



AMPC

AUSTRALIAN MEAT PROCESSOR CORPORATION LTD

ANNUAL REPORT TO MEMBERS 2013-14

This **Annual Report to Members** provides a snapshot of AMPC Programs and Projects conducted in the 2013-14 financial year. This Annual Report to Members is a companion to the **Audited Financial Report**.

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CHAIRMAN'S YEAR IN REVIEW



On behalf of the AMPC board I would like to present the AMPC's Annual Report to Members for 2013-14.

This year has seen record slaughter figures for cattle with the ongoing drought in northern New South Wales and Queensland contributing to the

high turnoff and resultant increase in levy fees received by the company. There has also been a significant increase in female slaughter numbers which indicates a substantial level of herd liquidation that will impact on cattle supply in the future particularly in northern Australia.

Strong demand for lamb and favourable season conditions in southern Australia resulted in slaughter numbers of over 21 million head for the second consecutive year. Sheep slaughter numbers also increased especially during the six months from October to March as the hot dry conditions in NSW resulted in a high turnoff. Western Australia also experienced a small increase in slaughter numbers, despite an improvement in seasonal conditions which may indicate a decline in flock numbers going forward.

AMPC's primary function is to provide Research, Development & Extension (RD&E) and Marketing activities on behalf of the red meat processing sector and ensure the long-term sustainability of its members and the industry as a whole. Our members have faced a number of challenges in 2013-14, and one of the most important has been maintaining and improving market access in our key export markets. AMPC continues to provide funding in this area particularly around the development of sound scientific solutions to trade barrier impediments and supporting effective trade reform activities.

One of the other key programs for the year was our investment in the domestic market to ensure increasing demand and meeting consumer expectations were priorities for the red meat sector. Demonstrating the importance of red meat in consumer diets combined with communicating eating quality standards and product consistency were key components of this program. We as red meat processors are familiar with competition and our industry must continue to invest in promoting our products to consumers because consumers have many choices in the protein sector. Maintaining stringent product standards and Quality Assurance systems are

integral to the industry objectives of product integrity, safety and wholesomeness.

We at AMPC recognise the need for our members to remain competitive on the global market, and processing efficiency and productivity are essential ingredients to achieve this. Our expenditure for the year included significant investment in the manufacturing and technology R&D that will hopefully lead to productivity gains in processing costs and the development of new innovative technologies to combat a labour intensive environment.

The Board of AMPC is committed to maintaining effective investment of member's levies that deliver positive outcomes for industry within the tight budgetary constraints of our Annual Operating Plan and three-year Strategic Plan. We also recognise the need to work closely with other industry stakeholders and Government in delivering benefits to our members.

I would like to take this opportunity to thank the AMPC Board, management and staff for their commitment and dedication to the company throughout the year.

Stephen Kelly
Chairman, AMPC

CHIEF EXECUTIVE OFFICER'S YEAR IN REVIEW



This year has seen a major transition in the operations of AMPC. At the direction of the Board and in agreement with Meat & Livestock Australia (MLA), AMPC now not only initiates projects in the core industry portfolio, but also contracts and

manages those projects to completion. The intent of this transition is to provide the Board and members of AMPC with a clearer line of sight on investments and deliverables and ensure substantive impacts are obtained. A transition of projects from MLA to AMPC took place throughout the period. Ongoing contracts were novated with those close to completion remaining with MLA. The operating basis for this new relationship is an AMPC: MLA Management and Relationship Agreement.

In accordance with its new role and operations, AMPC has put in place substantial changes to its business structures and processes to effectively manage projects and generate the annual investment portfolio. Five Core Programs were established (recently merged to four), that are managed by the newly established roles of Program Managers. Those programs are; *P1: Technology & Processing; P2: Environment & Sustainability; P3: Food Safety, Product Integrity and Meat Science; and P4: Implementation, Extension & Education.* It is planned to introduce a fifth program in FY 2014-15 to focus on system wide industry improvement and economic analysis.

Aligned with these Programs is an investment management process based on Program Advisory Committees (PACs). Each PAC comprises around ten elected members from industry with specialised expertise in each program field. Each PAC is chaired by an AMPC Board member and facilitated by an AMPC Program Manager. Invited guests bring additional skills to the table and ensure there is no duplication of investments across industry. This investment process provides a mechanism for broad industry consultation and transparency and was successfully launched in FY 2013-14 to develop a robust research portfolio based on industry needs.

In addition to the new Program Manager roles, AMPC has also recruited specialised expertise in marketing communications and business management in order

to lay the foundation for an overhaul and improvement in research management, business operations and communications to members. I was appointed to the role of Acting CEO & Business Manager in March 2013 whilst Michelle Edge was on parental leave.

As can be seen in the following pages, the scope of AMPC's investments on behalf of red meat processing members is extensive and has yielded important outcomes that are crucial to industry competitiveness and sustainability. These investments are primarily directed at the core program managed by AMPC but also include investments in the joint supply chain program managed by MLA. The joint program includes areas such as marketing and in particular market access, as well as research projects in food safety and product integrity. Notwithstanding the role AMPC has taken on for managing RD&E in the processing part of the supply chain, there remain areas where joint investments with MLA will cover the whole supply chain. An ongoing relationship with MLA is critical to ensure leverage and avoid duplication.

In summary, the changes implemented within AMPC during the last year have set the basis for a dynamic research management company that will operate as a commercially focused business driven by key goals and metrics. That transition is underway and will be substantially complete in the following financial year. It is an exciting time for the industry and for AMPC to deploy, on behalf of its members, world class RD&E and marketing capabilities in support of growth, sustainability and profitability.

Finally, I would like to thank the Chairman and the Board for their ongoing support and insights throughout the course of this year and the dedication of AMPC's staff, including Michelle Edge, in implementing new business operations and in delivering a professional service. Our members are our prime stakeholder and we strive to continually improve on that service. I look forward to continuing to work with you on that mission.

David Lind

Acting CEO and Business Manager, AMPC

INDUSTRY SNAPSHOT AND RESEARCH CONTEXT 2013-14

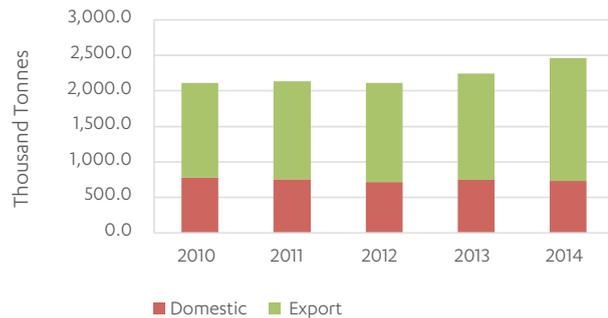
The red meat processing sector is a significant part of the Australian economy and makes a substantial contribution to the nation's wealth and exports. When flow-on effects are taken into account, the industry contributes over \$16 billion in gross domestic product or around 1.2% of total GDP. It also underpins around 140,000 full-time equivalent jobs across all sectors of the economy.



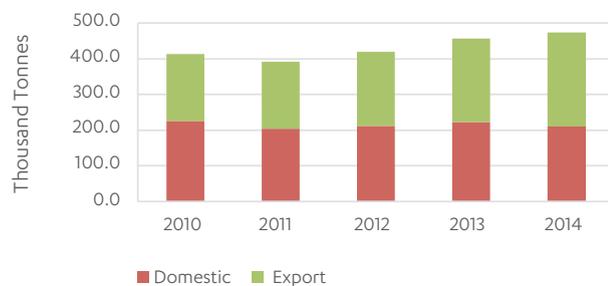
This year has seen a substantial growth in the number animals processed in Australia. In the year ended June 2014, 9.4 million cattle and calves were slaughtered nationally producing 2.5 million tonnes carcass weight of beef and veal. This compares to 2012 when 2.1 million tonnes were produced. For lamb and mutton the story is much the same. In 2014, 31 million sheep and lambs were slaughtered nationally producing 700,000 tonnes of mutton and lamb. Comparable figures for 2012 were 539,000 tonnes. It is unlikely that this will continue into the medium term, and as such any erosion in volume and/or margin will clearly impact profitability. In this environment, innovation will be a key to industry sustainability and prosperity.

The charts below for beef, veal and lamb show the recent strength of demand in export markets.

Livestock Production – Beef and Veal



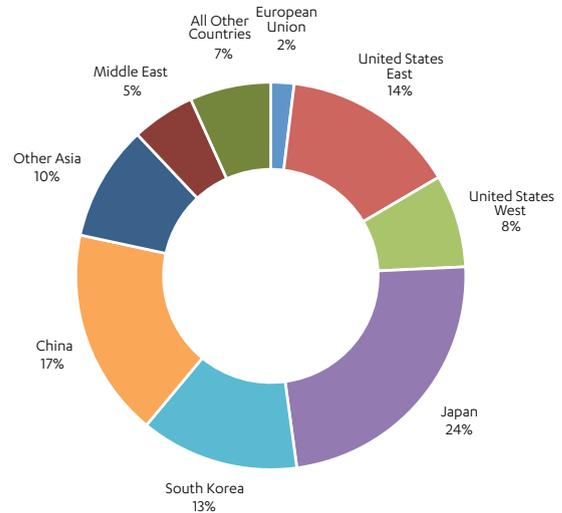
Livestock Production – Lamb



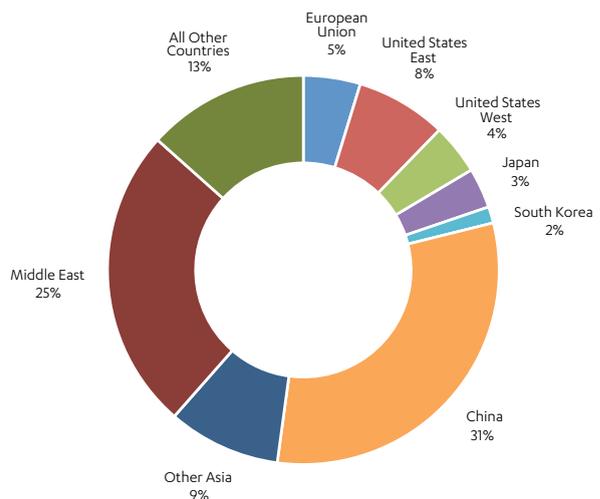
Australian meat processors operate complex businesses in an environment characterised by highly variable inputs and market conditions. Emerging challenges include labour and skill shortages, the high cost of production relative to global competitors, climate change and an increasing regulatory burden. In the face of these challenges, it is essential to deliver innovative tools, products, processes and manufacturing technologies that provide world leading meat processing efficiencies and value capture.

The charts below show the primary export destinations for both beef and sheepmeat in 2013-14.

Exports Countries – Beef



Exports Countries – Sheep



As global competition increases and trade barriers proliferate, it is important for Australian industry to differentiate and market its offerings on the basis of superior value, product quality, product integrity, safety and wholesomeness. These attributes can only be delivered through an innovative capacity that is built on sound and effective research programs and research management structures. The following section describes those structures within AMPC.

AMPC PROGRAM STRUCTURE AND FOCUS FOR THE YEAR AHEAD

The diagram on pages 10 and 11 shows AMPC's program structure and focus following the transition of core processing RD&E management from MLA to AMPC. The company has adopted this structure as the basis for day to day business operations and management reporting. This new structure aligns project delivery with reporting to the Board, communication to members and activities within Program Advisory Committees (PACs).



The program structure shown on pages 10 and 11 will be used in the year ahead to improve portfolio and project management. Within that framework it has been decided to consolidate the *Food Safety, Product Integrity and Market Access Program/PAC* with the *Meat Science & Meat Products Program/PAC*. This new Program/PAC will be called *Food Safety, Product Integrity & Meat Science*. Market access will be dealt with separately. AMPC intends to recruit a Market Access Trade Director in FY 2014-15 who will manage this area in consultation with industry, government, the Australian Meat Industry Council (AMIC) and MLA. This role will focus, in particular, on technical barriers to trade in key export markets such as China and the Middle East.

Each program contains within it a number of program streams which are clusters of common needs or technologies. Program streams may vary from year to year but will most likely remain in place for the medium term planning period of three years. Each program will develop a three-year Program Strategic Plan. Long range strategic planning for AMPC will be conducted through a ten-year Strategic Market Plan (SMP) to 2025. The SMP will be supported by technology roadmaps to describe how plan objectives will be achieved and provide a basis for investments in transformational research. Program Strategic Plans will refer to the existing AMPC Strategic Plan 2013-17 and associated industry plans, such as the Meat Industry Strategic Plan (MISP4).

As indicated in the year in review on page 5, the key objective of AMPC's operations improvement in the year ahead is to ensure that the company operates at high levels of performance and as a commercial business. Research providers will be actively project managed to deliver against milestones that are completed on full and on time. The company will reconfigure its processes for efficiency through work flow management and automation. New financial management, contract and project management, document and client relationship management automation tools will be introduced in FY 2014-15.

Extension and communications will be a key focus area in the year ahead. World class R&D delivery requires outputs which are effectively communicated to members and industry. Face to face extension will continue to be supported through the Implementation, Extension & Education Program. This will however be significantly enhanced by an improved on-line presence involving a range of interactive features. The new platform will enable the communication of targeted email alerts to members, information delivery via mobile devices, videos and regular updates of relevant industry data.

This **Annual Report to Members** is itself an important part of AMPC's communication to its members. The report provides a snapshot of projects that have been conducted during the past year with the intent of helping members to identify those areas of most interest and to encourage engagement with the company. AMPC can provide

additional information and advice in the form of fact sheets, case studies or full technical reports. We are only a phone call or email away and are keen to help members utilise the outcomes from these investments to improve industry sustainability, productivity and profitability.

The following sections describe in detail individual programs and a range of projects that were conducted during the period. I hope you find this report useful and we welcome your feedback at any time. Please contact me or one of the AMPC Program Managers listed on page 51 of this report for further information.

David Lind

Acting CEO and Business Manager, AMPC

AMPC PROGRAM STRUCTURE – FINANCIAL YEAR 2013-14

PROGRAMS

AMPC P1

TECHNOLOGY & PROCESSING

AMPC P2

ENVIRONMENT & SUSTAINABILITY

AMPC P3

FOOD SAFETY, PRODUCT INTEGRITY & MEAT SCIENCE

PROGRAM SUMMARY

Processing technologies that improve efficiency; reduce the cost of production and facilitate improved value capture

Technologies that improve red meat processing industry sustainability regarding environmental, economic and social outcomes

Technologies that enable high standards of food safety, product integrity and improved eating quality

PROGRAM STREAMS

- › Increasing Productivity
- › Improved Carcase Measurement
- › New Meat Products
- › Improved Material Handling Systems

- › Energy Efficiency Systems
- › On Site Energy Generation
- › Water Harvesting & Conservation
- › Solid Waste Management
- › Liquid Waste Management

- › Food Safety
- › Product Integrity
- › Meat Sensing & Measurement
- › Meat Packaging
- › Meat Quality Improvement
- › Meat Storage & Colour
- › Animal Welfare

PROGRAM EXAMPLES

- › Automation & Robotics
- › Manual Assist Technologies
- › Vision & Sensing Systems

- › Energy Efficiency
- › Water & Waste Treatment
- › Processing Sustainability

- › Real Time Pathogen Detection
- › Improved Packaging Technologies
- › Novel EQ Processing Interventions

AMPC P4

**IMPLEMENTATION,
EXTENSION
& EDUCATION**

The effective translation and communication of R&D outputs to stakeholders and the support of key training initiatives

- › Innovative Processes & Employees
- › Upskilling of Process Engineers
- › Attraction/Retention of Employees
- › Professional Development
- › Training & Extension Services

- › Scholarship & Training Networks
- › Marcom (reports, fact sheets etc.)
- › Capability Development Reviews

AMPC P5

**INDUSTRY
IMPROVEMENT &
ECONOMIC ANALYSIS**

New Program for FY 2014-15

Industry analysis, the evaluation of the impact of AMPC investments and mechanisms to improve industry performance

New Program for FY 2014-15

- › New Program for FY 2014-15

- › New Program for FY 2014-15

MLA JOINT PROGRAM

**MARKETING &
MARKET ACCESS**

Marketing and market access initiatives that provide growth opportunities in both domestic and international markets.

PROGRAM 1: TECHNOLOGY AND PROCESSING

PROGRAM 1: TECHNOLOGY AND PROCESSING

About the Program:

The objective of the Technology and Processing Program is to develop processing technologies that improve efficiency, reduce the cost of production and facilitate improved value capture.

The program operates across four program streams:

Program Stream 1: Increasing Productivity

Productivity growth and the ability to respond quickly to changing economic conditions are essential to maintaining industry competitiveness. Innovation and capability development are recognised across industry as underpinning productivity gains. This stream focuses on developing and implementing new products, processes and innovative technological solutions to improve business productivity and sustainability.

Program Stream 2: Improved Carcass Measurement

This stream focuses on research into the automatic measurement of key carcasses characteristics 'in-situ and on-line' in order to drive automation and increase processing efficiency and productivity. Multiple technologies are currently being investigated for different measurement targets. Many of the objective carcass measurement (OCM) technologies under evaluation have the potential to be used as visioning and sensing devices to drive higher levels of automation.

Program Stream 3: New Meat Products

The focus of this stream is to align new product innovation with the needs of customers and trading partners. It specifically focuses on assisting industry to identify market opportunities for lower value meat cuts and co-products, as well as developing a capability to access novel markets and value chains and create advanced technologies that maximise value.

Program Stream 4: Improved Material Handling Systems

The introduction of automated and robotics systems can reduce the number of operators required to perform material handling tasks and can deliver significant productivity gains in improved throughput, reduced product damage and loss, and enhanced product traceability. This stream focuses on building an effective portfolio of R&D investments in product handling. The portfolio consists of analysis and benchmarking of industry needs, identification of technological challenges and development of appropriate solutions.



PROGRAM 1: TECHNOLOGY AND PROCESSING

Project highlights: FY 2013–14

The following section highlights examples of projects conducted during the period.



Ovine shoulder break-up – stage two (2013/9219)

This project aimed to eliminate operator contact with bandsaws by developing a low-cost machine to break up lamb shoulders. The first stage of the project involved the capture of data to design and engineer a solution and the successful development of a prototype.

The objective of the second stage was to develop a stand-alone system for breaking up shoulders using the knowledge gained from stage one. The key was to develop a machine that was safe and easy to use, based on a simple process for loading and cutting, and adaptable to the variable size of primal shoulder pieces.

Stage two comprised of two steps: firstly the prototype machine was upgraded so that it could perform production trials in Australia; followed by research into the important aspects of reliability, blade life and life-cycle

assessment. A cost–benefit analysis was undertaken to determine the extent to which such a machine could add value to a processor’s business. An Australian processing plant conducted successful trials of the machine, which is now being developed for commercial use.

Automated container loading – stage one (2013/9201)

The majority of Australian meat is exported in cartons and packed in refrigerated shipping containers. This shipping method presents a number of challenges relating to workplace health and safety (WHS), damaged products, and inventory management and traceability. There are already semi-automated or load-assistance devices available for packing frozen cartons into containers; however, the majority of Australian processing and logistical systems require an alternative solution, particularly when packing meat cartons into containers prior to export.

PROGRAM 1: TECHNOLOGY AND PROCESSING

Project highlights: FY 2013–14

Chilled meat and frozen products present different practical challenges in relation to packing and load out. As such, this project was initially designed to deal with chilled products only. The project involved the development of design concepts and the management of prototype trials for an automatic system that loads chilled cartons into containers. The objective was to demonstrate the effectiveness of the solution under case-study conditions.

In the prototype system, the cartons move along a traversable conveyor belt fixed to a custom-built automated delivery system, which scan carton barcodes so they can be traced later and the load confirmed. The cartons undergo 3D profiling to detect bulges before a robot unloads them from the conveyor and stacks them into transport containers in the required pattern. The robot and conveyor system move in and out of the container and the cycle is repeated until the container is full.

As part of stage two, which is currently underway, the system is being reviewed in the context of material handling processes, inventory management requirements and related activities across a range of processing plants. Under these different conditions, system activities such as palletising, de-palletising, mixed-pallet sorting, mixed-pallet order picking and container loading will be varied to determine how the system can be most effectively integrated into each situation.

Determining intramuscular fat (IMF) in lamb (A.TEC.0096)

IMF accounts for up to 15% of the variation in palatability of beef, but it also greatly influences consumers' estimation of the quality of lamb. It is thought that a minimum level of 4–5% IMF is required for consumers to be satisfied with the lamb palatability. As such, it would be useful to have a method of rapidly and non-destructively determining the IMF% of a cut before sale. This would enable better quality control; provide a basis for marketing the cut in a targeted manner or value adding to certain cuts and allow processors to give suppliers feedback about the quality of product supplied.

This project investigated whether CT scanning could be used to measure IMF% in lamb meat, with the objective of determining:

- › whether there is a relationship between CT scan characteristics and IMF% in lamb meat

- › whether this relationship is consistent across a range of muscles within the carcass
- › how consistently IMF is distributed throughout other muscles in the carcass
- › whether this distribution is influenced by carcass Australian Sheep Breeding Values.

Results showed that a single measurement of IMF% taken from the *M. longissimus lumborum* in a lamb carcass is likely to be an adequate predictor of IMF% within the rest of the carcass. CT scanning can also predict the IMF% of individual muscles in the carcass, but at a relatively low level of precision. The majority of IMF% variation between muscles is usually based on knowledge of the muscle type alone; however, if this knowledge is used in conjunction with pre-slaughter information and carcass measurements, particularly CT-measured IMF%, the prediction of IMF% is greatly enhanced.

PROGRAM 1: TECHNOLOGY AND PROCESSING

Summary of other projects: FY 2013–14

The following table summarises examples of other program projects undertaken during FY 2013–14.

Project name	Project summary
Beef spinal cord removal (2013/5043)	This project focused on developing an automated, robot-operated method of removing the spinal cord from beef carcasses, replacing current manual operations. The solution was required to address the key requirement of consistently and fully removing spinal cord material, including dura mater, throughout the entire length of the spinal cord. It also needed to ensure the correct disposal of specified risk material (SRM), avoiding contamination during the pre-inspection slaughter process, and an ability to accurately detect the spinal cord profile prior to removal using suitable tools. The project report made a number of recommendations regarding the further work required to address known technical challenges for cord removal, and to strengthen the case for the development of a commercial solution.
Review of current developments and future R&D opportunities for lamb french-racking (2013/5013)	French-racking of lamb involves removing the meat, fat and intercostal membranes that connect individual rib bones. Currently Australian and New Zealand processors convert 80% of their product into frenched racks. This project reviewed previous french-racking investments and current proposals, and provided a summary report on outcomes achieved to date, remaining gaps, and future needs in this important area. Further research will include industry member surveys and needs analyses, including an assessment of the costs and benefits of different french racking technologies and the effect of gaps in available technology.
Review of picking and packing (2013/9203 – A.TEC.0093)	<p>Australian red meat processing facilities are experiencing increased logistical congestion in the sorting, packing and cold storage stages, which in turn increases labour requirements, operational constraints, and potential WHS risks to employees. A review identified challenges and opportunities for selecting and packaging ('picking and packing') carcasses, post-boned meat and sliced products. The review identified a list of priority tasks; conducted a detailed analyses of solutions that processors need or are seeking to adopt or adapt; and considered existing commercial technologies.</p> <p>The review analysed and benchmarked areas of industry need, identified potential technological solutions relevant to these needs, quantified the likely developmental challenges and conducted cost–benefit analyses for different approaches.</p> <p>A further four projects – established together with major technology providers and conducted concurrent to the review – examined specific engineering concepts that could address challenges associated with materials handling. Each provider worked with a partner meat processing plant to select a specific materials handling challenge and then designed a concept to enhance the practice at that site. The result was a series of systems that can automate identified product sorting and packing tasks, such as identifying primal cuts, or collecting and packing cuts into specific product cartons. The next phase of this work will focus on engineering selected solutions for commercial trials, and conducting cost–benefit analyses to determine feasibility for wider industry uptake.</p>

PROGRAM 1: TECHNOLOGY AND PROCESSING

Summary of other projects: FY 2013–14

Project name	Project summary
Scribe assist – feasibility (2013/9211 – A.TEC.0087)	<p>Beef scribing is one of the first processes completed within the beef boning room. Scribing is performed on beef primals and so must be performed by highly skilled operators to avoid small errors in accuracy that may significantly affect yield. The weight of the scribing saw, the position and orientation of the scribing locations and the danger of the rotating blade can lead to operator strain, fatigue and potential injury. In most cases, due to the inertia of the saws used for scribing, only larger and stronger operators are capable of maintaining their composure for extended periods while performing the task.</p> <p>This project investigated the potential for developing a manual-assist device based on the existing HookAssist® platform previously developed, to remove components of the task that cause strain and fatigue. The results of this research concluded that this approach has merit, and that a commercial manual-assist beef-scribing device could be effectively implemented under current production conditions and processes.</p>
LEAP cost benefit analysis (2013/9601 – A.CIS.0034)	<p>This project involved a third-party evaluation of the value proposition for a range of automated boning-room products. The evaluation reviewed and quantified the theoretical and actual benefits of different LEAP modules, and in collaboration with lamb processors considered the potential installation of these new technologies.</p>
Shoulder puller cost benefit analysis (A.TEC.0090)	<p>This report provides a cost–benefit analysis for a variable independent path (VIP) lamb and sheep shoulder puller. This machine is installed at a lamb processing facility, replacing a manual-load version of the same shoulder puller. Labour-related savings are the greatest benefit of installing this piece of equipment. The processor was able to reduce labour by three full time–equivalent (FTE) staff members compared with the fully manual pelt-removal operation. Some of the overall benefit was however diminished due to the lower quality of some pelts. This issue could be addressed by careful development and more a consistent supply of lambs.</p>
Lamb chining comparison (2013/9205 – A.TEC.0104)	<p>This project assessed four alternative equipment solutions for removing ovine chine bones in Australia and compared them against a baseline of the current manual operation. The four technologies are the LEAP IV chining module, and three semi-automatic options currently available or under development.</p>
Research into a saw blade–resistant glove (A.OHS.0061)	<p>Bandsaws are a standard technology for cutting warm and chilled meat; however, they pose a significant WHS risk. Currently, there are limited suitable personal protection devices, such as gloves or gauntlets suitable for bandsaws and, where these are available; there is a need for wider uptake within the industry.</p> <p>This project sought to develop a range of cost-effective solutions that could be adopted industry-wide. In addition to examining glove-based solutions, the two providers involved in the project looked at alternatives that included minimal cost in retro-fitting machinery (such as lasers), or areas of new technology that are used in other industries, show promise and could be successfully adapted for use in meat-processing plants. The providers developed information and options on a range of solutions, including polyurethane mesh gloves, fluorescing gloves, glove- and hand-position sensors, monitoring solutions that manage fatigue, adaptive saw blade technologies, machine-stop devices, ergonomic studies, new designs for a protective glove and testing programs. The next steps involve determining an optimal solution(s) to pursue for further research, and providing guidelines to industry on the current and emerging options for replacing bandsaws.</p>

PROGRAM 1: TECHNOLOGY AND PROCESSING

Summary of other projects: FY 2013–14

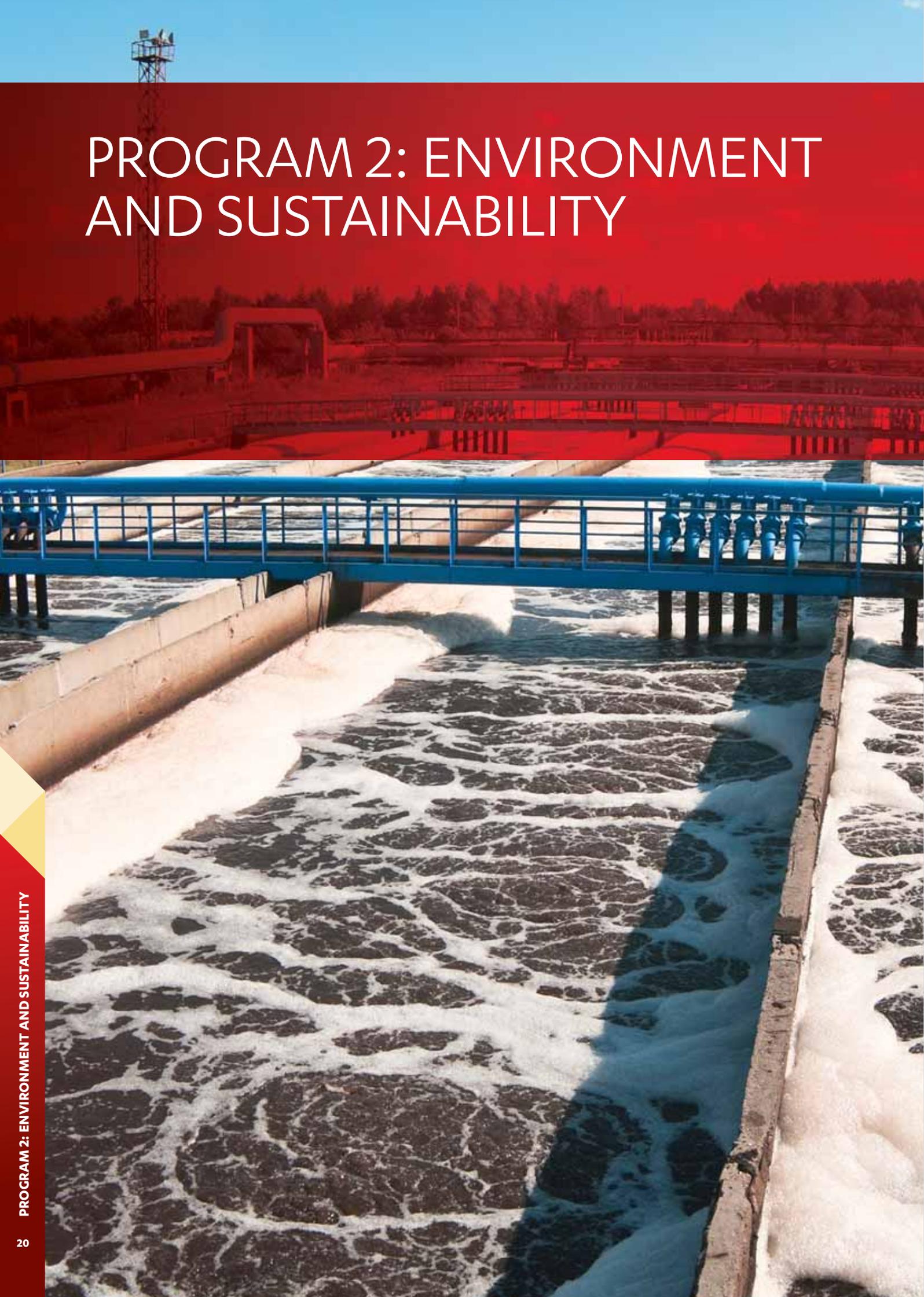
Project name	Project summary
<p>A predictive model (and tool design) for firm-level cost-benefit assessment when purchasing and implementing new processing technologies (2013/1028)</p>	<p>This project sought to broaden the assessment of available individual cost benefit analyses for new processing technologies, to provide industry-average figures that can then be incorporated into a more generic model. The idea is that by gathering additional data it will be possible to cross-reference similar technologies and develop a generic, user-friendly model the industry can use to assess prospective investments in automated technologies.</p> <p>Industry participants can use the model(s) that have been developed to assess the potential impact of installing Technology A on their 'bottom line', or to compare the effects of Technology A versus Technology B based on average industry standards derived from the data collected.</p>
<p>Integrating new meat processing technologies in a commercial setting – A resource kit for processing engineers – New technologies and their adoption within the plant (2013/5004 – A.TEC.0118) (2013/5001 – A.TEC.0119)</p>	<p>Numerous red meat processors in Australia have developed and integrated a wide range of processing, slaughter and automation technologies, including specialist machinery and robotics. The integration of these technologies presents many challenges, some of which are often unforeseen prior to the decision to implement a new technology within the plant. Many technology providers already publish guidelines on the specific engineering solutions that accompany their ongoing service support for the industry.</p> <p>This project developed a resource kit to underpin relevant (or new) engineering- and maintenance-related units in the MTM11 Australian Meat Industry Training Package, which are undertaken by engineers, plant supervisors, and maintenance or processing personnel. The resource kit assists processors by identifying the correct and appropriate preparatory considerations when implementing a new technology or automation solution, and outlining the methods for assessing, mitigating and addressing related key challenges.</p>
<p>IFFA study tour (A.TEC.0115)</p>	<p>This project supported a group of AMPC members attending IFFA, one of the largest international meat processing trade shows, in Frankfurt, Germany, as well as a broader study program involving visits to providers, processors and other key stakeholder sites in Europe to discuss technology approaches and strategies, and to view new innovations. The IFFA event showcased new technologies and automation products, and included a wide range of exhibits covering slaughtering, carcass break-up, further processing, weighing, packaging, conveying, cooling, storing and transportation. It also featured a wide variety of value-adding processes such as manufactured meal components, pre-cooked products, and small goods that use spices and additives, all destined for the retail and food service markets. This project allowed Australian processors to engage with key stakeholders in the European Union, to examine their specific approaches to technology development and other solutions; to assess whether these are applicable to Australian conditions; and report on their findings in a manner that will inform industry strategy for future investment.</p>

PROGRAM 1: TECHNOLOGY AND PROCESSING

Summary of other projects: FY 2013–14

Project name	Project summary
Bandsaw benchmarking (2013/9212 – A.TEC.0098)	<p>The bandsaw benchmarking project analysed, described and quantified the use of bandsaws to process lamb, sheep, goat and beef across the industry; benchmarked current practices; and identified and evaluated available and potential solutions. The project described benchmarks relating to impacts on yield and efficiency, as well as aspects of guarding, and the use of jigs and other bandsaw adaptations. Processing plants are already successfully using a range of simple and cost-effective solutions. AMPC is now working with MLA and individual companies that hold contracts and intellectual property for existing solutions, to make sure these are incorporated into resources that support the development of industry guidelines. This will include examining opportunities for producing and selling in-house solutions under licence. The project has also considered existing investments in more advanced technologies such as blade-stop and other engineered solutions that may need further RD&E before they are ready for sustainable long-term use. Using bandsaws wastes meat and bone in the form of dust generated by the grinding action of the saw blade cutter tips. Addressing identified issues and opportunities in relation to bandsaw use involves action in the following areas:</p> <ol style="list-style-type: none">1. Best practice: Improving work flows, processes, training, awareness and alertness2. Protective devices: Using blade stops and protective gloves3. Jigs and fixtures: Using the jigs and fixtures that have already been developed, trialled and implemented4. Semi-automation: Using Whitman devices and other systems5. Automation: Using robotic ovine cutter and the LEAP systems <p>Significant scope exists for automation, especially in lamb processing. There is also ample opportunity to apply existing technology or develop new devices to achieve the ultimate goal of eliminating bandsaws.</p>

PROGRAM 2: ENVIRONMENT AND SUSTAINABILITY



PROGRAM 2: ENVIRONMENT AND SUSTAINABILITY

About the Program:

The objective of the Environment and Sustainability Program is to develop technologies that improve industry sustainability in terms of environmental, economic and social outcomes.

The program operates across five program streams:

Program Stream 1: Energy Efficiency Systems

Red meat processing requires significant amounts of energy, which is ordinarily derived from the grid (electricity or gas), liquefied petroleum gas, coal, or oil/diesel. Energy is a major input and expense, as well as a source of greenhouse gas emissions. Major energy consuming activities include refrigeration and the production of steam and hot water. Less significant amounts of energy are used for processes such as lighting, ventilation, compressed air systems, motors and pumps. There is a large variation of energy usage across processing sites due to a range of factors such as the different ages and sizes of plants, different processing configurations, and the types of species processed (i.e. beef or sheep).

This stream focuses on generating innovative concepts and processes to reduce energy consumption at the site level (i.e. total energy consumption), as well as the energy intensity of red meat processing operations (i.e. energy consumed per unit of output).

Program Stream 2: On Site Energy Generating Systems

Increasingly, red meat processing facilities are exploring how to utilise available on site energy sources instead of relying on energy supplied externally. Drivers include rising energy prices, continued advancements in renewable energy technology, a desire for increased energy security and independence, and an ambition to maintain and enhance the industry's clean and green image by reducing greenhouse gas emissions.

This stream focuses on technologies that enable facilities to harness available on site energy sources such as methane (from solid and liquid waste treatment systems), solid biofuels (from paunch waste, sludge, or manure), liquid biofuels (from tallow), solar energy, geothermal energy, and wind energy.

Program Stream 3: Water Harvesting & Conservation Systems

Water is primarily used in red meat processing to ensure food safety and hygiene during operations. The primary source of water originates from mains water (town or bore) or nearby water bodies (rivers, or dam etc.). Constraints such as availability and cost are forcing processing plants to reduce consumption and consider new sources. However, current food safety requirements, particularly for export registered facilities, limit water recycling.

This stream focuses on technologies that will deliver a reliable, safe and affordable supply of water to red meat processing operations and includes water harvesting (i.e. use of alternative water sources such as rainwater and geothermal systems), reuse (i.e. reuse of water captured within the facility before it is sent to the wastewater

system), and recycling (i.e. treating and recycling wastewater for non-potable uses such as cattle wash) systems. Central to this stream is the need to ensure food safety standards are maintained, and this is factored into all research activities.

Program Stream 4: Solid Waste Management Systems

Red meat processing results in the production of a range of organic and inorganic solid wastes, including fats, oils, greases, manure, paunch, and sludge, as well as plastics and inorganic compounds. The majority of waste solids are organic in nature and are recycled by rendering and composting processes, or through reuse in land rehabilitation schemes. The disposal of solid waste can be costly, therefore processing facilities are incentivised to reduce waste production and consider alternative treatment and recovery options. This includes energy recovery (solid and liquid biofuels), nutrient recovery (nitrogen, phosphorous and potassium), composting and vermiculture, bioactives for pharmaceuticals and nutraceuticals, and ingredients for biodegradable plastics and food products.

This program focuses on technologies to reduce, reuse, recycle, and dispose of organic and inorganic solid waste in a way that minimises the impact on the environment, decreases waste management costs, and generates additional revenue streams through product recovery.

Program Stream 5: Liquid Waste Management Systems

Red meat processing plants generate large quantities of wastewater which requires varying levels of treatment prior to disposal to land or waterways. Sources of wastewater include stockyards, slaughter areas, offal processing areas and rendering processes. Depending on plant configuration, these sources can result in varying amounts of blood, fat, manure, meat, paunch and detergents entering the wastewater treatment system if not captured at the source and diverted into the solid waste treatment system. Wastewater constituents contain varying amounts of organic materials (such as nitrogen, phosphorous, salt, etc.), micro-organisms, and minor traces of chemicals (from cleaning processes) and heavy metals. Red meat processing wastewater can generate methane which is a valuable energy source and a greenhouse gas. The primary option available to the processing sector in reducing greenhouse gas emissions is generating energy on site through methane capture and use.

This stream focuses on technologies impacting liquid waste reduction, reuse, recycling and disposal in order to reduce the impact on the environment, reduce waste management costs, and generate additional revenue streams through product recovery. Product recovery can be in a number of forms including energy (methane) recovery, nutrient (nitrogen, phosphorous and potassium) recovery, bioactives and ingredients for biodegradable plastics and food products.

PROGRAM 2: ENVIRONMENT AND SUSTAINABILITY

Project highlights: FY 2013–14

The following section highlights examples of projects conducted during the period.



NGERS and wastewater management mapping wastewater streams and quantifying the impacts (A.ENV.0151)

This project identified the key contributors to waste stream loads and resources at abattoirs, including thermal, energetic and chemical factors. The project was developed in response to an identified lack of knowledge about the energy and nutrient analysis needed to guide informed decisions about building wastewater infrastructure at abattoirs.

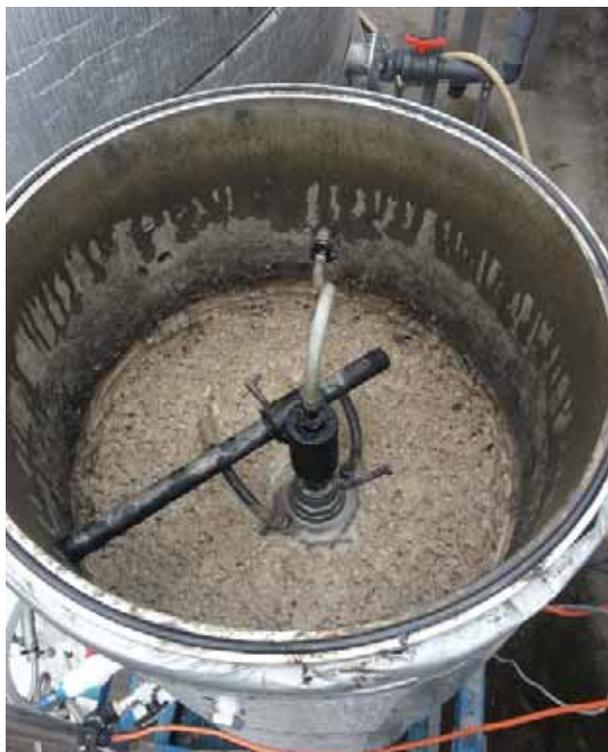
The composition of individual wastewater streams varied depending on the source within the slaughterhouse, and ranged from low strength (boning) to very high strength (rendering) with total chemical oxygen demand (TCOD) of more than 70,000 mg.L⁻¹. There were also large differences in the concentrations of key nutrients nitrogen (N), phosphorus

(P) and potassium (K). Biochemical methane (CH₄) potential (BMP) varied from 250–300 L CH₄ kg VS⁻¹ for cattle yard and paunch wastewater, to 500 L CH₄ kg VS⁻¹ for slaughter floor wastewater and more than 1,000 L CH₄ kg VS⁻¹ for rendering wastewater. However, there were also indications of oil and grease inhibition when treating rendering wastewater. Rendering and paunch wastewater were concentrated resource streams that contribute up to 75% of the methane potential, and phosphorus and potassium loads in only 20% of the volumetric flow. Compared to the final effluent, phosphorus was two to four times more concentrated in the rendering and paunch wastewater streams. These concentrated streams provide opportunities to enhance the recovery of nutrients using crystallisation technologies. The project report recommended capturing nutrients at the source and using specialised primary treatment of individual wastewater streams.

PROGRAM 2: ENVIRONMENT AND SUSTAINABILITY

Project highlights: FY 2013–14

Nutrient recovery from paunch and DAF sludge digestate (2013.4007)



This project examined nutrient recovery from dissolved air flotation (DAF) sludge and paunch waste digestate using in-vessel digestion technology, instead of conventional approaches, such as mechanical aeration. The work was conducted in collaboration with the Grains Research and Development Corporation (GRDC), using struvite recovery technology to obtain nutrients from meat processing wastewater.

Requirements for wastewater filtration, struvite precipitation and product recovery from pilot-scale in-vessel digester technology were examined and trialled at two beef abattoirs. Phosphorous recovery trials were conducted on anaerobic lagoon effluent at each abattoir.

A pilot plant has now been in operation at a large beef plant in Southeast Queensland for 12 months, and has produced more than 50 kilograms of crystallised fertiliser product (struvite) from crusted anaerobic lagoon effluent.

The nutrient recovery process includes three steps:

1. Aeration to increase the pH prior to precipitation and to reduce chemical consumption
2. Crystallisation of nutrient products
3. Overflow into tanks for product recovery.

The crystallisation process was highly effective, with a soluble phosphorous concentration of 6 mg.L^{-1} in the process effluent, indicating that 80% of the phosphorous was precipitated. The final project report includes an analysis of the recovered product composition and quality.

The pilot plant treated 1,500 litres of wastewater per day and precipitated 26 mg.L^{-1} P. This corresponds to struvite production of 400 g.d^{-1} ; however, only 300 g.d^{-1} struvite was harvested from the process, indicating that a portion of the precipitate was lost in the effluent. This has been identified as an area for subsequent optimisation work. The granulated struvite is now being used in several crop growth trials as part of GRDC's associated activities.

High-rate aerobic treatment combined with anaerobic digestion and ANAMMOX – Year 3 (2013.4006)

This project involves an evaluation of new technologies for maximising chemical oxygen demand (COD) and nutrient removal, whilst minimising the energy required in treating meat processing wastewater. Although this project focuses on developing and demonstrating the process on a laboratory scale, it will identify major design and performance parameters essential for evaluating the suitability and economics of the process at full scale.

Key objectives are to confirm the design, operating and performance parameters for this innovative technology, which could provide an economic alternative to current treatment options in situations where nutrient removal is important and/or there is limited space for treatment to occur. That is, where anaerobic lagoons and sequencing batch reactors (SBRs) are not an ideal option.

The project forms part of a three-year collaboration with the Advanced Water Management Centre at the University of Queensland. Previous research saw the integration of two separately evaluated processes – high-rate aerobic treatment and anaerobic sludge digestion – together with a newly established biological process for nitrogen removal from wastewater sludge dewatering liquor.

PROGRAM 2: ENVIRONMENT AND SUSTAINABILITY

Project highlights: FY 2013–14

The high-rate aerobic treatment stage has shown an unexpected and promising ability to remove phosphorous, and the anaerobic digestion stage produces a highly digestible sludge.

A lab-scale solids bioreactor (SBR) is being operated with a two-day solids retention time (SRT) and half-day hydraulic retention time (HRT) to further characterise the high rate of phosphorous removal. The investigation is currently focused on functional micro-organisms mediating the phosphorous removal at two days SRT.

The characterisation of phosphorous removal at two days SRT is ongoing with the next stage being to optimise the SBR cycle by adjusting the ratio of anaerobic to aerobic zones,

and thus maximising the efficiency of phosphorous removal. In the meantime, research will investigate the biochemical transformations involved in the phosphorous removal process.

Future work will focus on understanding key microbial functions through metagenomic analysis, based on the detection of specific functional genes (such as the *ppk1* gene for polyP, the *phaC* gene for PHA). Metabolic models of key populations in the polyphosphate-accumulating organism (PAO) communities will then be constructed. This information will support in-depth understanding of the whole ecosystem involved in the high-rate phosphorous removal process, allowing researchers to improve the functional stability of the process.



PROGRAM 2: ENVIRONMENT AND SUSTAINABILITY

Summary of other projects: FY 2013–14

The following table summarises other examples of environment and sustainability projects undertaken during FY 2013–14.

Project name	Project summary
Effect of rendering-blood processing on abattoir waste and emissions (A.ENV.0152)	<p>Waste streams from rendering and blood processing operations contain environmental pollutants that need to be removed by effluent treatment. These streams also contain protein, other solids and fats, which represent product losses. These losses are not necessary and are fully contained in products at independent renderers.</p> <p>This project aimed to benchmark the composition of rendering plant waste streams and identify strategies to reduce the contribution of waste streams to environmental loads and product losses. Pollutants and product losses in waste streams were quantified at wet- and dry-rendering plants, and associated blood-processing operations.</p>
Anaerobic digestion of paunch and DAF sludge (A.ENV.0155)	<p>Management of paunch waste and DAF sludge have been identified as key issues in the Australian red meat processing industry. Both paunch waste and DAF sludge are large by-product streams and represent a substantial potential source of energy and nutrients.</p> <p>This project involved operating a pilot-scale in-vessel anaerobic co-digester unit fed using paunch waste and DAF sludge at a large meat processing plant. The results of the previous project (A.ENV.0119) showed a high degree of degradability in the paunch solids (more than 60%), such that around 20% of the plant heating requirements could be generated from the paunch waste. Although the demonstration plant has previously proven the technology, this project was conducted to provide more certainty around operational performance and to increase usefulness to processors by maximising space loading (decreasing capital costs); evaluating the impact of anaerobic digestion on dewaterability and other factors (such as viscosity); and exploring co-digestion as a strategy to boost biogas yield.</p>
Integrated agri-industrial wastewater treatment and nutrient recovery – Year 2 (A.ENV.0149)	<p>Australian red meat processors generate large volumes of wastewater rich in organic contaminants and nutrients, and are therefore strong candidates for treatment processes aimed at recovering energy and nutrient resources. Traditional lagoon-based treatment processes are limited by large footprints, poor gas capture, poor odour control, limited ability to capture nutrients, and expensive de-sludging operations. This has led to an emerging and strong case for reactor-based technologies. Anaerobic membrane bioreactors (AnMBRs) are in-vessel anaerobic digesters that use diffusive membranes to retain almost all suspended solids within the process. This is an attractive option for replacing lagoons due to the excellent effluent quality, high tolerance to load variations, and ability to produce a solids-free effluent for reuse.</p> <p>This project is focused on developing and optimising AnMBR technology for the red meat processing industry. It forms part of the three-year collaboration with the Advanced Water Management Centre at the University of Queensland.</p>

PROGRAM 2: ENVIRONMENT AND SUSTAINABILITY

Summary of other projects: FY 2013–14

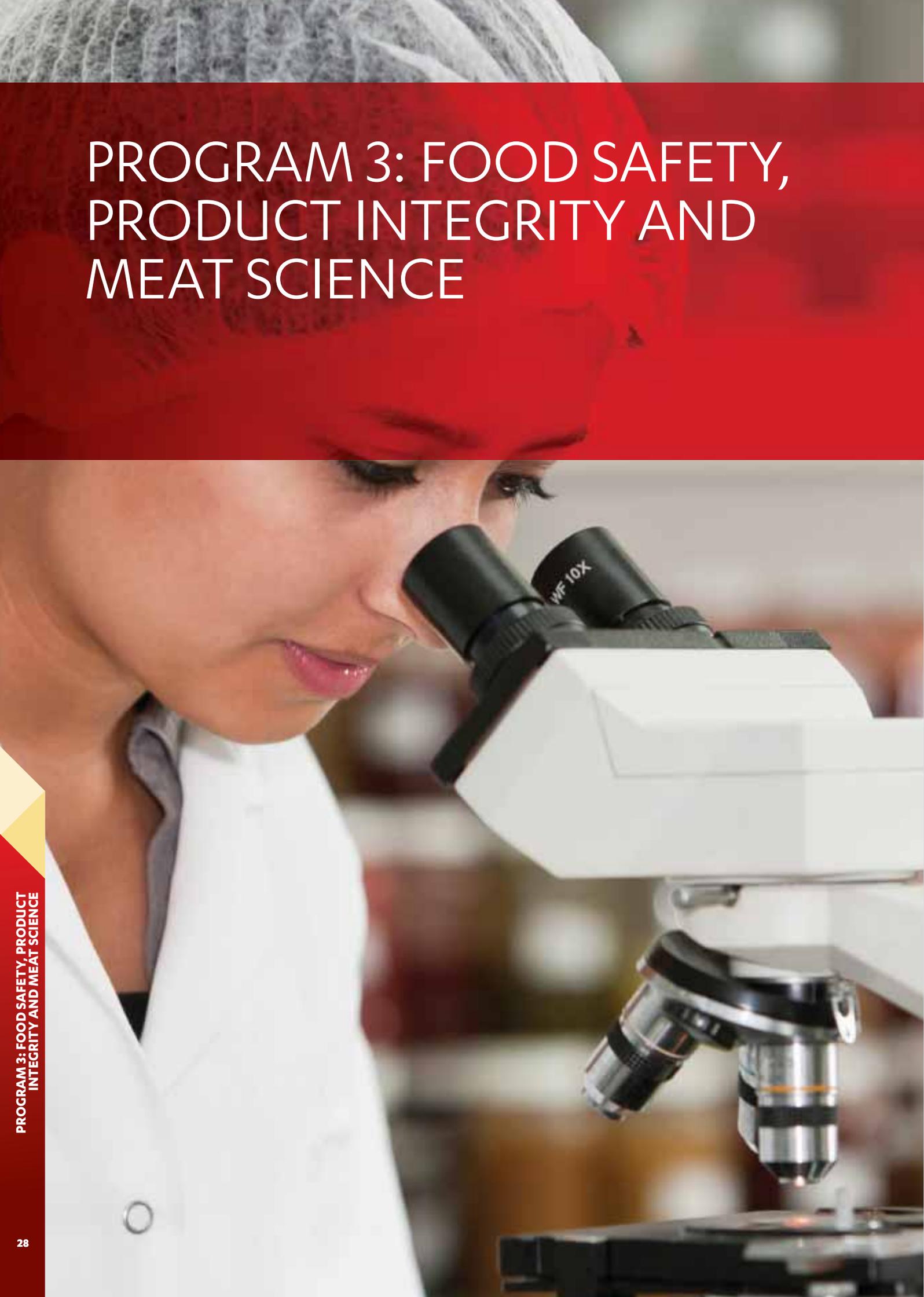
Project name	Project summary
<p>Torrefaction of animal waste for beneficial use, to reduce emissions and costs (2013.3009)</p>	<p>Rising costs of energy, waste management and sustainability issues pose significant challenges to the red meat industry. The industry must find new ways of mitigating costs and managing animal wastes in sustainable, energy-efficient ways, and developing by-products for beneficial use.</p> <p>Torrefaction is a low-oxygen thermal degradation process. When applied to organic waste it has the potential to produce renewable energy and fertiliser products. However, the technology is relatively unknown in the Australian red meat processing industry and additional research is needed to prove its value proposition.</p> <p>A number of key features and advantages make torrefaction attractive for processing organic waste into products for beneficial use. Previous RD&E activities undertaken within the meat industry have focused on converting manure and paunch into biofuels using conventional steam-drying and pyrolysis techniques, as well as composting.</p> <p>This project involved a feasibility study into the application of torrefaction technology at red meat processing facilities. Paunch waste, manure and sludge from an anaerobic digestion process were passed through the torrefaction process so researchers could assess the economic and environmental value of the output, and the technical feasibility of using the technology in commercial abattoirs.</p>
<p>Renewable energy options for off-grid red meat processing facilities (2013.3010)</p>	<p>Long-term energy costs and security at red meat processing facilities can be better managed using alternative energy resources. Many renewable energy resources such as solar and wind have no associated input fuel cost. Other fuel options use waste products associated with the meat processing industry.</p> <p>This project considered the feasibility of one approach to address these challenges by making a facility energy self-sufficient (that is, removing the need for any external energy sources such as grid electricity, mains gas, coal, oil, etc) by using the low- and zero-carbon energy sources available onsite or near the site, or via offsetting arrangements.</p> <p>One area that has not been fully explored is the role that energy storage can play in maintaining supply when the energy resource is unavailable, or intermittent (as is the case for solar photovoltaic energy). This will be an important factor in considering whether abattoirs can be self-sufficient in meeting their energy needs.</p> <p>The project involves a literature review and desktop study into the feasibility of taking a small, medium and large abattoir 'off-grid' and making it self-sufficient in terms of energy.</p>
<p>Emissions reduction fund briefing and opportunity analysis (2013.5044)</p>	<p>The Australian red meat processing industry already has access to technologies for reducing energy use and managing waste. The challenge is to select optimised solutions that meet required economic constraints. With that in mind, the proposed Emissions Reduction Fund (ERF) provides an additional revenue stream for 'new' energy efficiency and greenhouse gas (GHG) emissions offsets.</p> <p>This project analysed a number of efficiency and emissions offset projects. The results are presented in the form of a marginal abatement cost curve (MACC), which presents the dollar (as a cost or saving) per tonne of carbon dioxide equivalent (t CO₂-e) abated; and an energy cost curve (ECC), which presents the dollar revenue or savings per kWh generated for power projects, and dollar revenue or savings per gigajoule of heat generated for process heating projects. The research takes a 10-year life cycle approach, which estimates capital costs, operating costs and maintenance costs, and revenue/savings for power, heat, waste management and the ERF (where indicated).</p>

PROGRAM 2: ENVIRONMENT AND SUSTAINABILITY

Summary of other projects: FY 2013–14

Project name	Project summary
<p>Opportunities for using recycled water for sustainable food production and manufacturing (A.ENV.0142)</p>	<p>This project identified water-recycling opportunities in the agri-food industry through an integrated systems analysis and technology assessment. The effort focused on addressing current industry challenges including regulatory and policy pressures; developing strategies to increase acceptance by recycled-water consumers, enhancing the sustainability positioning with customers and consumers; evaluating economic and higher-value propositions; and applying new technologies and risk assessments to enable broader and increased implementation of new technologies.</p> <p>The project involved a cross-sector approach, and conclusions that address water-recycling interests with stakeholders in meat, dairy, horticulture, and broader food manufacturing and retail industries.</p>
<p>Tripe wastewater recycling – Steam sterilisation of viscera trays – Dry-cleaning of chillers (A.ENV.0136/0137/0138)</p>	<p>Industry consultation had identified the need to determine specific water- and energy-efficiency options for dealing with components of slaughter, boning, chilling, rendering and hide processes. This consultation found that there is a range of available options, and that although equipment and processes vary considerably between plants, there is scope to examine activities with this broader objective in mind.</p> <p>Three projects cover key areas where there is an opportunity to improve water efficiency and to apply alternative practices and technologies, provided food safety targets are maintained.</p>
<p>Biogas manual (A.ENV.0160)</p>	<p>The introduction of the carbon pricing mechanism and the consistent rise in energy costs are drivers for determining mechanisms to minimise GHG emissions from wastewater treatment systems.</p> <p>GHG emissions from anaerobic wastewater treatment accounts for around half of Scope 1 GHG emissions at large meat processing facilities. As such, industry is conducting research into anaerobic waste water treatment technologies, especially covered anaerobic lagoon (CAL) technology with biogas capture and combustion systems, which enable the capture of GHG contained within the biogas, as well as the capture of energy from waste applications such as biogas boilers. Future research will focus on gathering credible data relating to biogas installation, quality, management and capture.</p>

PROGRAM 3: FOOD SAFETY, PRODUCT INTEGRITY AND MEAT SCIENCE



PROGRAM 3: FOOD SAFETY, PRODUCT INTEGRITY AND MEAT SCIENCE

About the Program:

The objective of the Food Safety, Product Integrity and Meat Science Program is to develop technologies that enable high standards of food safety, product integrity and eating quality.

The program operates across seven program streams:

Program Stream 1: Food Safety

Food safety is a non-negotiable aspect of red meat production. This stream focuses on technologies and tools that ensure industry has an ability to validate, demonstrate, understand and manage responses to food safety issues. This stream includes technologies that improve current food safety systems and ensures that the Australian red meat processing industry is responsive to global food safety requirements.

Program Stream 2: Animal Welfare

Export markets and global consumers demand that the processing industry provide evidence of high standards of animal welfare. The Australian red meat processing industry needs to continue to ensure that the current high level of animal welfare standards are regularly reviewed, are widely disseminated and implemented. Reportable outcomes are required to maintain market access. This stream focuses on refining animal welfare measures and practices in livestock handling and slaughter, determining how these practices relate to meat quality and establishing performance measures that can be communicated to government and trading partners.

Program Stream 3: Product Integrity in the Supply Chain

This stream focuses on the development of an overall product integrity framework by which Australian red meat is produced, and includes traceability, management of biosecurity and disease threats, animal health and welfare measures and overall meat processing quality standards. The outcome of this stream is to enhance product integrity standards and quality assurance, and to maintain a world leading traceability system.

Program Stream 4: Meat Sensing and Measurement Systems

The ability to produce consistent high quality red meat requires mechanisms to monitor, evaluate and respond to products which do not meet specifications (pH, tenderness, colour, intramuscular fat, etc.). This stream focuses on the development and validation of new sensing and measurement technologies (especially online systems) and understanding their barriers to adoption. This stream will inform Technology and Processing Program Stream 2: Improved Carcase Measurement in developing an integrated carcase

measurement technology that covers the measurement of composition (lean, fat and bone), structure (to inform automated cutting lines), meat quality measurements, cut product recognition and detection of contamination and disease.

Program Stream 5: Meat Packaging Systems

Global standards and regulations for fresh meat hygiene and safety are becoming more stringent whilst retailers are demanding more cost effective ways to extend shelf life and display products on the shelf in the most attractive manner. Improved and intelligent meat packaging is one approach to achieving that outcome. This stream will focus on the further optimisation of current packaging technologies e.g. vacuum packaging, overwrap and modified atmosphere packaging and develop new packaging solutions to enable functional and cost-effective options to be taken up by industry e.g. active packaging, intelligent packaging and labelling, novel films, and biodegradable packaging.

Program Stream 6: Meat Quality Improvement

Meat processors want to maximise value to customers and increase the demand for red meat and red meat products. This is best achieved by delivering high quality consistently to customers and consumers. Meat quality is dependent on a combination of functional characteristics such as tenderness, intramuscular fat, flavours etc. which all impact on the consumer's perception of eating quality. This stream focuses on understanding all the key variables impacting meat quality and developing processing and sensing technologies that can further enhance quality and consistency.

Program Stream 7: Meat Storage & Colour

The requirements of retail display demands that meat products fit an acceptable colour profile and have a suitable shelf life. Research into factors which affects meat shelf life and colour include the effects of microbial populations, processing technologies and temperature (freezing and chilling). The focus of this stream is to provide guidelines and technologies that optimise colour stability and shelf life for different meat products and markets.

PROGRAM 3: FOOD SAFETY, PRODUCT INTEGRITY AND MEAT SCIENCE

Project highlights for FY 2013–14: Food Safety and Product Integrity

The following section highlights examples of projects conducted throughout the period.

Meat hygiene assessment webinar and flipcharts (2013/5105)

In FY 2013-14, a series of port-of-entry inspection failures gave rise to concerns about the capability of Australian meat processing personnel to quickly and accurately identify contamination of carcasses, and their ability to take appropriate corrective and preventative action.

As part of its response, the industry decided to create awareness materials for processors to use when training staff in how to identify zero-tolerance (ZT) contamination of carcasses and carton meat.

This approach developed two tools:

- ▶ a webinar to help personnel understand the importance of detecting and removing ZT contamination
- ▶ a flipchart for training Meat Hygiene Assessment (MHA) monitors, trimmers and packers how to detect physical contaminants.



AMPC consulted with the Department of Agriculture and AMIC in developing these materials. The webinar and flipcharts are now available on request from AMPC.

Metagenomics analysis of the microbial communities contaminating meat and carcasses (2013/9510)

Testing meat and carcasses for contaminating micro-organisms is standard practice required to both confirm safety and assure market access. Traditional testing

methods focus on detecting specific pathogens and easily cultivatable organisms. However, these microbial ecosystems are often populated by numerous previously unknown and uncultivable micro-organisms, so there is a need to better understand, detect and control troublesome pathogenic micro-organisms such as *E. coli O157:H7*. Metagenomics is a primary tool used in microbial ecology, and can be used to examine the microbial ecosystem on bovine hides and processed carcasses, for comparison against the micro-organisms present in the animal's faeces.

Metagenomics is a broad term to describe the analysis of microbial communities by sampling genetic material from cells without culturing them. New high-throughput analysis techniques analyse the genetic material to gather a snapshot of everything present in a DNA sequence common to all organisms, but sufficiently variable to determine what species it comes from. This gives both a picture of what kinds of organisms are present, as well as the ratio of one to another.

Metagenomic analysis of the sources of contamination demonstrated that the hide is the primary source (providing around 60%) of bacteria on the carcass. The remaining 40% of bacteria on the carcass is derived from non-animal sources. It seems likely that the *Pseudomonas* was derived from the environment and *S. epidermidis* may be derived from workers' hands.

Highly contaminated hides did not appear to contaminate the associated carcass, but most likely contributed to a generalised contamination in the processing environment. Faecal contamination of hides was low, and the source of this contamination was not necessarily the same animal.

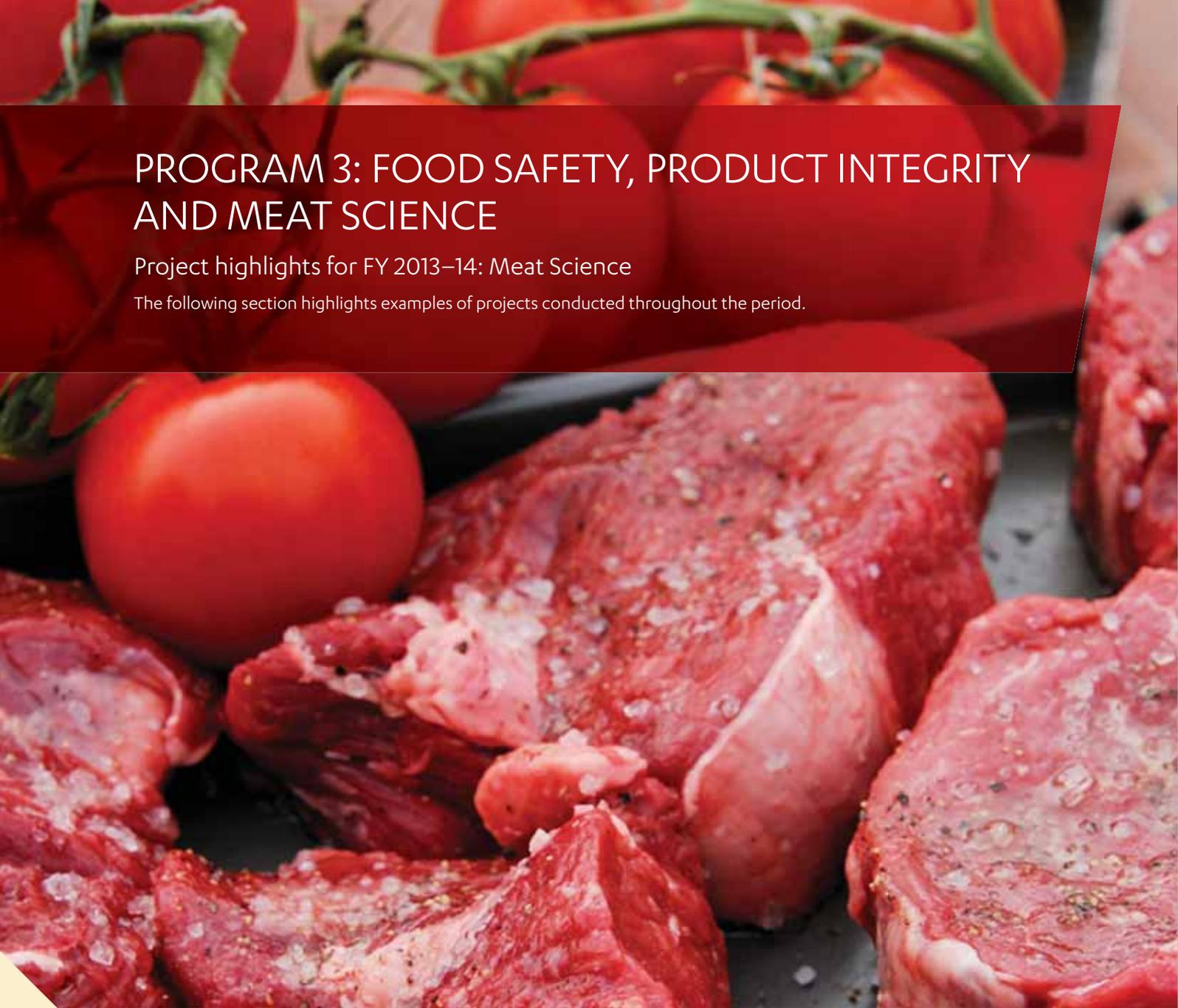
While this is a preliminary study, the project has demonstrated that metagenomics analysis can be used to understand microbial ecology in an abattoir and suggests the importance of managing aerosols and particulates derived from the hide.

PROGRAM 3: FOOD SAFETY, PRODUCT INTEGRITY AND MEAT SCIENCE

Summary of other projects for FY 2013–14: Food Safety and Product Integrity

The following table summarises other examples of food safety and product integrity projects undertaken during FY 2013–14.

Project name	Project summary
Small stock interventions – Assessing the effectiveness of a carcass hot-water decontamination cabinet in small-stock processing (3000/5124)	<p>This project included trialling a hot-water small-stock intervention wash cabinet for removing visual defects from the surface of small-stock carcasses at a major processor.</p> <p>The trial assessed the effectiveness of hot water (at 88°C ±2°C) as a means of eliminating ZT defects on small-stock carcasses, under normal commercial operating conditions. The trial evaluated the wash cabinet with regard to two small-stock categories: sheep and skin-off goat carcasses.</p> <p>Following an initial evaluation, the cabinet was adjusted to improve operational performance. Preliminary observations have found that the cabinet is effective in removing some, but not all contamination.</p>
Small stock interventions – Microbiological assessment and validation of hot-water wash cabinet (3000/5121)	<p>This complementary project to 3000/5124 aims to provide microbiological and temperature data to help validate the hot-water small-stock wash cabinet system described above.</p> <p>Validation studies include:</p> <ul style="list-style-type: none"> › temperature measurement on test carcasses passing through the wash cabinet › challenge testing with a known strain of non-pathogenic <i>E. coli</i> or <i>Klebsiella oxytoca</i> › sampling program after implementing the system, to compare incidental bacterial contamination of carcasses before and after treatment in the cabinet. <p>A formal submission to the Department of Agriculture for a protocol to conduct the abovementioned <i>E. coli</i> challenge testing has been lodged.</p>
AHA TSEFAP 2013–18 (3000/5105)	<p>Animal Health Australia’s (AHA’s) Transmissible Spongiform Encephalopathy Freedom Assurance Program (TSEFAP) has been in operation since January 2004. It aims to enhance market confidence that Australian animals and animal products are free from TSEs, due to the structured and nationally integrated management of animal-related TSE. AMPC contributes funds to the National TSE Surveillance Program, the Ruminant Feed Ban Compliance Scheme, and related communication and management activities.</p> <p>AMPC will continue to provide funding support to the FY 2013-18 TSE Freedom Assurance Program as indicated in the business plan.</p>
Implementation project for the AMIC Animal Welfare Accreditation Program (3000/5002)	<p>The Australian Livestock Processing Industry Animal Welfare Certification System (AAWCS) is a sector-wide initiative to ensure best-practice animal welfare outcomes for processors. AAWCS is an AMPC-supported initiative of AMIC and is administered by AUS-MEAT.</p> <p>The AAWCS is an independently audited certification program used to demonstrate compliance with the industry best-practice animal welfare standards <i>Industry Animal Welfare Standards for Livestock Processing Establishments Preparing Meat for Human Consumption</i>. By attaining certification under the program, processors can demonstrate their strong commitment to animal welfare best practices.</p> <p>AAWCS is an important new initiative that was launched at the AMIC Conference on 19 September 2013.</p>



PROGRAM 3: FOOD SAFETY, PRODUCT INTEGRITY AND MEAT SCIENCE

Project highlights for FY 2013–14: Meat Science

The following section highlights examples of projects conducted throughout the period.

Quantifying the benefits of developing a CT marbling solution for beef (2013/9204)

This project assessed the feasibility of estimating total fat and lean meat using CT and the development of an equation to estimate IMF in hot-boned beef primals.

Experimental studies conducted in phase one of this project had indicated that it was feasible to measure fat under hot-boning conditions. It also confirmed a large variation between the MSA grade and chemical IMF% within primals. The correlation between MSA grade and chemical IMF% ranged from 0 to 0.94 across 20 primals. An equation was developed ($\text{AdjR}^2 = 0.84$) to estimate the IMF%.

Phase two involved a cost–benefit analysis (CBA) which found that if a processor were to purchase a \$500,000

CT machine, and the current error rate on carcass yield measurements was approximately 1 mm at the P8 site, then abattoirs processing more than 500 head of cattle per day could potentially justify the investment. The study found that the benefits of hot-boning beef primals, including reduced moisture loss, more accurate grading and less chance of grading error, could produce financial benefits in the order of \$4.4 million (for abattoirs processing around 500 head of cattle per day).

Predicting the colour and flavour stability of meat based on pre-slaughter assessments (2013/9506)

To determine whether the circulating level of blood isoprostane is an effective biomarker for predicting changes in the colour and/or flavour stabilities of prime lamb meat post-slaughter, this project involved a

PROGRAM 3: FOOD SAFETY, PRODUCT INTEGRITY AND MEAT SCIENCE

Project highlights for FY 2013–14: Meat Science

determination of the circulating level of blood isoprostane in 84 lambs finished on four different diets: lucerne, ryegrass, commercial feedlot ration and a combination of ryegrass and commercial feedlot ration. The circulating level of isoprostane for each animal was then compared with traditional meat quality measurements for colour and/or flavour stabilities. This included measuring the lipid oxidation levels in meat (thiobarbituric acid reactive substances (TBARS) analysis), muscle vitamin E content and the redness and brownness of meat as determined by a HunterLab colour assessment.

Researchers found that lambs finished on ryegrass had the highest level of muscle vitamin E content (2.9 mg/kg), whereas lambs finished on the commercial feedlot ration had the lowest muscle vitamin E content (0.73 mg/kg or $P < 0.001$). Lipid oxidation levels were lowest in lambs finished on the ryegrass diet, highest for lambs finished on the commercial feedlot ration and intermediate for lambs finished on lucerne and the combination ration ($P < 0.001$). After eight weeks of finishing, blood isoprostane levels positively correlated with the level of lipid oxidation in fresh (five days) and aged (60 days) meat displayed for 96 hours under simulated retail conditions ($P < 0.01$). There was a negative linear relationship between isoprostane concentration and muscle vitamin E concentration ($P < 0.07$), and lipid oxidation and muscle vitamin E concentration ($P < 0.001$). So after 96 hours of simulated retail display, lambs finished on ryegrass contained a concentration of vitamin E in the muscle that reduces lipid oxidation in both fresh and aged meat. Conversely, lambs finished on a commercial feedlot ration had a significantly lower muscle vitamin E concentration, which promoted greater levels of lipid oxidation in fresh and aged meat under the same conditions. Increased levels of lipid oxidation after the meat leaves the farm gate influences the flavour and aroma of the lamb, which has a negative impact on the consumer eating experience. However, the researchers did not observe a significant relationship between the overall redness of meat stored under simulated retail display conditions after one and four days, and a) blood isoprostane concentrations at week zero, four, six or eight of finishing, or b) the muscle vitamin E concentration.

The overall results show promise and prove that blood isoprostane concentration can be used as a biomarker to predict oxidative stress in farm animals before they

leave the farm. Increased oxidative stress is associated with reduced meat quality and flavour deterioration in lamb due to higher levels of lipid oxidation. This is the first known report to identify a link between a biomarker of oxidative stress (isoprostane concentration) and reduced meat quality in sheep meat.

Greening of vacuum-packaged lamb – Causative factors (2013/9503)

Australian vacuum-packaged lamb has at times been rejected because the meat has turned green after storing for as little as six weeks. In the past, greening of beef was associated with high-pH meat, so researchers developed a multi-pronged program to determine the main factors involved in the greening process. The program included:

- › a survey to determine the incidence of high-pH lamb
- › a storage trial using lamb cuts with different pH ranges
- › inoculating lamb cuts from carcasses with different pH ranges with a micro-organism expected to cause greening, packing these samples in films with different oxygen transmission rates, and storing them at -1°C and 2°C for up to 12 weeks.

Lamb knuckles and blades have a higher pH than the rack and also higher incidence of high-pH meat. More than 97% of the knuckles and blades sampled had a pH above 5.7, whereas only 64% of racks were above pH 5.7. The breed of sheep was the major factor influencing ultimate pH; full-blood Merinos had a higher pH than mixed and other breeds.

The storage trial and the inoculation trial both indicated that temperature control is the main factor in preventing greening. Storing chilled, vacuum-packed lamb at a temperature of -1°C or below will prevent greening and enable a storage life of nine weeks or more.

PROGRAM 3: FOOD SAFETY, PRODUCT INTEGRITY AND MEAT SCIENCE

Summary of other projects for FY 2013–14: Meat Science

The following table summarises other examples of meat science projects undertaken during FY 2013–14.

Project name	Project summary
<p>Improving beef colour at grading (2013/3005)</p>	<p>The colour of beef at grading is one of the key criteria for determining the value of a carcass. Beef carcasses can be downgraded because the striploin is too dark or has a high ultimate pH. Electrical stimulation (ES) can be used to increase the number of carcasses with ideal colour scores (scores below 4) but can also have negative impact on other quality traits such as sensory appeal.</p> <p>Research on meat colour has focused on reducing the ultimate pH by increasing muscle glycogen and also using ES. Although early research showed that muscle structure has a role in determining beef colour at grading, there has been little recent research. Using a novel microscopy technique, the project team has gathered new evidence about the role of muscle structure in determining beef colour. The project aimed to:</p> <ol style="list-style-type: none"> 1. understand the role of muscle structure in determining beef meat colour 2. investigate pre- and post-rigor strategies for manipulating the muscle structure to improve muscle colour 3. develop scientific expertise and industry capability in the area of beef meat colour 4. incorporate new disciplines into the area of meat quality (including confocal microscopy, mathematics and process engineering) and train a PhD student in these disciplines. <p>This project is ongoing until August 2017.</p>
<p>Muscle structure and water retention in fresh and cooked meat products (2013/5009)</p>	<p>Because meat is sold by weight, the loss of fluid from meat during pre-rigor processing, and then during storage and cooking, is economically important in terms of the yield of raw and cooked meat products, and also in terms of consumer acceptability. Meat can lose 15% of its weight during storage and up to 40% during cooking, both due to water loss.</p> <p>This project focuses on the basic mechanisms responsible for fluid loss during storage and cooking, and is investigating the relative importance of each structural change that occurs. The project involves a series of six experiments to determine the structural basis of water loss during cooking. Researchers are working to develop a mechanistic understanding of this water loss in relation to sensory traits (using the Warner-Bratzler shear force test to determine tenderness), to challenge current thinking in meat science.</p> <p>There is little information available to help predict cooking loss and product outcomes in meat from beef carcasses destined for different end markets. Meat processors are keen to increase the value and number of products they can derive from carcasses. In particular, they want a reliable product outcome from muscles throughout the carcass. The information from this project will complement and add to existing knowledge, enabling beef processors to better predict product performance.</p> <p>This project is ongoing until August 2017.</p>

PROGRAM 3: FOOD SAFETY, PRODUCT INTEGRITY AND MEAT SCIENCE

Summary of other projects for FY 2013–14: Meat Science

Project name	Project summary
<p>Optimising meat quality and functionality using novel processing interventions (2013/5041)</p>	<p>This project investigates potential processing technologies that will help secure new value-added red meat opportunities, focusing especially on rapid tenderisation and increasing the value of non-primal cuts. Adding value to underutilised ‘tough’ muscles will increase the overall value of the carcase.</p> <p>The project team is working to:</p> <ul style="list-style-type: none"> › identify and develop processing interventions that extend and enhance the quality traits of fresh muscle › evaluate and develop post-slaughter technologies to produce ready-to-eat (RTE) meat products. <p>The team will research the effects of identified processing technologies on meat quality, food safety and stability.</p> <p>This project will improve industry knowledge and understanding of post-slaughter processing technologies, and develop new knowledge about the relationship between processing technologies and meat industry sustainability.</p> <p>This project is ongoing until August 2017.</p>
<p>Enhancing meat measurement approaches (2013/3003)</p>	<p>Measurement of carcase composition and muscle characteristics is an ongoing area of investigation. Classical measures like the Warner-Bratzler shear force test are a proxy for judging tenderness but they destroy the meat samples used and are not applicable to online measurement. Other traits such as intramuscular fat have remained elusive in terms of being available for online measurement. Bio-impedance is one of two technologies that have the potential to address this lack of measurability. There have been major recent improvements in using this technology to measure carcase composition.</p> <p>This project examines the use of synchrotron technology and bio-impedance to differentiate the muscle characteristics (fibre type, collagen and lipid droplets) associated with meat tenderness and texture.</p> <p>Lamb and sheep carcasses were sampled from a variety of processors and the loin and topside muscles were subjected to bio-impedance and synchrotron measurement, and also traditional meat quality measurement. The resulting data is currently being processed and analysed statistically.</p> <p>This project is ongoing until May 2015.</p>
<p>Enhancing the retail colour stability and shelf life of lamb meat for key markets (2013/3003)</p>	<p>The project is examining the effect of heat stress on blood lipid metabolites and antioxidant potential in live animals and on the colour of fresh and stored lamb meat. The aim is to determine how dietary antioxidants can be exploited at supranutritional levels to improve colour stability, shelf life and nutritive value. Researchers examine lambs for heat stress (measured by respiration rate and rectal temperature) and oxidative stress (measured by free radical estimation and antioxidant potential in blood samples) during the finishing phase, transportation and lairage. The researchers then assess the quality of fresh and packed meat samples after slaughter, and the oxidant and antioxidant levels in fresh and aged muscle samples from animals reared under heat stress and thermoneutral conditions.</p> <p>The first outcome will be to enhance the retail colour stability and shelf life of lamb meat by supplementing grain-based diets with high levels of antioxidants during the finishing period under heat-stressed conditions. Preliminary analyses showed that high levels of vitamin E and selenium improved feed intake and weight gain in finisher lamb, even under heat stress.</p> <p>This project is ongoing until April 2016.</p>

PROGRAM 3: FOOD SAFETY, PRODUCT INTEGRITY AND MEAT SCIENCE

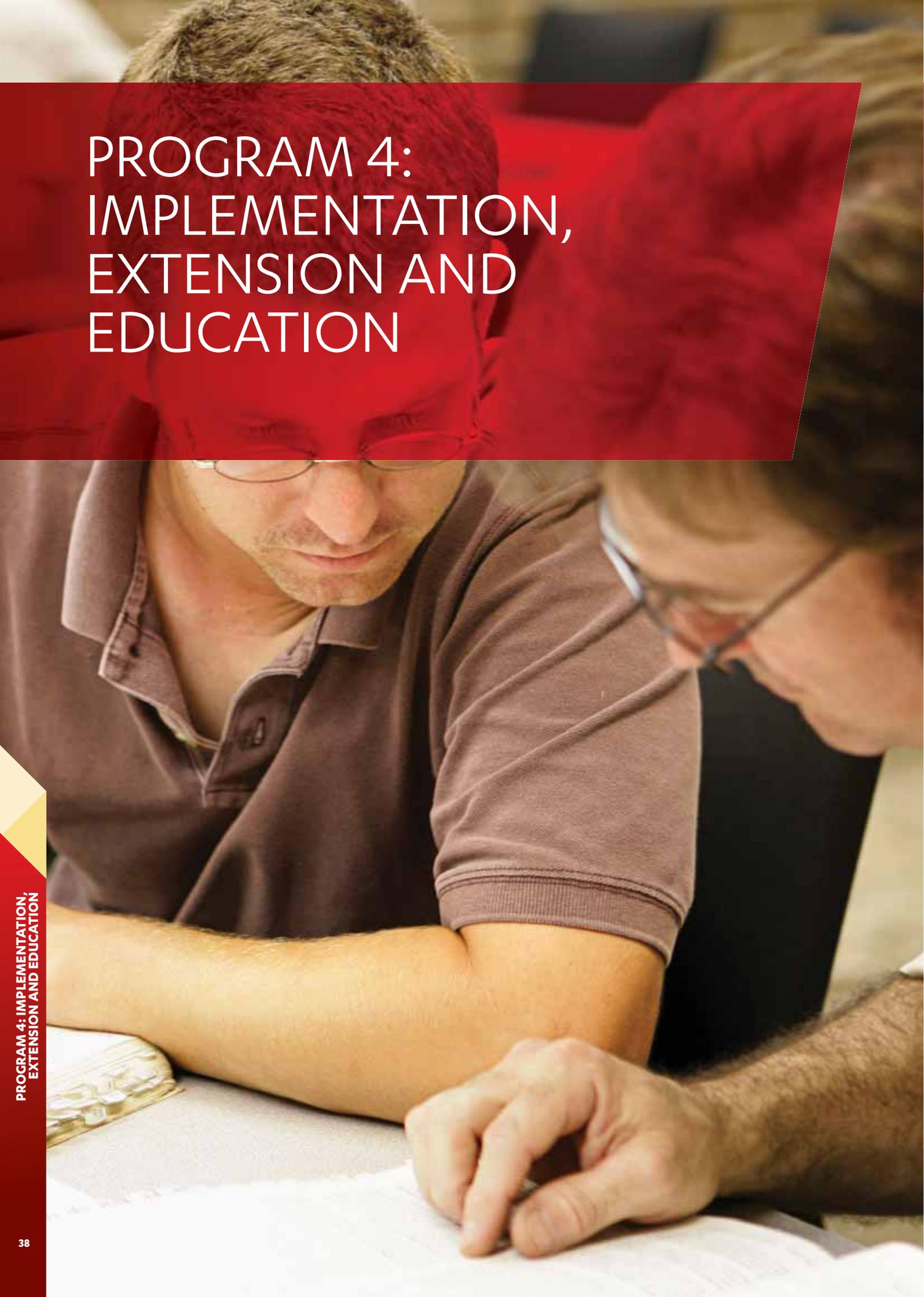
Summary of other projects for FY 2013–14: Meat Science

Project name	Project summary
Meat quality from dielectrically stunned cattle (2013/5034)	<p>Commercial service providers have developed a dielectric stunning system. Trials on anaesthetised animals have been successful and a limited number of conscious cattle trials will now be conducted.</p> <p>This project aims to assess the quality of the stun and the quality of the meat from animals processed with dielectric stunning compared to a conventional stunning control. Researchers will collect and analyse blood samples for stress hormones (cortisol, ACTH, β-endorphins and catecholamines) and will collect brain samples for histology. Meat samples will be held for 10 weeks, then tested for meat quality (based on the Warner-Bratzler shear force test, lipid oxidation, colour and water-holding capacity).</p> <p>This project is ongoing until January 2015.</p>
Development and validation of a probe to measure meat quality – For online application (2013/9501)	<p>This project follows on from previous work in the Cooperative Research Centre for Sheep Industry Innovation (Sheep CRC), which demonstrated the potential for using a handheld probe to measure lamb tenderness.</p> <p>The project also provides a framework for a student to undertake a PhD in meat science. The student will focus on establishing the probe's ability to predict tenderness and other traits in lamb, and aiding the commercial application of the probe.</p> <p>This project is ongoing until mid-August 2015.</p>
The influence of pre-slaughter stress on the meat quality and carcass yield of prime lambs (2013/9504)	<p>This project is testing the role of chronic and acute stress on meat quality and carcass yield in prime lambs. It aims to develop industry recommendations for managing chronic stress (such as dehydration and extended curfews) and acute stress (for example handling leading up to stunning) with a view to optimising carcass yield, animal welfare and meat quality.</p> <p>This project uses Sheep CRC Information Nucleus lambs and other commercial animals, to examine a wide range of lamb genetics and production systems. This research is the first large-scale analysis in this area.</p> <p>This project is ongoing until October 2016.</p>
Enhancement of meat quality by pulsed electric field application (2013/9505)	<p>Pulsed electric field (PEF) technology can be used to improve the tenderness of cold- and hot-boned topsides, and cold-boned loins. The technology appears to be flexible as applied to topsides, where the improvement in tenderness does not depend on the post-mortem time (as long as it is applied within three days). This could allow the use of PEF technology without any post-mortem time constraints, but needs to be confirmed with other muscles, combined with understanding the biochemical basis of the tenderisation. The technology does not depend on the meat pH or fibre direction, so it can be applied to meat without being limited by these two factors.</p> <p>This project has found that:</p> <ul style="list-style-type: none"> ➤ the tenderness of the loin samples benefited from PEF treatment (with a 19.5% reduction in the shear force) regardless of the electrical input ➤ the topside samples became more tender by increasing the treatment frequency (with a 4.1%, 10.4% and 19.1% reduction in shear force at 20Hz, 50Hz and 90Hz respectively) ➤ the tenderness of the loin samples benefited from repeated PEF treatment ➤ the tenderness of the hot-boned topside samples benefited from PEF treatment (with a 21.6% reduction in the shear force) regardless of the electrical input, whereas the loin muscle shear force tended to increase by increasing the treatment frequency ➤ PEF treatment generally increased the purge loss and decreased the cooking loss; however, this varied depending on the muscle type and the post-mortem time (whether the meat was cold- or hot-boned).

PROGRAM 3: FOOD SAFETY, PRODUCT INTEGRITY AND MEAT SCIENCE

Summary of other projects for FY 2013–14: Meat Science

Project name	Project summary
<p>The effect of intramuscular fat on the eating quality, flavour generation and flavour release in beef (2013/9509)</p>	<p>IMF or marbling is an important reservoir of beef flavour, directly affecting the way flavour is released during eating and contributing to the consumer perception of juiciness. This project looks to link objective measures of IMF, tenderness and flavour measurements with descriptive and dynamic sensory data in a selection of commercially obtained meat samples.</p> <p>In December 2012, the project team obtained 42 MSA-graded beef striploins from grass-fed, grain-finished Angus and grass-fed Wagyu, covering a range of nominal marbling levels from low, medium to high, from northwest Tasmania. The lowest-fat samples were the grass-fed Angus (5.2% low, 7.8% medium and 9.9% high), followed by the grain-fed Angus (10.2% low, 13.7% medium and 14.9% high fat) and the grass-fed Wagyu (7.8% low, 10.9% medium and 17.5% high). The concentration of omega-3 fatty acids and conjugated linoleic acid in the IMF was higher in grass-fed beef compared to grain-fed, in agreement with existing literature.</p> <p>Researchers cut and froze standardised 25mm steaks for later sensory evaluation and flavour analysis. A trained panel developed an appropriate 'grilled beef' vocabulary to measure sensory attributes across the samples. They applied more than 30 consensus attributes to assess beef odour, flavour, taste and texture attributes. Most sensory attributes were directly correlated to the level of marbling (MSA-MB) regardless of the breed or feed type. As a whole, the overall flavour intensity, beef flavour, caramel odour, grassy flavour, oily mouthcoating and sweetness positively increased with marbling. As the level of marbling decreased, acidity, astringency, and hay, grain and liver flavours became more apparent. The panellists noted more subtle flavour and texture differences when comparing breeds and feed sources.</p> <p>Analysis of headspace volatiles by gas chromatography mass spectrometry indicated that the concentration of most volatile compounds increased with marbling are strongly associated with the 'grilled beef' flavour. Further analysis of the samples showed that highly marbled beef had unique temporal (time-related) flavour-release properties. Key odour-active volatiles were released more rapidly in the mouth at higher levels of marbling, leading to more intensely perceived flavour. Similarly, the release rate of non-volatile taste compounds (free amino acids and organic acids) during eating was more rapid in higher-marbled samples. Different ratios of sweet and bitter amino acids in the grilled beef corresponded to different taste properties. Overall, beef fed on grass or grain with high marbling scores (over 500 MSA-MB) or a fat content of more than 7.5% had quite similar flavour properties. Only the samples with the lowest fat content (less than 5%), the low-fat grass-fed Angus, were characterised by more acidic, metallic and lingering aftertaste attributes.</p> <p>Taken as a whole, the data demonstrates the essential role of IMF in generating beef flavour, controlling flavour release and improving texture attributes.</p>

A photograph of two men in polo shirts looking at a document on a table. The man on the left is wearing glasses and a brown polo shirt. The man on the right is also wearing glasses and a brown polo shirt. They are both looking down at a document on the table. A red semi-transparent box is overlaid on the top left of the image, containing the text 'PROGRAM 4: IMPLEMENTATION, EXTENSION AND EDUCATION'.

PROGRAM 4: IMPLEMENTATION, EXTENSION AND EDUCATION

PROGRAM 4: IMPLEMENTATION, EXTENSION AND EDUCATION

About the Program:

The objective of the Implementation, Extension and Education Program is to provide effective translation and communication of R&D outputs to stakeholders and to support key training initiatives.

The program operates across five program streams:

Program Stream 1: Developing Innovative Processes and Employees

This stream focuses on developing innovative capabilities within the red meat processing sector and its personnel. There is a need to accelerate the introduction of new technologies to ensure Australia remains a global leader in red meat processing. To achieve that outcome requires innovative employees. Key to the continual development of those employees is industry's absorptive capacity regarding new technologies and an identification of the training, education and capability gaps within industry that must be filled.

Program Stream 2: Upskilling of Processing Engineers

Industry process engineering capability is a key factor in increasing red meat sector processing efficiency. Rapid technological change has led to the need for a review and analysis of process engineering technological capability and training requirements. This need relates to the continued evolution of automation, sensing and information technologies on-plant, and the need for maintenance engineers to remain up-to-date with the skill sets required to service and maintain these technologies. This stream aims to deliver priority pathways to build the required capabilities. Critical to its success will be the effective extension of R&D outcomes through industry engineering networks.

Program Stream 3: Attraction, Acquisition and Retention of Skilled Employees

The attraction and retention of labour is an ongoing concern within the red meat processing industry. Many companies seek to address this issue by a commitment to the provision of accredited training and career pathways, support for skilled migrants and an emphasis on workforce planning and education. There remains however a lack of data on the mobility of personnel within the sector and strategies that might be adopted to improve the attractiveness of the industry. This stream focuses on factors influencing the acquisition and retention of meat industry personnel and the perceptions of stakeholders on employment within the industry.

Program Stream 4: Professional Development of Meat Industry Personnel

Given constantly changing operating and regulatory requirements within the red meat processing industry, employee professional development and training is an ongoing requirement. An investment in professional development is important for industry personnel operating at the plant level through to PhD researchers undertaking R&D for the benefit of industry in the long term. This stream focuses on programs that address current and future priorities as identified by industry. Additionally, the stream provides investment for research scholarships in areas such as meat science, technology and automation, environmental sustainability and market access.

Program Stream 5: Delivery of Priority Training and Extension Services

The value of research and development is only delivered when outcomes are taken up and successfully implemented by industry. AMPC continues to support the implementation of red meat processing adoption strategies to realise the full benefit of R&D extension/education investments. This stream aims to develop new extension programs and networks that will facilitate the delivery of R&D outcomes to meat processing personnel. Also important is the development of new, innovative and engaging extension platforms that can further increase the accessibility of research information and advice.

PROGRAM 4: IMPLEMENTATION, EXTENSION AND EDUCATION

Project highlights: FY 2013–14

The following section highlights examples of projects conducted throughout the period.

Enhancing the industry's capacity to monitor and audit electrical carcass stimulation (2013/1057)

Many sheep and beef processing plants across Australia have successfully adopted medium-voltage stimulation technology. These electrical units are relatively inexpensive, are easy to install and require minimal isolation from workers, which explains their high rate of adoption.

Several years ago, the NSW Department of Primary Industries (NSW DPI) researched the effectiveness of electrical stimulation in plants that were already using the technology. In some cases the stimulation units were achieving less than optimal results; the initial installation achieved the desired improvement in meat quality, but staff members were not always trained in how best to monitor and maintain the system. For this reason, certain plants were not using stimulation units effectively and were not gaining maximum value in terms of meat quality.

As a result, AMPC, MINTRAC and the NSW DPI collaborated to develop a training program that addressed shortfalls in current practice and helped processors to use electrical stimulation technology more effectively. This project funded the development of both written and e-learning materials that were delivered in a webinar setting.

The training units and supporting written materials cover a number of topic areas:

- › the importance of electrical stimulation
- › how electrical stimulation is used in the Australian meat industry
- › relevant WHS requirements
- › how to monitor and check electrical stimulation units



- › the process for auditing carcass compliance with recommended pH temperature ranges
- › how to respond in the event of non-compliance with these ranges.

These e-resources can be delivered by webinar, as in-house training or to support accredited training units in electrical carcass stimulation. The training resources are self-paced, so there is no need to take large numbers of workers off the floor for group training.

PROGRAM 4: IMPLEMENTATION, EXTENSION AND EDUCATION

Project highlights: FY 2013–14

ABARES 2014 Science Awards (2013/9901)

The ABARES Science and Innovation Awards for Young People in Agriculture, Fisheries and Forestry supports young people in the pursuit of innovative scientific ideas that will deliver long-term benefits for Australia's rural industries. Since 2008, AMPC has partnered with the Australian Bureau of Agricultural Resource Economics and Sciences (ABARES) to provide scholarships and ongoing academic support for students wishing to undertake studies focused on the red meat processing industry.

The award for 2014 was presented to Sandra Corbett from Murdoch University at the ABARES Outlook 2014 Conference. Sandra's project is evaluating the effect of increased blood ammonia on glycogen metabolism and muscle glycogen concentration in sheep at slaughter. Low muscle glycogen levels cause a syndrome known as dark cutting. This syndrome costs the Australian beef industry in excess of \$35 million each year, reducing the quality of lamb and sheep meat and leading to a lower price at slaughter.

Previous studies in cattle have shown that elevated blood ammonia levels are associated with reduced muscle glycogen concentrations. Elevated blood ammonia levels occur when cattle are fed large amounts of fermentable protein or nitrogen, such as when feeding on lush growing pasture or when urea is added to the diet.

Sandra's project will examine how high levels of fermentable protein and nitrogen affect the occurrence of dark cutting in sheep meat, and aims to determine if improved pasture production and urea feed supplements could be the source of excessive dietary nitrogen.

The project will clearly benefit the sheep meat industry by providing new information on optimal pre-slaughter feeding; increasing our understanding of the relationship between blood ammonia and glycogen concentration; and making it possible to reduce the frequency of dark cutting and subsequent economic losses.



PROGRAM 4: IMPLEMENTATION, EXTENSION AND EDUCATION

Project highlights: FY 2013–14

WHS extension information (2013/5019)

This project follows on from a previous project *A.MIN.0104 – WH&S Kit revision and e-learning package*, which commenced in 2011 and included the development of a WHS manual for supervisors which addressed new legislation, areas of critical risk, training opportunities, and supervisor roles and responsibilities.

A preliminary review found gaps in the information available to industry members, and in how that information is managed, updated and subsequently integrated into new training programs. This project identified those gaps and new information requirements by comparing the existing WHS manual against areas of identified need, and by developing additional standard operating procedures and resource materials.

To identify and address these gaps, meat industry WHS personnel and registered training organisations (RTOs) completed a comprehensive survey. This survey aimed to:

- › identify current and future WHS information needs for meat processors
- › determine where meat processors most frequently seek WHS information
- › identify what resources are most appropriate and useful to those working in WHS
- › identify the preferred delivery mechanism for addressing any identified information gaps.

Survey respondents indicated that current fact sheets on the WHS for meat industry supervisors' website (www.mintrac-whs.com.au) effectively addressed previously identified risks facing the industry. However, the majority of respondents also identified a range of additional WHS areas that involve critical risks that were, as yet to be addressed. These risks include:

- › hazardous chemicals
- › stock handling
- › working at heights
- › working with forklifts, trucks and vehicles
- › alcohol and other drugs
- › noise
- › hot water and steam

- › fatigue
- › working alone.

Participants found fact sheets to be the most appropriate resource for addressing the critical WHS risks identified, but suggested that DVD or video footage would also be useful.

Desktop auditing for meat processing quality assurance managers (2013/1059)

The Australian Department of Agriculture is currently reviewing approved arrangements within industry as part of a planned change in the department's auditing arrangements.

As the department's review progresses, meat processing companies will need to develop the capacity to conduct their own desktop audits and to identify shortfalls in approved arrangements before external Department of Agriculture audits. The skills to effectively carry out this audit process will progressively become a standard part of any meat quality assurance role. To meet this need, it was necessary to develop new skills as part of a standard accredited training package for quality assurance managers.

Accordingly, AMPC contracted MINTRAC to develop an accredited audit training program against regulatory, importing country and customer requirements. A technical reference group oversaw the development of the training program, which was tested and modified in the course of six workshops.

This work developed a new unit, *AMPX425 Conduct a document review*, which will be submitted to the National Skills Standards Council for endorsement in December 2014. The training and assessment materials have been completed and are now available to industry members. As a result, more than 70 people across the industry have the appropriate skills to undertake document reviews that meet Department of Agriculture expectations. Two RTOs can now deliver the accredited training program.

Further training courses will be made available to meat processors during 2014–15, as required through the Meat Industry Professional Development Program.

PROGRAM 4: IMPLEMENTATION, EXTENSION AND EDUCATION

Project highlights: FY 2013–14

Meat Industry Professional Development Program (2013/9412)

AMPC funds the Meat Industry Professional Development Program, which provides accredited courses and general-purpose workshops so meat industry personnel and industry trainers are exposed to the latest R&D, and can gain the skills and knowledge required to change practices.

For each type of training, learning program or professional development course, the program enables AMPC and MINTRAC to establish suitable models of delivery and assessment, a body of competent trainers, appropriate support materials and a viable market in which this training can be conducted. In this way, AMPC encourages training capacity to be built in all states around Australia.

In 2013–14, the program delivered 15 professional development programs and a further 23 other programs associated with RD&E projects.

Professional development programs run specifically under this program have focused on:

- › animal welfare officer skillsets
- › low-stress livestock handling
- › the National Livestock Identification Scheme (NLIS).

Meat Inspection and Quality Assurance Network (2013/9411)

In 2013–14, AMPC continued its partnership with MINTRAC to facilitate meetings of the Meat Inspection and Quality Assurance (MI/QA) Network. The MI/QA Network targets meat industry employees on matters regarding the quality and food safety environment in which the Australian meat processors operate. The target audience includes plant managers, quality assurance managers, meat inspection personnel and industry regulators.

The content for these meetings covers a range of industry R&D outcomes. In 2013-14, this focused on yard design, electrical carcass stimulation, sources of *E. coli*, animal welfare and micro-contamination. The network also addressed a wide range of state and Commonwealth government policy changes impacting the meat industry.

The 10th annual MI/QA Conference was held in Melbourne in September 2013 and attracted 110 delegates from all states and territories. Speakers addressed a range of topics from slaughter-floor interventions to the control of

microbial contamination, process control, animal health feedback, and cross contamination in laboratories. Many of the workshops presented findings from current industry projects or research work.

The MI/QA Network has been critical in helping industry develop strategies to address some of the major challenges it faces in the near future, including:

- › increased review of export documentation
- › providing meat inspection services in the export sector
- › training meat inspection students in new environments
- › biosecurity training for staff
- › supply chain quality assurance.

Meat Industry Training Network (2013/9409)

The Meat Industry Training Network helps ensure that R&D outcomes, innovations, new regulatory requirements and industry requirements are embedded in the meat industry training system, and that training is delivered and assessed consistently across the industry.

Almost 330 delegates attended the 12 network meetings held throughout 2013–14, which examined a range of issues, initiatives and outcomes.

Industry trainers received new knowledge by discussing AMPC-funded projects, particularly those in which MINTRAC was directly involved. A number of AMPC RD&E projects have resulted in the development of new units of competency, which are now ready to be included within the Australian Meat Industry Training Package. Other projects have led to existing training materials being reviewed and updated.

The 10th annual National Meat Industry Training Conference was held over two days in March 2014, and provided a comprehensive program of presentations, workshops and celebrations of training achievement. This year's Meat Industry Training Awards and prizes were presented at the training conference dinner in March.

PROGRAM 4: IMPLEMENTATION, EXTENSION AND EDUCATION

Summary of other projects: FY 2013–14

The following table summarises other examples of implementation, extension and education projects undertaken during FY 2013–14.

Project name	Project summary
RIRDC Primary Industries WHS Partnership (PIHSP) (2013/5045)	<p>The PIHSP is committed to achieving significant WHS benefits for all primary industries by developing research projects that address primary industry-wide issues.</p> <p>The PIHSP:</p> <ul style="list-style-type: none"> › determines what influences WHS in primary industries › identifies and addresses the barriers to adopting improved WHS outcomes › helps industry members apply approaches that will deliver improved WHS outcomes within primary industries. <p>The partnership is currently in its early stages. AMPC is establishing reference groups to explore the various barriers and facilitators that exist in the meat processing industry, and to encourage the development of strategies to address these barriers. AMPC is also analysing WHS research to form a primary industry-wide view of focus areas and gaps in WHS research.</p>
Request for permit (RFP) validation training (2013/5037)	<p>Until recently, on-plant personnel authorised by the Department of Agriculture validated and authorised RFPs. The Department of Agriculture has now resumed responsibility for this process; however, on-plant personnel need to maintain a holistic understanding of the processes and assurances underpinning RFP validation.</p> <p>Due to issues with the integrity of the current RFP process, AMPC recently commenced a project to determine the current company processes underpinning RFP validation, and to identify the quantum of training required to address European Union (EU), Department of Agriculture and broader industry concerns.</p> <p>This project includes:</p> <ul style="list-style-type: none"> › determining the nature of EU, Department of Agriculture and broader industry concerns › assessing the sources of ongoing difficulty in raising accurate RFPs › identifying and addressing short-term training needs. <p>Since commencing this project in mid-2014, AMPC has consulted with the Department of Agriculture, export processors and AMIC to identify major issues associated with raising RFPs and issuing health certificates.</p> <p>AMPC has also delivered workshops designed to meet companies' operational requirements, and to ensure companies have interim training materials that help them meet ongoing compliance requirements.</p>

PROGRAM 4: IMPLEMENTATION, EXTENSION AND EDUCATION

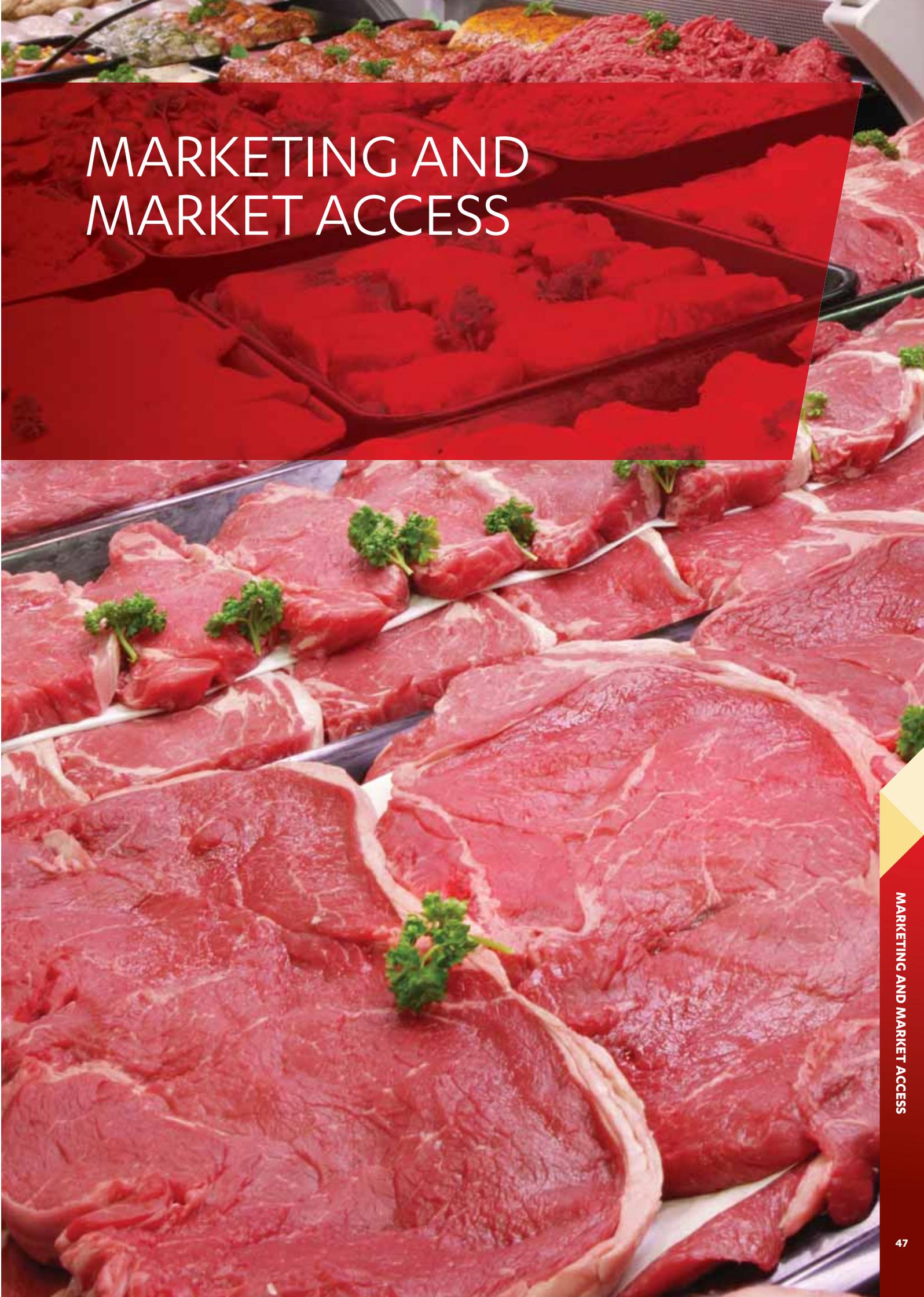
Summary of other projects: FY 2013–14

Project name	Project summary
Review and update of the Australian Meat Industry Training Package training and assessment materials (2013/1060)	<p>As a part of the continuous improvement of the Australian Meat Industry Training Package (MTM11) and following submissions from industry to have new training units developed, it was decided to redevelop these key training and assessment materials.</p> <p>There are currently around 500 units of competency. Stage one of this projects has involved:</p> <ul style="list-style-type: none"> › reviewing and updating training text, as required › transferring training text to a new template › identifying and actioning technical review requirements › confirming all references to standard Acts › updating tables of contents and reference lists.
Intercollegiate Meat Judging Competitions 2011–16 (2013/9209)	<p>AMPC has been a major sponsor of the Australian Intercollegiate Meat Judging Association (ICMJ) since 2004. The ICMJ enables students to enhance their knowledge base and expands the network of young meat industry representatives that will represent and drive the Australian meat industry into the future.</p> <p>In 2014, almost 150 students from 10 Australian universities – and four international teams from the United States, Japan, South Korea and Indonesia – competed for the Roy McDonald Shield sponsored by MLA. Thirty-five coaches supported the various teams. The overall winner of the event was the All American Team from Garden City Community College and Clarendon City College in Kansas.</p>
Australian Rural Leadership Program Course 21 (3000/5102)	<p>AMPC has been a major contributor to the Australian Rural Leadership Program (ARLP) since 2003. In 2013, AMPC sponsored Beau Taylor from Teys Australia to take part in the program.</p> <p>The ARLP is a leadership development program that facilitates a network of informed, capable and ethical leaders who are able to work collaboratively to advance the interests of their industries, businesses, communities and rural Australia in general.</p>
Extension to the yard lairage and restrainer design project (2013/5028)	<p>AMPC previously funded a project which reviewed existing research into the appropriate design for stockyards and restrainers. In the same project the existing resources and training available to help industry personnel design and modify stockyards were considered. As a result of this review, a paper-based resource focusing on yard and restrainer design was developed.</p> <p>As an extension to this project, AMPC has provided funding to conduct professional development sessions focusing on yard design, and to develop an e-learning extension package that addresses industry needs.</p>

PROGRAM 4: IMPLEMENTATION, EXTENSION AND EDUCATION

Summary of other projects: FY 2013–14

Project name	Project summary
<p>Meat science electronic webinar tutorials (3000/5082)</p>	<p>Uncertainty over the implications of detecting Shiga toxin <i>E. coli</i> (STEC) in the United States continues to affect Australian shipments of grinding meat exported to the US market.</p> <p>A range of research projects are currently exploring controls for <i>E. coli</i>; however, there is no assurance that processors have access to up-to-date information on the various interventions available or to other approaches that enable individual processors to minimise risk.</p> <p>This web-based interactive learning platform complements these initiatives and provides industry members with the most up-to-date information.</p>
<p>Livestock handling training for meat processors – extension to include dogs and horses (2013/9410)</p>	<p>This project sought to evaluate the existing training and assessment programs in place for livestock handlers using working dogs and stock horses at meat processing establishments.</p> <p>As a result of this project, a new unit of competency for working-dog handlers has been developed along with training and assessment support materials. This training has been piloted with trainers, students and lairage workers, and was received well.</p> <p>The training and support materials for the existing unit of competency for stock-horse handlers has been rewritten in order to place more emphasis on establishing baseline riding skills as well as good WHS practices. These materials have been successfully trialled with experienced stock handlers and trainers. A number of companies are now introducing the course as a basic induction program for new stock handlers using horses.</p>
<p>Identifying barriers to technology adoption in the red meat processing industry (2013/9207)</p>	<p>This project aimed to determine the extent to which drivers of and barriers to technology adoption are associated with meat processors' technology practices, and processors' knowledge and attitudes in relation to technology uptake.</p> <p>Overall, the factors that independently influenced adoption were:</p> <ul style="list-style-type: none"> › the size of the organisation › levels of concerns about the possible barriers › positive attitudes to adoption › capital costs › being considered an industry leader in adopting technology.



MARKETING AND MARKET ACCESS



MARKETING AND MARKET ACCESS

As has been mentioned earlier in this report, in addition to AMPC investments in the core program, the company also invests with MLA in the joint program which focuses on through supply chain activities, and in particular market access.

Market Access

MLA assists industry and government to defend or increase access to export markets by providing research and market intelligence services, undertaking trade liberalisation advocacy programs, and building in-market alliances.

MLA invested \$7.4 million in supporting industry and government to maintain and liberalise export markets during 2013-14, including \$3.5 million of AMPC contributions. Priorities during 2013-14 included assisting government in finalising Free Trade Agreements (FTAs) with Korea and Japan, progressing priorities under the Australia-China FTA and Trans-Pacific Partnership trade talks, assisting in alleviating access impediments in Indonesia, and directing efforts to tackling technical trade barriers.

With the protracted World Trade Organization Doha Round talks failing to deliver any outcomes on market access over the past year, the successful conclusion of FTA negotiations with major trading partners has been the highest priority for industry.

These efforts paid dividends in the recently-concluded FTA negotiations with Korea. On 8 April 2014, the Korea-Australia Free Trade Agreement (KAFTA) was signed by the respective governments following seven years of negotiations. The KAFTA delivered on industry's priority for beef by securing elimination of the 40 per cent import tariff over a 15-year time period that is equivalent to (albeit lagging) the Korea-United States FTA. Importantly, this outcome will minimise

the competitive disadvantage Australian beef faces in our fourth largest beef export destination.

KAFTA also secured the elimination of the 22.5 per cent tariff on sheepmeat and goat meat over 10 years, elimination of the 18 to 27 per cent offal tariffs over 15 years, elimination of the majority of tariffs on processed meat and co-products over 15 years, and the elimination of the majority of tariffs on live animal exports over 15 years.

The second major trade agreement negotiated during 2013-14, was the Japan-Australia Economic Partnership Agreement (JAEPA), which was signed on 8 July 2014. As with KAFTA, the JAEPA process involved close liaison between industry and the Australian Government. Although the Japanese beef tariff regime was a major point of conjecture in the negotiations, the JAEPA outcome will result in the tariff on frozen Australian beef entering Japan dropping from the current 38.5 per cent to 19.5 per cent over an 18-year period and the tariff on chilled beef reducing from 38.5 per cent to 23.5 per cent over 15 years. Importantly, in year one of the JAEPA, the tariff on frozen beef will be cut by 8 per cent to 30.5 per cent and there will be a 6 per cent cut for chilled beef – delivering a clear preferential tariff advantage over other imported beef suppliers into the market.

Following MLA research undertaken last year which quantified the impact of various technical barriers to trade (TBTs), industry through AMPC is currently strengthening its capability in tackling these barriers in conjunction with the Australian Government with an initial focus on impediments in the Middle East and China. Updated in May 2014, MLA's research identified more than 260 TBTs in 40 key markets – 139 of which have significant trade distorting impacts. In combination, these TBTs have a total impact of almost AU\$1.3 billion per year.

MARKETING AND MARKET ACCESS

Domestic Marketing

During 2013-14, AMPC invested \$908,000 in beef domestic marketing with MLA, which included the rollout of two major beef marketing campaigns during the key consumption seasons in summer and winter.

The summer campaign entitled *Throw another steak on the Barbie* was launched in November 2013 and encouraged Australians to cook steak on the barbecue rather than shrimp. During the campaign, fresh beef sales volumes increased by 2.5% and steak sales increased by 1.4% year-on-year. The winter beef campaign, which was undertaken during June and July 2014, empowered Australians to cook more winter beef meals by dispelling confusion about cuts and cooking methods.

A new mobile app, *SteakMate*, was launched to help Australians cook the perfect steak by providing the proper cooking instructions. The *Beef Oracle* website, www.askthebeeforacle.com, which answers consumers' beef questions, had over 90,000 unique visits.

During the period, AMPC also invested \$312,000 in lamb domestic marketing with MLA, which involved the roll out of three domestic lamb marketing campaigns.

Sam Kekovich celebrated a decade as *Lambassador* in the Australia Day campaign in January 2014. With Sam Kekovich taking a step back, *Generation Lamb* was developed. During the Australia Day week, lamb sales rose by 21.9%.

MLA's spring lamb campaign *Lamb is for Lovers* was launched in September 2013. However due to an increase in lamb prices, retail sales volumes of lamb decreased by 3.8% year-on-year.

MLA's *Easy Lamb Roast* campaign, which promoted small cuts that can be roasted in 30 minutes, was undertaken during the autumn period. This campaign featured the launch of a new *LambRoast* mobile app that had almost 1,240 downloads by 30 June 2014. However due to a 10.9% price increase, lamb sales volumes fell by 10.7%, which resulted in value share falling by 0.5% to 12.9%.

Demonstrating the importance of red meat in the diet

During 2013-14, AMPC invested \$690,000 in this program which demonstrates the importance of red meat in the diet. The *Proper Dinners* campaign targeted consumers with messaging based on key life stages. The campaign reached an accumulative audience of 16 million consumers in outdoor advertising, 8.8 million in print advertising and 13 million in online advertising impressions.

Sixteen nutrition research projects were funded during 2013-14 into the role of beef and lamb in the Australian diet. These projects addressed the importance of red meat in the diet, with a particular focus on ageing, young women, toddlers, depression, diabetes, gut health and sleep. MLA held a nutrition symposium on *getting the balance right*, which addressed dietary imbalances. Hosted by the Dieticians Association of Australia, the symposium attracted more than 420 attendees.

A *Back to School* campaign in January 2014 concentrated on the preparation of healthy school lunches and quick, nutrient-rich dinners for children. The campaign offered tips and recipes on turning left-over healthy beef and lamb meals into lunch ideas.

MLA worked with GPs to promote beef and lamb's role in a healthy weight loss diet as part of the *Live Well Plan*, which was independently reviewed by the National Heart Foundation and the Dieticians Association of Australia. This plan was aimed at adults needing to lose weight and improve cholesterol, blood pressure or blood glucose levels. An online training module launched in September 2013 was developed for GPs on how to treat overweight patients using the *Live Well Plan*. A total of 950 GPs have completed the module.

LIST OF ACRONYMS

AAWCS	Australian Livestock Processing Industry Animal Welfare Certification System	RD&E	Research, development and extension
ABARES	Australian Bureau of Agricultural Resource Economics and Science	RDC	Research and Development Corporation
AHA	Australian Health Australia	RFP	Request for permit
AMIC	Australian Meat Industry Council	RTE	Ready-to-eat
AnMBRs	Anaerobic membrane bioreactors	SBR	Solids bioreactor
ARLP	Australian Rural Leadership Program	SMP	Strategic Market Plan
CBA	Cost benefit analysis	SRM	Specified risk material
CAL	Covered anaerobic lagoon	SRT	Solids retention time
COD	Chemical oxygen demand	STEC	Shiga toxin <i>E. Coli</i>
DAF	Dissolved air flotation	t CO ₂ -e	Per tonne of carbon dioxide equivalent
ECC	Energy cost curve	TBARS	Thiobarbituric acid reactive
ERF	Emissions Reduction Fund	TCOD	Total chemical oxygen demand
ES	Electrical stimulation	TSEFAP	Transmissible Spongiform Encephalopathy Freedom Assurance Program
EU	European Union	VIP	Variable independent path
FTE	Full-time equivalent	WHS	Workplace health and safety
GHG	Greenhouse gas	ZT	Zero tolerance
HRT	Half-day hydraulic retention time		
ICMJ	Intercollegiate Meat Judging		
IMF	Intramuscular fat		
MACC	Marginal abatement cost curve		
MHA	Meat hygiene assessment		
MI/QA	Meat Inspection and Quality Assurance		
MISP4	Meat Industry Strategic Plan		
MLA	Meat & Livestock Australia		
NSW DPI	NSW Department of Primary Industries		
OCM	Objective carcass measurement		
PAC	Program Advisory Committee		
PAO	Polyphosphate-accumulating organism		
PEF	Pulsed electric field		
PIHSP	Primary Industries WHS Partnership		

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