Methane to Markets in Agriculture R&D Plan
2007 – 2009
Methane to Markets in Agriculture Program

Research & Development Plan
2007 to 2009

by Griff Rose

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Foreword

The Methane to Markets in Australian Agriculture Program was established in June 2007 by a collaboration of the Australian Government and industry and forms part of the Methane to Markets Partnership of international countries.

The Australian intensive livestock industry is the principal focus of the Methane to Markets Program. It is both diverse and expanding, with many benefits to be gained by the capture and use of emitted methane as an integral part of its operation.

This Program Plan builds on the outcomes of stakeholder meetings conducted in late 2006 and early 2007 and industry consultation to determine the key issues and priorities for research support. The Plan identifies key objectives for investment and areas for future consideration and details the agreed strategic research and development needs that RIRDC will pursue in partnership with industry.

The Program is funded by the Department of Agriculture, Fisheries and Forestry from the Natural Heritage Trust and the National Landcare Program. Industry funding and support has been received from the Rural Industries Research and Development Corporation, Dairy Australia, Australian Pork, Meat and Livestock Australia and the Australian Lot Feeders’ Association.

This research and development plan is an addition to RIRDC’s diverse range of over 1,700 publications, and part of our New Rural Industries Portfolio. It aims to assist in the widespread uptake of methane capture and use in Australia’s intensive livestock and associated processing industries.

Most of RIRDC’s publications are available for viewing, downloading or purchasing online through our website:


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**Peter O’Brien**  
Managing Director  
RIRDC

**Ralph Leutton**  
Chairman  
M2M in Agriculture Steering Committee
Snapshot of the Program Plan

Goal
To encourage and enable development, adaptation and use of methane capture and use technology in the Australian intensive livestock industries.

Objectives
1. Development and adaptation of methane capture and use technology for application in the Australian intensive livestock industries.
2. Reduction of the uncertainty, risk and cost of installing methane capture and use systems.
3. Effective communication of the project outcomes.
4. Facilitation of commercialisation of on-farm systems for methane capture and use technology.

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1. Introduction

Methane capture and use has been identified as a priority area for emission reductions in the livestock sector as part of the National Agriculture and Climate Change Action Plan 2006-2009. Internationally, the Methane to Markets (M2M) Partnership is designed as an action-oriented initiative aiming for multiple benefits to reduce methane emissions worldwide, while enhancing economic growth, promoting energy security through diversification and improving environmental returns.

M2M partners have agreed to focus on practical, cost-effective, near-term projects to recover methane for use as a clean energy source.

The M2M Partnership involves 19 member countries, including nine of the top 10 methane emitting countries. Founding members account for 60 per cent of human-influenced methane emissions.

Australia’s National Greenhouse Gas Inventory estimates that on-farm activities (excluding energy use) produce around 18 per cent of overall national emissions. This is greater than Australia’s transport based emissions, making the agricultural sector the second largest source of greenhouse gases in the country (after electricity production). Methane is the dominant agricultural greenhouse gas in Australia, with methane from livestock representing 12 per cent of national greenhouse gas emissions.

The potential for capture and use of methane from livestock is greatest in the intensive livestock industries, where manure management is estimated to contribute three per cent of emissions from Australian agriculture.

The Methane to Markets in Australian Agriculture Program is part of Australia’s response to the M2M Partnership, which has recently commenced to explore the potential for economic and sustainable mitigation of methane in the intensive livestock industries. The program is a collaboration of industry and government to specifically target the dairy, beef feedlot and pork sectors and associated processing operations.

This document is the Research and Development (R&D) Plan for Australia’s Methane to Markets in Agriculture Program. It focuses on the areas of R&D that have the greatest potential value for the enhanced uptake of technologies for methane capture and use in Australia’s intensive livestock industries and associated processing sectors, and where there are capabilities to provide high quality R&D.

Historically methane capture and use in Australia’s intensive livestock industries has had limited scope for implementation. With few notable exceptions, the available benefits have not matched the capital and operational costs of prospective projects. Much of the delay has largely revolved around economies of scale and the relative price of energy.

In a carbon constrained economy with emissions trading, however, the viability of this technology will be substantially changed and the scope of its application enhanced. This Methane to Markets R&D program will concentrate on adapting existing technologies to suit the characteristics of Australian intensive livestock industries.
Preparation of the Plan
The R&D plan was developed by the Program Steering Committee in consultation with key stakeholders. The key issues identified were:

- What issues are facing the industry that requires R&D as part of the process towards solving these issues?
- What are the pathways by which the R&D outputs will contribute to the solution?
- What is already being addressed well overseas?
- In what priority areas do Australian researchers have an advantage?
- What level of investment is required for the science to be successful and for its adoption to occur?
- What communication paths are available and suitable to inform the industry of the results of the program?

Overview of the Program Plan
The vision and mission for the Methane to Markets R&D Program have been developed to guide the implementation of the program over its expected life.

Vision
Australian intensive livestock and related processing industries benefiting environmentally and economically from technologies for sustainable and profitable capture and use of methane from livestock waste.

Mission
Manage investment in research and development from Australian intensive livestock industries and government to:

- ensure the best environmental outcome with respect to methane gas emissions
- make methane capture and use viable
- enhance the skills, knowledge and capability of people in the industries in relation to methane capture and use.

Goal
To encourage and enable development, adaptation and use of methane capture and use technology in the Australian intensive livestock industries.

Objectives
1. Development and adaptation of methane capture and use technology for application in the Australian intensive livestock industries.
2. Reduction of the uncertainty, risk and cost of installing methane capture and use systems.
3. Effective communication of the project outcomes.
4. Facilitation of commercialisation of on-farm systems for methane capture and use technology.
5. Derivation of maximum benefit for Australia from the international M2M Expo in Beijing in November 2007. 2. Alignment with Government and RIRDC priorities
This plan is consistent with the ‘Mitigation’ strategies under the *National Agriculture and Climate Change Action Plan 2006-2009* and also aligns with the Federal Government’s *National research priorities and Rural research priorities* and with RIRDC’s corporate objectives.

**National Agriculture and Climate Change Action Plan 2006-2009**

This Action Plan provides strategies and actions that promote the mitigation of greenhouse gases for multiple benefits to agriculture and natural resource management. Specifically the Plan targets the reduction of methane emissions from intensive livestock industries and associated processing operations through research and development and integration with best management practices to improve efficiency.

**National research priorities**

The relevant national research priorities and the contribution the Plan makes to these priorities are set out below.

- An environmentally sustainable Australia
- The Plan has strategies designed to identify and reduce the impact of the intensive livestock industries on the environment. The capture and use of methane from these industries has the potential to reduce both the global warming impact of the methane itself and reduce the demand for fossil fuels.
- Safeguarding Australia

A major focus of the Program is introducing a level of energy self-sufficiency in the crucial sector of food production.

**Rural research priorities**

The objectives of the Plan, and associated research, will meet on an individual basis either one or more of the rural research priorities set out below.

- Manage natural resources sustainably
- Improve competitiveness through a whole-of-industry approach
- Create a culture of innovation, largely by investing in the sector’s most important asset—its people.

**Contribution to RIRDC Goals**

RIRDC has an overarching goal of maximising the return across the triple bottom line of its investments. The Methane to Markets Program is part of the Bioenergy, Bioproducts and Energy Program in RIRDC’s New Rural Industries portfolio, the key objective of which is:

To meet Australia’s research and development needs for the development of sustainable and profitable bioenergy and bioproducts industries.
3. Target Industries

Dairy

*The industry*

The dairy industry is one of Australia’s major rural industries. Based on a farm gate value of production of A$3.3 billion in 2005-06, it ranks third behind the beef and wheat industries. Approximately 40,000 people are directly employed in the dairy industry, on farms and in manufacturing plants. The national dairy herd is about three million head. Dairy is also one of Australia’s leading rural industries in terms of adding value through further downstream processing. The Australian Bureau of Agricultural and Resource Economics (ABARE) estimates a regional economic multiplier in the order of 2.5 from the dairy industry.

The industry has traditionally been divided into two main sectors. Approximately 20 per cent of production goes into the drinking milk sector, the rest into manufacturing. The four major manufactured product streams are:

- skim milk powder, butter milk powder
- butter/casein
- cheese
- whole milk powder.

*Location and structure*

The industry is predominately pasture based, with approximately 75 per cent of cattle feed requirements coming from grazing. This results in efficient, low-cost, high-quality milk production. Australian milk production costs are well below those in most other major dairy-producing regions around the world. Most dairy production regions are located in coastal areas, where pasture growth generally depends on rainfall.
There are two inland irrigation schemes located in northern Victoria and southern NSW that are very significant and account for around a quarter of national milk production. Feedlot dairying remains the exception in Australia although the use of supplementary feed – grains, hay and silage – is widespread.

Owner operated farms dominate the Australian dairy industry, with share farmers accounting for 16 per cent of the industry. Over the last twenty years farm numbers have halved but total production has remained fairly constant. Improvements in genetics and farm practices have seen the average yield per cow increase from 2,850 litres per year to around 5,000 litres per year over the past two decades.

The industry is beginning to see the emergence of very large dairy operations and 50 per cent of the milk is now produced by 20 per cent of dairy farm businesses. Whilst the average herd size in 2005-06 was 224, larger operations may have several herds of 1,000 cows.

There is no legislative control over the price that milk processing companies pay farmers for their milk. Farm gate prices can vary between manufacturers, with individual company returns being affected by factors such as product and market mix, marketing strategies and processing efficiencies.

**Main markets**

Around 65 per cent of manufactured product overall (in milk equivalent terms) is exported and the remaining 35 per cent is sold on the Australian market.

While Australia accounts for an estimated two per cent of the world’s milk production, it is an important exporter of dairy products. Australia ranks third in world dairy trade with a 12 per cent share of the trade, behind New Zealand and the European Union.

Australian exports are concentrated into Asia/East Asia, which represented 66 per cent of the total value A$2.7 billion in 2005-06.

**Methane capture and use**

The greenhouse gas emissions for dairy are:

- **methane** – 67 per cent (of which 1.3 per cent of the overall total is due to methane emissions from effluent ponds the rest is enteric methane)
- **nitrous oxide** – 24 per cent (from fertiliser, urine, dung and soils)
- **carbon dioxide** – 9 per cent (from energy).

As the figures indicate methane production from effluent ponds is only very small in comparison to enteric emissions. The potential benefits of a methane digester may be associated with energy saved in the dairy.
Beef

The industry

The beef industry is one of Australia’s major rural industries. The national beef cattle herd size is 27 million head, down from 1970s highs of 30 million head. Each year Australia produces just over 2 million tonnes of beef and veal (ABS 2005-06). The gross value of Australian cattle and calf production (including live cattle exports) is approximately A$7.4 billion (ABARE 2005-06).

Location and structure

A total of 71 per cent of Australian beef and veal production is sourced from Queensland and NSW (ABS 2005-06). In the June quarter 2007 there were 870,025 head of cattle on feed (with the majority of cattle on feed located in Queensland and New South Wales) and there was national feedlot capacity for 1,124,067 (ALFA/MLA Survey). However, the beef cattle industry as a whole is extremely diverse – both geographically and in management style. It ranges from extensive large scale unfenced cattle stations in the north and west of Australia, to intensively managed small holdings in the south-east.

Australia has a ‘whole of chain’ approach to the production of safe and wholesome beef. It relies on each sector implementing a HACCP-based quality assurance system to ensure safe practices and enable traceback to all levels, right back to the property of birth.
Main markets

In 2005-06, Australia exported 65 per cent of its total beef production (DAFF/ABS). The value of total beef exports in 2005-06 was approximately A$4.5 billion (ABS). Australian live cattle exports were valued at A$404.4 million in 2005-06 (ABS). About 87 per cent of live cattle exported from Australia are shipped from WA and the NT in 2005-06 (ABS).

Domestic expenditure on beef is estimated at A$6.4 billion in 2005-06 (MLA estimate). Australians eat around 35.6 kg per person yearly (carcase weight—MLA 2005-06 estimates). With a 35 per cent market share beef is the number one selling fresh meat at retail (Roy Morgan Brand Planner 2005-06). In volume terms beef is the second most popular fresh meat consumed through the food service industry after chicken (BIS Shrapnel).

Methane capture and use

The beef cattle industry and specifically the beef cattle feedlot industry face several challenges not faced by the pork and dairy industries with respect to the capture of methane. Physically the vast majority of manure produced on a feedlot is harvested in a semi dry form that precludes it from anaerobic digestion without the addition of significant amounts of water.

Effluent management within a feedlot utilises effluent sedimentation, holding and evaporation ponds. The volume of methane produced from these ponds is currently unknown and obtaining this knowledge is part of an M2M research project.

Most of Australia’s larger feedlots process their grain using a process called ‘steam flaking’ where the grain is cooked with steam. The steam is produced by either a gas or diesel fired boiler. The gas requirement for an average steam flaking feedlot is on the order of 750,000+ litres of LPG per year. This could be directly substituted with methane in its raw form from an anaerobic digester.

Feedlots also have significant electricity requirements, though given the ease of use of methane through a boiler the use of methane to run a generator may be unviable or unrealistic.

The processing industry produces significant amounts of effluent that would be ideally suited to anaerobic digestion. Abattoirs also have significant requirements for electricity and for fuel to fire a boiler. Methane could be utilised for both of these.
Pork

The industry

The Australian pork industry produces pork to be eaten fresh or manufactured into other products such as ham, bacon and salami. The farm gate value of pork in 2005-06 was A$867 million (ABARE) while the value of the wider pork industry is estimated at A$2.6 billion (APL 2007). The industry provides in excess of 30,000 jobs.

Location and structure

The pork industry is predominately located in Australia’s major grain production regions. Of the states, New South Wales, Queensland and Victoria have the largest number of pigs.

Figure 1: Distribution of Australian Pig Producers (APL 2005)

Approximately two-thirds of Australia’s pork production capacity is found in about 100 large piggeries—each with over 500 sows. This shows a strong trend towards intensification in the industry. The number of pork producers has halved every 7-9 years since the ABS included piggeries in its agricultural surveys in the 1960s while sow numbers have remained close to 310,000 over this period. Pork output has shown increases due to improved productivity per sow and increased carcase weight.

Main markets

Australia produces approximately 5.3 million pigs per year and 380,000 tons of pork. Approximately 13 per cent is exported by weight while the remainder is sold domestically for fresh pork or used in the manufacturing or food services sectors.
Australia’s main pork export markets are Singapore and New Zealand, with Japan, Korea and south-east Asian countries taking smaller quantities or specialist products such as offal. Exports were worth A$157 million in 2006-07.

*Methane capture and use*

For efficient methane capture, the pork industry will need to retrofit existing anaerobic lagoons or install smaller purpose-built lagoons. Currently the industry is assessing digester designs to digest solids waste from deep-litter pig housing.

At sites with less than 20,000 pigs, biogas will probably be flared for carbon credits and/or used to replace LPG for heating in the farrowing house and weaner sheds. At larger sites electricity generation will be considered.
4. Key Challenges

The key challenges for this program are:

1. **The need to reduce costs of installation and operation of methane capture and use systems**
   Generally to date, projected capital and operating costs have prevented potential methane capture and use projects from progressing. While mooted carbon trading has the potential to improve the equation, substantial cost reductions are still essential.

2. **The need for bankable lifecycle assessments**
   Appropriate project financing will only become available, and be taken up by the project principals, if all factors and costs can be reliably projected for the long term.

3. **The need for development and communication of decision support systems to allow adoption**
   The availability of comprehensive cost modelling tools, based on costs and income factors, derived from extensive R&D, are essential to enable informed and confident decisions to progress.

4. **The need to address regulatory failures and standardise policy settings across all jurisdictions**
   Risk, unnecessary cost and confusion (arising from regulatory failures and varying and conflicting policies and standards across Australia’s multi-level government structures) frequently result in abandoning project aspirations.

5. **The need to increase biogas yields**
   Given the extensive costs in establishing methane capture and use projects, researching methods to maximise the volume of methane captured for profitable use is essential.

6. **The need for appropriate and up to date design standards for relevant technologies**
   Safety, environmental issues, cost, reliability, and profitability are all dependant on appropriate and up to date design standards.
5. Research Directions

Common Issues
There are significant and often non-technical barriers and impediments to the adoption of methane capture and use. These include:

• the low cost of energy
• the lack of a sufficiently high environmental incentive to compensate
• the lack of uniform and suitable regulations
• the dispersed nature of the industries in Australia.

Dairy
The dairy industry identified the following issues:

• the development of a business case for farmers
• the identification of farm/factory synergies
• the need for simple and clear, two-way communication.

Beef
The beef industry identified the following issues:

• the need for a technology now to handle semi-dry feedlot waste
• the need for a range of site and capability innovation for feedlot and processors.

Pork
The pork industry identified the following issues, which are not all about money:

• social
• odour
• urban encroachment

the need for real data from at least four sites, demonstrating the technology at a small but credible scale.

Goal
To encourage and enable development, adaptation and use of methane capture and use technology in the Australian intensive livestock industries.

Objectives
The objectives that drive this Plan are:
1. Development and adaptation of methane capture and use technology for application in the Australian intensive livestock industries.
2. Reduction of the uncertainty, risk and cost of installing methane capture and use systems.
3. Effective communication of the project outcomes.
4. Facilitation of commercialisation of on-farm systems for methane capture and use technology.

Each of these objectives with its proposed strategies is addressed below.

Objective 1: Technologies

Objective
Development and adaptation of methane capture and use technology for application in the Australian intensive livestock industries.

Strategies
- Assess appropriate methane capture and use models that best suit the characteristics of the Australian intensive livestock industries.
- Assess Australian Standards and suitability of equipment for methane flaring against requirements of Europe and the US.
- Assess methane capture and use research and development activities occurring in both Australia and New Zealand.
- Pursue the identified priorities out of the above three preliminary reports.

Targets and indicators
- Publishing and promoting at least two independent reports produced by the Program
- Publishing and implementing this Research and Development Plan for the Program incorporating the priorities identified
Objective 2: Risk Reduction

Objective
Reduction of the uncertainty, risk and cost of installing methane capture and use systems.

Strategies
• Establish, monitor and evaluate demonstration and pilot sites for the intensive livestock industries.
• Develop tools to enable producers and processors to assess the viability of methane capture and use technology for their enterprises.
• Develop guidelines, design principles and technical specifications for industry best practice for methane capture and use.
• Implement processes to communicate effectively the results of the Program to participants in Australia’s intensive livestock industries.

Targets and indicators
• Capturing methane from at least one new site in each of the beef, dairy and pork sectors
• Publishing the results of performance monitoring at each site
• Publishing guidelines, design principles and technical specifications developed by the Program

Objective 3: Communication

Objective
Effective communication of the project outcomes.

Strategies
• Prepare ‘user-friendly’ reports and ‘how to’ guides.
• Deliver R&D results at appropriate fora.
• Assist with travel to remote demonstration sites for:
  – potential adopters of the demonstrated technology and procedures
  – potential project financiers.

Targets and indicators
• Publishing at least two ‘user-friendly’ reports and ‘how to’ guides developed by the Program
• Presenting Program results at the 2007 Bioenergy Australia Conference
• Assisting at least three potential adopters or financiers with travel to remote demonstration sites
Objective 4: Commercialisation

Objective
Facilitation of commercialisation of on-farm systems for methane capture and use technology.

Strategies
• Support and encourage commercialisation through Bioenergy Australia including:
  – providing links between the research providers and potential commercialisers through access to member networks
  – preparing feasibility studies and applications for funding of demonstrations from other sources
  – exploring potential funding for commercialisation such as:
    – Commercialising Emerging Technologies (COMET)
    – Renewable Energy Development Initiative (REDI)
    – Commercial Ready
• Disseminate reports through Bioenergy Australia

Targets and indicators
• Distributing at least three Program reports to Bioenergy Australia members
• Facilitating at least one feasibility study external funding application

Objective 5: M2M Expo

Objective
Derivation of maximum benefit for Australia from the international M2M Expo in Beijing in November 2007.

Strategy
Coordinate appropriate Australian representation.

Targets and indicators
• Managing the Australian agriculture sector’s successful participation in the Beijing M2M Expo
# 7. Budget

Table 7.1 Proposed Methane to Markets R&D Budget 2006-2008

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Appendix 1  Steering Committee

Members
Mr Ralph Leutton (Chair)
Mr Bruce Edgerton (Australian Pork Ltd.)
Ms Berenice Kincaid (Dairy Industry Representative)
Ms Cathy Phelps (Dairy Australia)
Mr Stephen Reynolds (Feedlot Industry Representative)
Dr Stewart McGlashan (Meat and Livestock Australia)
Mr Johnathan Duff (Pork Industry Representative)
Mr Griff Rose (RIRDC – Research Manager, Australian Methane to Markets in Agriculture Program)
Dr Roslyn Prinsley (RIRDC – General Manager, New Industries Portfolio)
Mr Simon French (Department of Agriculture Fisheries and Forestry)
Ms Vera Krisko-Jowe (Department of Industry, Tourism and Resources)
The Methane to Markets in Australian Agriculture Program was established in June 2007 by a collaboration of the Australian Government and industry and forms part of the Methane to Markets Partnership of international countries.

The Australian intensive livestock industry is the principal focus of the Methane to Markets Program. It is both diverse and expanding, with many benefits to be gained by the capture and use of emitted methane as an integral part of its operation.

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RIRDC manages and funds priority research and translates results into practical outcomes for industry. Our business is about new products and services and better ways of producing them. Most of the information we produce can be downloaded for free from our website: www.rirdc.gov.au.

Books can be purchased online or by phoning 02 6271 4166.