ML/yr of condensate from milk and whey powder evaporators for reuse as processing and boiler feed water. Almost 40% of the site's water requirements are supplied by the recovered condensate.

The initiative, while costing less than $150,000 to implement, means the site saves around $30,000 a year in town water, has reduced gas consumption for water pre-heating and saves more than $100,000 worth of water treatment chemicals a year. In addition, less wastewater is sent to the effluent treatment farm, saving a further $40,000.

Every drop counts: Dairy Farmers Lidcombe

Establishing accurate water balances and monitoring flow is the first step to managing water effectively. Dairy Farmers Lidcombe joined Sydney Water's Every Drop Counts program and installed 27 water meters across the site to develop an accurate understanding of water flows. An assessment identified savings that could be made by:

- preventing cooling tower overflow;
- recirculating homogeniser water, crate wash water and DAF water;
- reducing the water used for cleaning;
- repairing leaks; and
- reviewing truck washing practices.

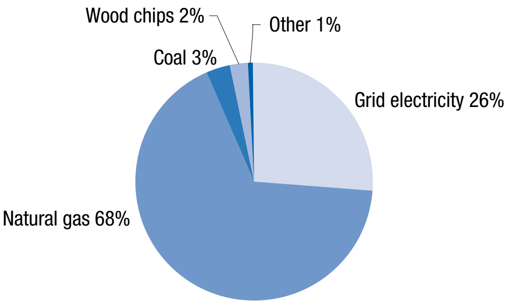
The project identified potential water cost savings of $300,000 for an initial cost of $150,000 and on-going costs of $26,000 a year.

Conveyor chain lubrication: Parmalat South Brisbane

Parmalat switched to a Teflon-based lubricant for its conveyor chains and was able to reduce water usage by 32 kL a week.

Figure 6

Sources of energy



energy than those producing mainly liquid milk because of the additional energy needed to operate evaporators and spray dryers (Table 3). This is usually in the form of gas for heating, so a lower proportion of electrical energy is used to produce powdered products (Table 4).

The sites surveyed used 7.2 million gigajoules of energy for processing (excluding transport fuel). The industry has radically improved its energy efficiency over the past 20 years (in some cases by as much as 50%) through industry-wide equipment upgrading (evaporators and dryers) and the closure of smaller, less-efficient factories.[5] Opportunities being explored by the industry to further reduce energy include:

- optimising the operation of energy-consuming equipment;
- recovering heat energy;
- matching the plant's load requirements with electricity supply demands; and
- exploring alternative sources of energy, such as biogas.

Table 3

Total energy MJ/kL raw milk intake

	Min.	Max.	Av.	No. sites
Milk & dairy desserts	356	1,485	623	13
Cheese and whey	437	975	683	5
Powders	715	2,478	1,648	11
Representation	***70%***			

Table 4

Electricity as a percentage of total energy use

	Min.	Max.	Av.	No. sites
Milk & dairy desserts	34%	67%	50%	12
Cheese and whey	24%	45%	32%	5
Powders	9%	48%	19%	11
Representation	***70%***			

Co-generation has been investigated by some processors, but to date it has not been found to be cost effective. Future energy gains are expected to be incremental unless older, less-efficient equipment is replaced.

Chemicals

Dairy manufacturers use a wide range of chemicals for water and wastewater treatment, maintaining boilers and cooling towers, and cleaning processing equipment. The most commonly used cleaning chemicals are sodium hydroxide (caustic soda), sodium hypochlorite, nitric acid

Heat recovery: Bonlac Foods Wynyard

Heat recovery is where waste heat sources such as those from spray dyers, flue gases or condensate recovery systems are recovered and used in other applications. Bonlac Foods Wynyard now uses waste heat from cheese whey to preheat raw incoming milk before it is pasteurised. The energy savings were sufficient to shut down a boiler previously used to supply steam.

Optimising refrigeration systems: Bega Cheese

Refrigeration systems can approach 20% of the total energy consumption of a milk processing plant. Bega Cheese was able to reduce energy demand by installing a new process control system for refrigeration that allowed more efficient monitoring and control. The system reduced energy consumption and greenhouse gas emissions by 10%, with a payback period of only two years. The site has also fitted several large motors with variable speed drives that continually match motor speed with equipment load. The motors' energy requirements were reduced by 25%, with a payback of a year.

Eliminating steam leaks: Bonlac Foods Spreyton

Bonlac Foods Spreyton generates steam and distributes it at 4,000 kPa – the pressure required for spray dryer air heating. All other duties use steam at 1,000 kPa, which is produced at four 'letdown' stations located near the points of use. Design faults at the letdown stations allowed continual steam leakage. The stations were rebuilt with heavy-duty automated isolating valves and improved design. The improvements saved more than $70,000 in coal supply costs. The cost of implementation was around $150,000.

and phosphoric acid. Sulphuric acid is also used by some processors for wastewater treatment.

After use, most chemicals are discharged in the wastewater stream and can present a significant environmental impact depending on the method of disposal. During 2004/05, the sites surveyed reported the use of sodium hydroxide (4,713 tonnes), sodium hypochlorite (50 tonnes), nitric acid (2,582 tonnes), phosphoric acid (68 tonnes) and sulphuric acid (1,007 tonnes). Further information on the use of chemicals is shown in Table 5.

Chemicals are supplied in various strengths, but the data presented is for pure chemicals only. As Table 5 shows, there are wide variations in the quantities of chemicals used. This is not necessarily an indication of chemical use efficiency, but may be due to differences in cleaning regimes. However, there are opportunities to significantly reduce chemical use in dairy manufacturing.

The use of sodium-based chemicals produces salty waste that can be a major issue for dairy processors, particularly those that use wastewater for irrigation. Research is investigating the optimum concentrations of the chemicals required for cleaning and alternative sodium-reduced chemicals. Some chemical suppliers are partnering with processors to optimise chemical consumption by closely monitoring use and providing regular reports.

Cleaning the Cleaning Solution

The Dairy Process Engineering Centre's latest industry research project is called Cleaning the Cleaning Solution. Using a cross-functional team of industry personnel, suppliers and university researchers, strategies have been identified for Australian dairy companies to significantly reduce their chemical consumption and the environmental impacts of cleaning-in-place (CIP) through effective recovery and reuse. The project has found that sodium discharges from plants can be reduced by 80% to 95% using chemical recovery, compared with single-use systems. Most recovery options were financially favourable for large dairy operations with centralised CIP systems, whereas simple reuse is found to be the most cost effective for smaller localised CIP recovery systems.

Packaging

Dairy manufacturers use a variety of packaging materials. Their primary function is to maintain the quality of the product from manufacture through to use by the consumer. Packaging is classified into three types:

- Primary packaging comes into direct contact with the product. The main materials are high density polyethylene (HDPE), polyethylene (PET) and liquid paperboard for milk; polypropylene and polystyrene for dairy desserts (e.g. yogurt containers); polyethylene laminates and PET for cheese products; and paper, PET and polypropylene multi-layer bags for powdered products.
- Secondary packaging is used to group quantities of primary packaged goods for distribution. It consists mainly of returnable polyethylene and polypropylene milk crates and recyclable cardboard boxes.
- Tertiary packaging is used to facilitate handling and transport and consists mainly of plastic films, paper sacks, and reusable pallets and bins.

Primary packaging is typically made from virgin materials due to stringent food safety standard requirements. However, most of these materials can be recycled. Some sites manufacture their own HDPE and PET milk bottles, and, if possible, clean off-cuts from these processes are reworked into new packaging.

The majority of secondary and tertiary packaging is reusable, recyclable or made from recycled product (Table 6). Intermediate packaging such as plastic film is sometimes used to protect the integrity of products between processing operations.

Table 5

Cleaning and waste treatment chemical use (kg pure chemical / ML of raw milk processed)

	Min. kg/ML	Max. kg/ML	Median kg/ML	Average kg/ML	Total tonnes	Sites reporting use	No. sites reported	% raw milk prod
Sodium hydroxide	1	1,759	835	841	4,713	20	24	64%
Sodium hypochlorite	<1	32	<1	10	50	16	24	64%
Nitric acid	25	1,565	296	390	2,582	24	25	66%
Phosphoric acid	1	98	5	21	68	16	24	64%
Sulphuric acid	16	1,927	114	429	1,007	11	24	64%

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Table 6

Packaging types*

Material type packaging	Item	Recyclable
Primary packaging		
High Density Polyethylene (HDPE)	Milk & cream bottles	✓
Liquid Paper Board	Milk cartons	✓
Polystyrene	Yogurt & dessert cups	x
Low Density Polyethylene (LDPE)	Bottle caps & bottle sleeves	✓
Liquid Paper Board UHT	UHT milk cartons	x
PET	Milk bottles	✓
Composite materials	Labels, lids, cheese wraps	x
Cardboard	Inner product sleeves	✓
Polypropylene	Cream & dessert packs	x
Mixed plastic	Cheese bags & film	x
PVC	Cup lids & shrink sleeves	x
Aluminium	Foil lids	x
Glass	Cheese jars	✓
Wax	Cheese packaging	x
Balsa wood	Cheese boxes	x
Cloth	Cheese wrapping	x
Steel	Cheese jar lids	x
Paper	Multi-layer bags	x
Polyethylene	Multi-layer bags	x
Polypropylene	Multi-layer bags	x
Secondary packaging		
Cardboard	Outer cartons	✓
Polypropylene	Milk crates	✓
Tertiary packaging		
Polyethylene	Pallet stretch wrap	✓
Cardboard	Pallet liners	✓

* *Reproduced and adapted from National Foods National Packaging Covenant Report 2005.*

National Foods has added 15% recycled content to its polypropylene milk crates, which is expected to reduce the use of new materials by more than 60 tonnes a year. The Victorian sites have also eliminated pallet liners, resulting in a net saving of 23 tonnes of cardboard annually.

Bonlac Stanhope reduced the paper component of 25kg powder bags and reduced paper use for 800,000 bags by 198 tonnes.

Dairy Farmers' manufacturing sites increased recycling quantities from 39% to 51% by improving reporting systems and increasing staff awareness.

A complete data set showing the tonnes of packaging used and the percentage of recyclable packaging could not be obtained for this report. Dairy manufacturers are working towards gathering this information for the next *State of the Environment Report*.

Of the nine companies surveyed, six were signatories to the National Packaging Covenant (33 of 36 individual sites surveyed, 67% representation). The 2005 covenant committed signatories to a national recycling target of 65% for packaging and no further increases in packaging waste disposed to landfill by the end of 2010.

The National Packaging Covenant's definition of recyclable packaging for a product means reasonably able to be recovered in Australia through collection or drop-off systems, and able to be reprocessed and used as a raw material for the manufacture of a new product.

The industry is pursuing various initiatives to reduce the impact of packaging. Dairy processors are working with their suppliers and industry networks (such as the Australian Food and Grocery Council, the Royal Melbourne Institute of Technology's Sustainable Packaging Alliance and Polystyrene Australia) to reduce the amount of packaging and ensure that the proportion of recyclable material increases. This may be by developing effective recycling systems and markets, the use of bulk materials, increasing recyclability and using fewer inputs. Larger processors are more formally adopting the National Packaging Covenant's Environmental Code of Practice into their management plans. Further information, including examples of packaging initiatives by dairy manufacturers, can be found in the Reports and Plans section of the National Packaging Covenant's website (www.packcoun.com.au).

Solid waste and by-products

The solid wastes produced by dairy manufacturers can be categorised as organic or non-organic (Table 7). Organic wastes include reject and unsold product and sludge from waste treatment processes. It may be composted or, where appropriate, used as animal feed. Non-organic wastes include packaging materials such as cardboard, paper, cartons and plastic. It is recycled, reused or otherwise disposed to landfill.

The industry faces some challenges in recycling, particularly at those factories located in regional areas, where facilities may not be available or economically feasible. Waste is generated during processing or when raw materials and products are being transported, stored and handled.

Recovering valuable products from waste: Murray Goulburn Rochester

The most effective way to minimise waste is to avoid producing it or to turn it into a value-added product. Membrane technology is often used by the industry to separate substances that were previously sent to waste or used as stock feed. Ultra-filtration, for example, is used to recover protein and lactose from whey. Murray Goulburn's Rochester site uses membrane technology to process around 800 kL of whey a day to produce whey and lactose powders. Separated water is recycled, thus reducing the need for fresh water by up to 70,000 kL a year.

Increasing recycling rates: Dairy Farmers Lidcombe

Dairy Farmers Lidcombe partnered with Resource NSW (part of the NSW Department of Environment and Conservation) to identify ways of reducing waste across the site.

A waste assessment was conducted and found that 58% of the waste that was sent to landfill could be diverted through a reuse and recycling system.

A recycling system was established, which halved the quantity of waste sent to landfill and reduced transportation and landfill fees by $40,000 a year.

The dairy industry also produces a range of value-added by-products. For example, whey produced during cheesemaking is further processed into useful food ingredients, such lactose, whey protein concentrates and whey powders.

The availability of solid waste data for all dairy processors varies and methods of measurement are inconsistent and inaccurate. Solid waste tonnages could not be reported for 20004/05, but processors are working with service providers to gain more accurate data for future reports. Some indication of the amount of organic waste has been provided, with the sites surveyed reporting the generation of more than 11,000 tonnes of sludge and stock feed (54% representation).

The Closing the Loop project,[7] as mentioned earlier in this report, has made some important advances in understanding the composition of solid organic wastes and the options for reuse. Waste composition has been compared to assess potential reuse options, such as land application (directly or as compost/fertiliser), animal feed, anaerobic digestion and biofuel (biodiesel or direct burning) (Table 8). The suitability of dairy processing waste for composting and the land application of sludge is also being assessed. In addition, a new CTL project is investigating reprocessing salty streams into new products.

Wastewater

Dairy factories produce wastewater by cleaning and flushing processing equipment. The wastewater generally consists of product residue, and cleaning and waste treatment chemicals, and may be high in fat and salt. Methods of waste treatment include dissolved air flotation (DAF) and biological treatment, such as aerobic and anaerobic digestion. Many factories discharge directly to

Table 7

Sources of solid waste in dairy processing plants*

Type of waste	Disposal stream
Non-organic	
Cardboard boxes, paper, slip sheets	Recyclable
Plastic wrap	Recyclable, depending on cleanliness and plastic type
HDPE bottles and caps	Recyclable
Foil seals	Non-recyclable
Liquid paperboard	Recyclable
Labels generally	Non-recyclable
Plastic and metal drums and containers	Returned to supplier, reused or recycled
Polystyrene	Recyclable in some areas
Office waste (e.g. toner cartridges, paper)	Recyclable
Canteen waste (e.g. aluminium cans, polystyrene cups)	Recyclable in some areas
Miscellaneous (e.g. waste oil, oily rags, damaged pallets)	Recycled or landfill
Organic	
Reject product, including in-process	Animal feed
Returned final product	Animal feed
Obsolete or out-of-date raw materials	Animal feed
Lab samples and samples for online testing	Animal feed
Separator de-sludge	Animal feed
Baghouse fines, dryer sweepings	Animal feed
Effluent sludge	Animal feed or compost
Membrane retentate sludge	Animal feed or compost
Cheese fines	Animal feed
Fat recovered from effluent	Animal feed

** Reproduced from Dairy Processing Eco-efficiency Manual, August 2004*

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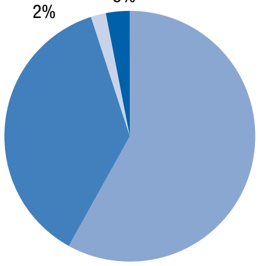
Table 8

Recommended applications of organic dairy factory wastes – Closing the Loop project

	Land application	Animal feed	Tallow manufacture	Anaerobic digestion	Biofuel
Sludge	✓			✓	✓
Fat		✓	✓		✓
Cheese curd		✓	✓		✓
Other	✓	✓			

Figure 7

Wastewater disposal methods



sewers or land with minimal treatment. Some factories discharge to the ocean and small quantities are discharged to stormwater (Figure 7). The discharge of all wastewater is closely monitored and regulated under EPA or local water authority trade waste agreements. The sites surveyed produced more than 11,000 ML of wastewater for the year (70% representation).

The environmental impact of wastewater disposal varies according to where the waste is received; hence wastewater is treated to the quality appropriate to the disposal method. For example, factories that dispose to sewers are generally not required to treat the waste to the level of that required if it is irrigated. Tables 9-11 show there is a wide range in the quantity and quality of wastewater at the point of disposal. Factories producing powdered products would generally produce less wastewater if their condensate is treated and reused.

The range of ratios for wastewater to raw milk of 0.4-3.2 indicates that there is an opportunity for some factories to further reduce the volume of wastewater they generate. The factories surveyed also indicated the discharge of 10,700 tonnes of nutrients (e.g. product residue) measured as Biological Oxygen Demand (BOD) and 270 tonnes of phosphates. In addition, approximately 1,860 tonnes of sodium salt was discharged with irrigated water and 660 tonnes was discharged to sewers. As mentioned in the section on chemical use, the industry is investigating the use of sodium-free or sodium-reduced chemicals.

Importantly, high levels of nutrients and spent chemicals in wastewater represent a loss of valuable resources. The industry is, therefore, continually investigating ways of reducing wastewater by segregating and/or separating waste streams, and treating and reusing appropriate quality water and chemicals. In recent years, more advanced technologies, such as diversion and monitoring systems and membrane separation, have been introduced to detect wastewater quality and prevent the loss of valuable resources.

Parmalat's Rowville factory reduced wastewater BOD levels by 20% using staff education and plant modification.

End-of-run milk, previously sent to the trade waste system, was reclaimed and then collected by local farmers for reuse. The cost of the project was $20,000 and the saving was $ 97,548 a year.

Bega Cheese has several initiatives for reducing wastewater generation, such as reusing salty whey in cheese processing and optimising the operation of the pasteuriser to minimise water needs.

Bonlac Stanhope installed a screen to recover cheese fines from a waste stream. The installation recovered approximately 110 tonnes of cheese fines during 2003/04, saving more than $100,000 in product, and avoided waste disposal costs.

Warrnambool Cheese and Butter Factory at Allansford introduced a resource efficiency project that identified that residual cream in the load in/out system was being lost to the drain. The process programming was optimised and a recovery silo installed to allow the capture and reuse of residual cream. The project reduced fat loading to the treatment plant by 66% and reduced waste fat disposal by 60% over two years. Product efficiency was increased by 0.88% and the project recovered its cost in 2½ years.

Table 9

Wastewater to milk ratio-L/L milk

	Min.	Max.	Av.	No. sites
Milk & dairy desserts	0.9	2.2	1.3	12
Cheese and whey	1.1	3.4	2.0	4
Powders	0.4	3.2	2.0	13
Representation	***70%***			

Table 10

Wastewater characteristics – mg/L wastewater

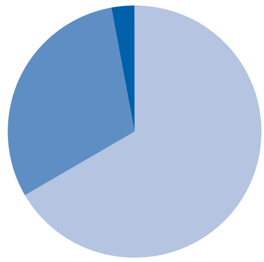
	Min.	Max.	Av.	No. sites
BOD				
Milk & dairy desserts	1,500	5,000	2,980	9
Cheese and whey	247	1,768	824	6
Powders	5	4,262	1,260	12
Representation	***61%***			

Greenhouse gases

Greenhouse gases are emitted during the combustion of fossil fuels for power or steam generation. In dairy manufacturing and distribution the fuels consumed are grid electricity, natural gas, direct on-site combustion of coal and a small quantity of wood chips, while diesel and LPG are used as transport fuels. This report includes the generation of greenhouse gases for dairy processing only and does not include those produced from transport.

Figure 8

Sources of greenhouse gas emissions (kg CO_2 equivalent)



Greenhouse emissions are reported in tonnes of CO_2 equivalent using conversion factors from the *Australian Greenhouse Office Factors and Methods Workbook 2005*[8] and take into account the source of fuels in each State.

The main sources of greenhouse gases are the combustion of natural gas at the processing site and the generation of electricity at the location of power generation (Figure 8). At the sites surveyed, 954,000 tonnes of CO_2 equivalent were was or 94.3 tonnes per ML raw milk processed (69% representation).

Of the nine companies surveyed, eight were signatories to the Greenhouse Challenge. Initiatives undertaken by the industry to reduce the use of fossil fuels and greenhouse gas emissions are discussed in the earlier section on energy.

Table 11

Wastewater characteristics

	Min. mg/L	Max. mg/L	Av. mg/L	Total tonnes /yr	No. of sites	Representation*
BOD						
Sewer	32	5,000	2,283	4,483	14	68%
Irrigation	5	4,262	1,102	6,217	12	91%
COD						
Sewer	106	8,000	4,567	2,429	5	37%
Irrigation	20	6,645	1,754	8,812	11	91%
Phosphates						
Sewer	16.0	116.2	51.0	130	5	45%
Irrigation	2.0	45.0	21.0	140	11	90%
Sodium						
Sewer	230.2	570.2	346.3	658	4	40%
Irrigation	143.4	976.0	522.3	1,862	8	56%

** Indicates percentage of sites providing data that dispose to sewer or irrigate e.g. for BOD data, 91% of sites that irrigate have provided data for BOD.*

Complaints and incidents

In this survey, 203 complaints and incidents were reported for the period 2001-2005 or 0.02 per ML of raw milk processed (70% representation). Dairy manufacturers have strict guidelines for the handling of such incidents. They must be reported and documented as part of management systems to ensure that appropriate corrective and preventative actions are put in place.

As shown in Figure 9, the majority of complaints (59%) were about odour and noise, which impact on local amenity. Odour (31%) emanating from wastewater treatment plants and ponds were the leading cause of complaint. Odour problems were usually addressed by strict process controls or the use of odour control technology such as bio-filters.

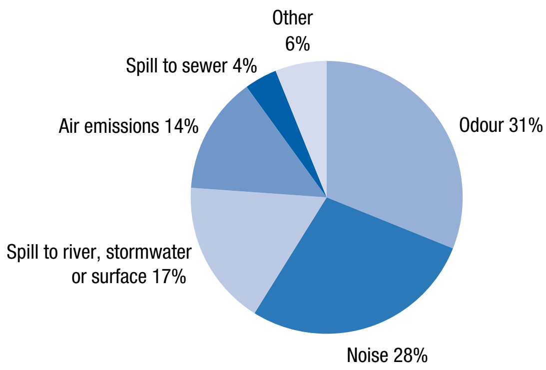
Noise accounted for 28% of complaints, usually as a result of truck movements and general factory noise caused by alarms or motors. As with many manufacturers, urban encroachment on processing plants means that those operations causing noise must be closely managed. This may require operating procedures to be modified or, in the case of trucks, movements to be restricted.

There were 42 reported incidents of spills to sewers, surface water or stormwater during the reporting period. All spills were reported to local authorities and minor incidents were investigated according to the corrective action procedures of individual companies. The measures used by processors to prevent spills included process control, alarm and video monitoring (CCTV).

Air emission complaints typically concerned the release of solid particles, such as soot from boilers or powder from milk dryers. Most of the complaints in this category (60%) related to one incident, where a processor was forced to burn soot-producing black coal as a substitute for coal briquettes when a local briquette factory burnt down. Complaints due to air emissions are therefore expected to fall in the following years.

Figure 9

Incidents and complaints



Life Cycle Assessment

Life Cycle Assessment (LCA) is a tool used to compare the environmental impacts of products or processes over their life cycle from the extraction of raw materials through to processing, production, consumer use and disposal. In 2003, the University of New South Wales Centre for Water and Waste Technology completed an LCA study for the Australian dairy industry.[5] The scope of the study included farm, transportation and dairy manufacturing processes. The environmental impacts included total energy and water consumption, climate change and soil salination, and these impacts were reported per tonne of product and tonne of raw milk processed. The impacts of note relating to dairy manufacturing were:

Energy – the dairy industry consumes approximately 41 PJ per year for all processes included in the production of raw milk and the manufacturing of the products, which is equivalent to 0.9% of Australia's total energy consumption. Some 43% of the total energy use is associated with milk production on-farm and 8% for milk transportation. Figure 10 shows the variation in energy use per tonne product. The variation reflects the higher levels of processing needed to produce products such as cheese or yogurt.

Water – the total amount of water used over the life cycle of the dairy industry is approximately 3,000 GL per year. This is equivalent to 13% of Australia's total fresh water resources. Of the total water used by the dairy industry, 1% is consumed by dairy processors (Figure 11). The total water figure for Australia includes consumption by agriculture, manufacturing, electricity and gas, water and sewerage, and household use. This assumes that the total net surface and groundwater consumption for Australia during 1996-1997 was approximately 22,186 GL.[5]

Climate change – the entire dairy industry contributes approximately 2.4% to the total greenhouse gas emissions of Australia, i.e. 12.7 Mt CO_2-eq. Some 1.3 Mt CO_2-eq. originates from dairy processing factories, 0.4 Mt CO_2-eq. from milk transportation and 11.0 Mt CO_2-eq. is emitted during milk production. Most of the emissions produced during milk production are methane produced by cows. Figure 12 shows the variation in greenhouse gas emissions for four product groups.

The findings of the LCA show that there is no one part of the industry that consumes significantly more energy and that opportunities for reducing energy use should be focused across the industry, including farm, manufacturing and packaging.

Figure 10

Energy use per tonne product

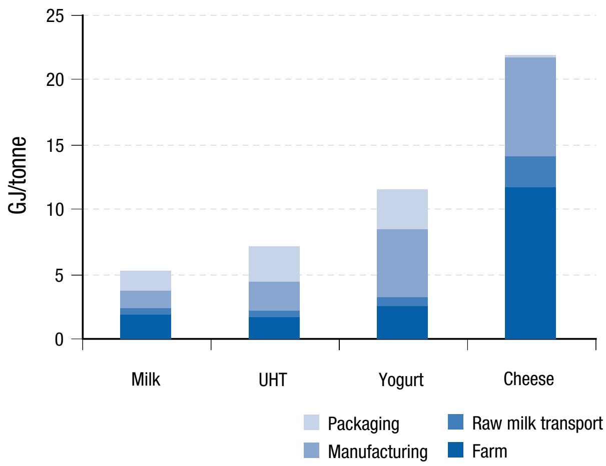


Figure 11

Life cycle water use – market milk manufacturing

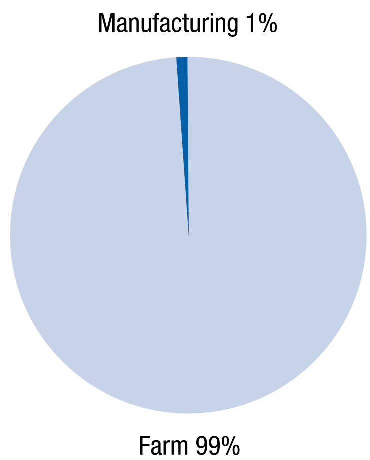
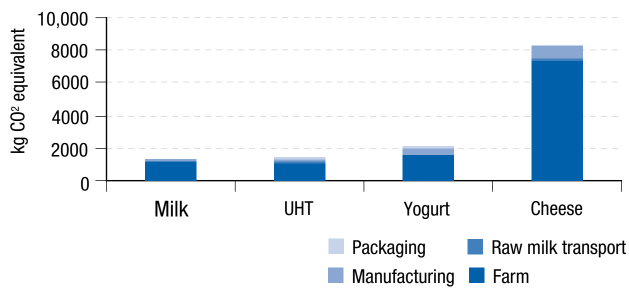


Figure 12

Greenhouse gas emission per tonne product



The dairy industry's greatest environmental impact is in water usage, which is used to produce feed for cattle. This is not a surprising result given that 67% of Australia's water is consumed by agriculture.[9] However there are still many opportunities for reducing water use during dairy processing.

The production of greenhouse gases is largely due to the methane emitted by cattle during rumination. With this aspect removed, opportunities for reducing greenhouse emissions should be focused across the industry, as with energy consumption.

Future initiatives and reports

The dairy industry is pleased to present *State of the Environment Report 2005* to demonstrate its commitment to reducing the environmental impacts of dairy processing. This report is an important benchmark from which the industry can move forward and work towards becoming a genuine leader in environmental sustainability through expertise, drive and passion for excellence.

The formation of the DMSC is testament to this commitment. Projects supported by the council include the completion of an industry social impact report, the development of technical guidelines for water recycling and reuse, a review of energy consumption and greenhouse emissions, and continued research and development in value-adding of bio-solids through the continuation of the work carried out in the Closing the Loop project.

Though there is insufficient data to report fully on environment performance indicators such as solid waste and packaging, the industry, through the DMSC will encourage the collection of this information for inclusion for the next report. It is the intention of the DMSC to develop this report into a holistic sustainability report to be produced every three years. The next *State of the Environment Report* will assess the environmental performance indicators for 2007/08.

Appendices

Glossary

BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
CIP	Clean In Place
CTL	Closing The Loop
DAF	Dissolved Air Flotation
DISC	Dairy Industries Sustainability Consortium
DMEF	Dairy Manufacturers Environment Forum
DMSC	Dairy Manufacturers Sustainability Council
DPEC	Dairy Processing Engineering Centre
EPA	Environment Protection Agency
HDPE	High Density Polyethylene
ISO 9001	International standard for quality management
ISO 14001	International standard for environmental management
KPI	Key Performance Indicator
LCA	Life Cycle Assessment
Mt	Megatonnes, 106 tonnes
PET	Polyethylene
SPA	Sustainable Packaging Alliance

Weblinks

Bega Co-operative Society	www.begacheese.com.au
Bonlac Foods	www.bonlacfoods.com
Burra Foods	www.burrafoods.com.au
Closing the Loop Project	www.dpec.com.au/closingtheloop.php
Dairy Australia	www.dairyaustralia.com.au
Dairy Farmers	www.dairyfarmers.com.au
Dairy Industry Association Australia	www.diaa.asn.au
Dairy Processing Engineering Centre	www.dpec.com.au
Dairy Australia Eco-efficiency Project	www.dpec.com.au/eco_efficiency.html
Murray Goulburn Co.	www.mgc.com.au
National Foods	www.natfoods.com.au
National Packaging Covenant	www.packcoun.com.au
Parmalat	www.parmalat.com.au
Tatura Milk Industries	www.tatmilk.com.au
Warrnambool Cheese and Butter Factory	www.wcbf.com.au

References

1. *Australian Dairy in Focus 2005* www.dairyaustralia.com.au
2. *Australian Food Statistics*, 2005. Australian Department of Agriculture, Fisheries and Forestry. www.daff.gov.au
3. *Australian Dairy in Focus 2003* www.dairyaustralia.com.au
4. National Foods, 2004. Information from Every Drop Counts Program
5. Lundie, S., Feitz, A., Jones, M., Dennien, G. and Morian, M. (2003), *Evaluation of the Environmental Performance of the Australian Dairy Processing Industry using Life Cycle Assessment*, Dairy Research and Development Corporation
6. ETSU 1998, *Reducing energy costs in dairies – a guide to improved profitability, Good Practice Guide 209*, UK Energy Efficiency Best Practice Programme. Oxfordshire
7. Allinson, G. Closing The Loop Project Manager. Department of Primary Industries Queenscliff. graeme.allinson@dpi.vic.gov.au, 03 5258 0111
8. AGO, 2005. *Factors and Methods Workbook*, www.greenhouse.gov.au
9. Australian Bureau of Statistics. *4610.0 – Water Account, Australia*, 2000-01. www.abs.gov.au

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