Greenhouse emissions attributed to agriculture are predominantly sourced from rumen fermentation, animal excreta and nitrogen fertilisers. Agricultural emissions represented 15.7% of Australia’s total net greenhouse emissions in the 2004 National Greenhouse Gas Inventory, the second highest source after stationary energy.

The main greenhouse gases emitted from agriculture are methane (CH$_4$) and nitrous oxide (N$_2$O), both powerful gases with 23 and 297 times the global warming potential of carbon dioxide (CO$_2$), respectively. Nationally, agriculture is the dominant source of both methane (60%) and nitrous oxide (85%).

Methane Emissions

Ruminant livestock are the single biggest source of methane emissions in Australia and the largest source of emissions from agriculture (71%). Large quantities of enteric methane are produced during fermentation in the rumen and released by burping or breathing. In Victoria, around 40% of all agriculture’s methane emissions are from dairy cattle, with beef cattle and sheep contributing 30% each. Over the past decade methane emissions from the Victorian dairy industry have increased by 25%, whilst emissions from the beef and sheep industries have declined, influenced mainly by changes in livestock numbers.

Methane is a highly concentrated form of energy; its emission represents a significant loss of energy from dairy production systems, energy that could be used in milk production. The energy lost from one dairy cow in a year represents enough methane to power a six-cylinder LPG car for over 1000km.

Methane Research: Dairy Cows

DPI Victoria’s Greenhouse in Agriculture (GIA) Methane team is investigating ways in which this lost energy can be efficiently re-directly back into production to provide a win-win outcome producing more milk, while also reducing greenhouse emissions.

Initial research focused on developing accurate measurement techniques, essential for investigating potential abatement practices and for achieving greater accuracy in national and industry estimates.

Measurement Techniques

Collaborating with research teams from the Universities of Melbourne and Wollongong, New Zealand and Canada, the GIA Methane team have tested and validated three techniques that ensure world class measurement capabilities:

- **Sulphur Hexafluoride (SF$_6$) Tracer method**: a technique for measuring methane from individual cows in the field, using evacuated canisters around the cows’ necks that continuously samples expired breath.

A dairy cow fitted with the SF6 collar for measuring methane in the field.
• **Open Circuit Respiration Chambers** – are sealed and climatically controlled rooms that house a single cow each, allowing the analysis of all the gases produced by the animal. This method is the “gold standard” for measuring methane as part of energy balance studies in cattle and has been used by the team to calibrate the SF₆ technique. Two of these chambers have been constructed at DPI-Ellinbank.

A dairy cow inside the respiration chambers viewed through the front feed access doors.

• **Open Path FTIR** – A technique for measuring methane from an entire herd in the field by passing a beam of light over a long path downwind of the cows.

**Quantifying Emissions**
Accurate measurement techniques have enabled the GIA Methane team to identify differences between individual animals, with animals being either high (450g methane/cow/day) or low (250g methane/cow/day) emitters of methane. This gives promise that cows can be bred for higher feed conversion efficiency and lower methane emissions.

They have also demonstrated that diet quality affects methane production, with animals on high quality pasture or balanced rations producing less methane (270 – 350 g methane/cow/day) than those on poor quality pasture or feeds (370 - 450 g methane/cow/day), linking productivity to emission rates. Improved feeding and breeding has potential to both improve milk production and reducing methane emissions.

**Current Research – Dietary supplements to mitigate methane emissions**
The GIA Methane team is currently testing a range of dietary supplements that in the first instance increase milk production economically, and secondly reduce methane production.

Condensed tannin from black wattle (Acacia mearnsii) and whole cottonseed are two feed supplements currently being investigated. Recent evidence from these and other studies have shown up to 30% reductions in methane, but the current research is also evaluating milk production impacts.

Monensin is a commercial dietary supplement currently used in bloat prevention. Research has shown economic increases in milk production with potential to reduce methane emissions.

**Research outcomes for the Dairy Industry**
There is potential to reduce methane emissions while improving the overall efficiency of milk production, through improved feeding and breeding of dairy cows. This is entirely consistent with continuous improvement in farm production efficiency.

The research is developing best management practices for feeding, breeding and management of dairy cattle that benefit both the environment and dairy farming systems. These practices are being integrated into existing industry extension programs.

This research has been funded by the Department of Primary Industries and the Victorian Greenhouse Strategy, with support from the Australian Greenhouse Office, Dairy Australia, AgResearch New Zealand and Agriculture and Agri-Foods Canada.

**Further Information**

- Research Web site
  - Best Management Practices
  - Emission calculators
  - Research newsletter

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