Estimated Greenhouse Gas Emissions

Jason & Michele Bake, Bonville, NSW

How are Greenhouse Gas Emissions measured on dairy farms?

The Dairy Greenhouse Gas Abatement Strategy calculator was developed to estimate the greenhouse gas (GHG) emissions for Australian dairy farms. DGAS estimates 3 sources of GHG, these being:

- **Methane** (CH_4) produced in the rumen by bacteria as a by-product of fermentation & in effluent storage as bacteria break down waste. **(Ruminant Digestion & Effluent Storage)**
- **Nitrous oxide** (N_2O) emitted with the management of animal waste and from nitrogen fertilisers **(Urine, Dung & N Fertilisers, Effluent Spreading)**. Direct (occurring on farm) and Indirect (loss to the environment through leaching/runoff and volatilisation).
- **Carbon dioxide** (CO_2) from the consumption of electricity and fuels on farm **(Power, Diesel & Petrol)** and CO_2 associated with the production of key farm inputs such as grains, forages & fertilisers. **(Pre farm gate manufactured products)**

CH_4 and N_2O have a higher potential to warm the environment, compared to CO_2, all emissions are converted into carbon dioxide equivalents (CO_2e). DGAS estimates the CO_2e emissions both as an annual total figure (tCO_2-e/annum) and as per tonne of Milk Solids produced (tCO_2e/tMS). This figure allows comparison between farms, irrespective of differences such as milking herd size and milk production.

What sort of Greenhouse Gas emissions can we expect on Australian dairy farms?

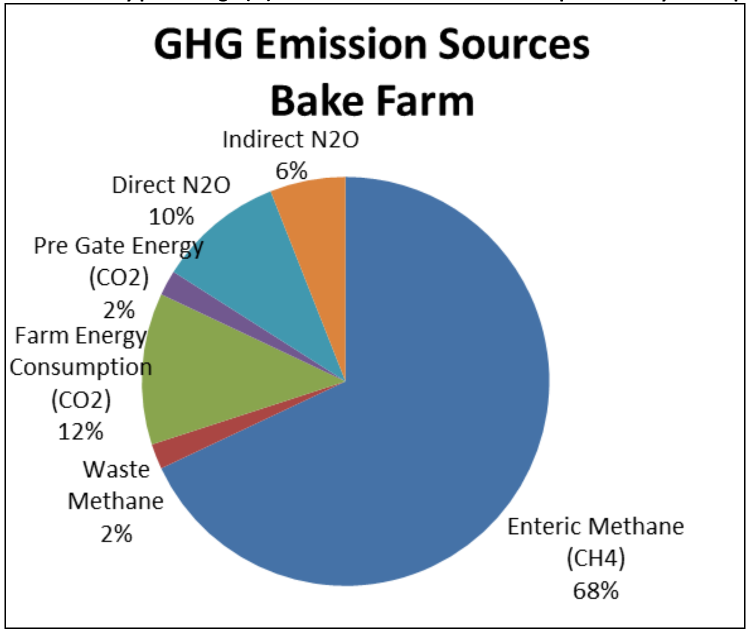
Recent data from The Dairy Farm Monitor Project indicates that GHG emissions on NSW dairy farms range between 9.4 to 17.2 tCO_2e/ t MS (DA Dairy Farm Monitor Project 2014/15). We can compare the Bake property to the NSW averages for the same period.

Table 1 GHG emissions intensity according to source against NSW State average (DFMP Project 14/15).

	Bake Farm 14/15		NSW Average 14/15	
	tCO_2e/t MS	%	tCO_2e/t MS	%
Enteric Methane (CH_4)	8.0	68	7.5	62
Waste Methane (CH_4)	0.2	2	0.6	5
Farm Energy Consumption (CO_2)	1.4	12	1.4	12
Pre Gate Energy Consumption (CO_2)	0.2	2	0.3	2
Direct N_2O	1.2	10	0.9	8
Indirect N_2O	0.7	6	1.5	12
TOTAL (tCO_2e/t MS)	**11.8**		**12.2**	

Estimated GHG emissions from the Bake's farm 14-15: 11.8 tCO_2-e/ t MS and or 1,711 total greenhouse gas emissions (tCO_2e/annum)*

Figure 1 Breakdown by percentage (%) of the source of GHG emissions produced by farm operations



***A full Qantas A380 flight from Sydney to London conservatively produces 1,759 tCO2e**

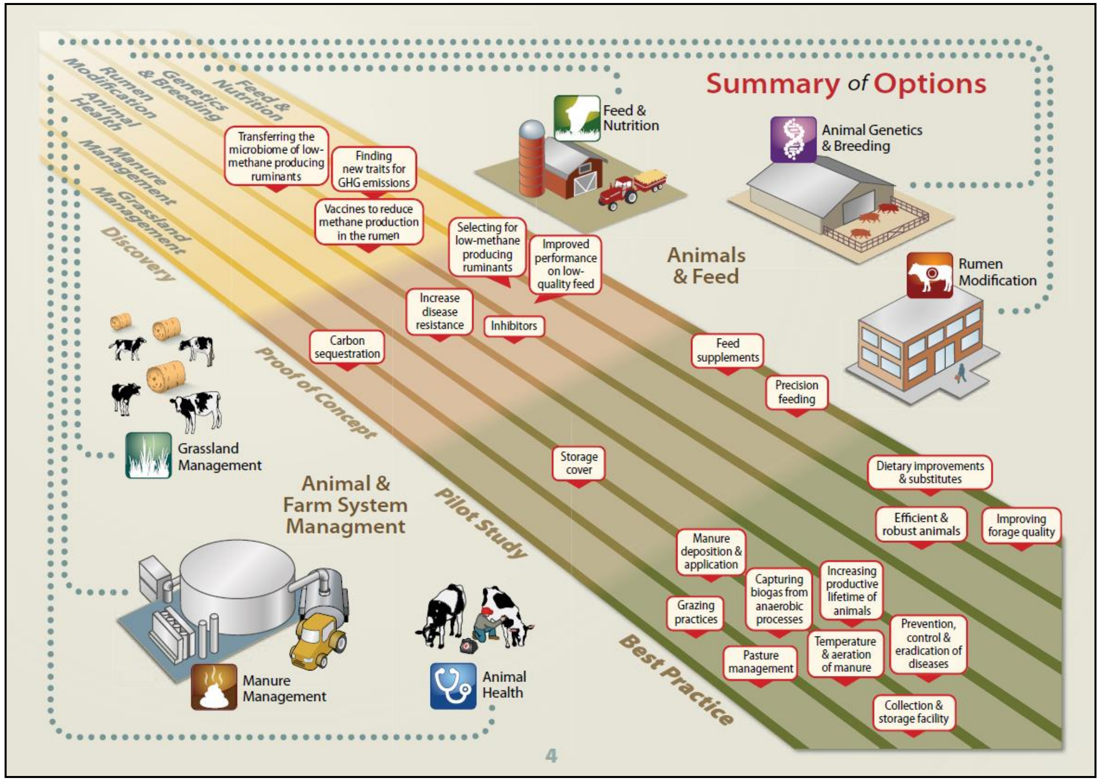
How are the Bakes performing?

- The farm has a GHG emissions intensity 0.4 tCO_2e/t MS under the NSW State average.
- The farm is significantly lower than the State averages for Waste CH_4 & Indirect N_2O because of their relatively low N use and effluent re-use management from both the dairy & feed pad.
- Both enteric methane and direct N_2O are above the State average, perhaps a reflection on feed quality and the efficiency with which the milking herd can convert the energy to milk.
- Energy consumption on the farm is equal to the NSW State average. Of the 12% of emissions from this source, 8% is from power and 4% diesel & petrol. It must be noted that the Bakes use their own machinery & equipment for most activities on the farm.
- 8ha of revegetated area on the farm is sequestering approximately 326.3 tCO_2-e/annum. If these trees were removed from the system, the emission intensity would rise to 14 tCO_2e/t MS, well above the State average.
- Jason & Michele are working towards a 310 lactating period for their milkers. This will not have any effect on the GHG emissions for the farm.

What can we do to reduce Greenhouse Gas emissions on dairy farms?

The most effective and efficient strategy to reduce enteric methane production is to manipulate the diet by increasing quality of feed through improved pastures and adding concentrates. Adding fat supplements such as whole cotton seed and linseed oil into the diet is also a proven method, though it is recommended that fats should not be more than 6-7% of the dietary dry matter. At present, well managed farms have few options to reduce emissions without significant changes to their farming or feeding system. With no formal incentive in place to reduce GHG emissions, Australian farmers should consider emissions reduction options that lead to productivity gains or have cost benefits. Any option should be looked at within the whole farm system. There is much research underway.

Figure 2 Options currently or in the future available to dairy farms to reduce greenhouse gas emissions



What are some potential options for the farm to reduce GHG emissions?

- Diet manipulation to decrease enteric methane & direct nitrous oxide emissions, especially those that demonstrate a production benefit (ie. increasing kgMS/cow) should be explored. Supplements with a higher dietary fat/ oil content and improving the digestibility of both winter & summer pastures should make a marked difference in total & intensity of emissions. For example, supplementing summer feed with greater quantities of Hominy meal that is already used on the property, or Brewers Grain.
- If the existing herd increased production by 5% (no other change), the GHG emissions intensity would reduce by 0.04 t CO_2-e/t MS, however, overall emissions would rise by 3.1 tCO_2e/annum.
- Improvements in the dairy shed and irrigation equipment to minimise power usage is always the best initial strategy. A pump performance assessment across the farm would be beneficial.
- Michele & Jason have identified solar energy options as something they would like to explore. The two examples below are only estimate costings and do not consider any incentives available, income potential if power is sold back into the grid or maintenance.
  - Solar hot water options for the dairy shed at an approximate cost of $11,000 to install may save an average 11,000 kWh annually ($3,212 based on current 29.2 c/kWh rate) , the GHG emissions intensity would reduce by 0.08 t CO_2-e/t MS and overall emissions would decrease by 11 tCO_2.e/annum.
  - A 30 kW solar panel option, at an approximate $70,000 cost to install, may save an average 37,000 kWh annually ($10,804 based on current 29.2 c/kWh), the GHG emissions intensity would reduce by 0.25 t CO_2-e/t MS and overall emissions would decrease by 37 tCO_2.e/annum.
- Further tree belts for shade & shelter are planned for the property. If a further 2 ha of revegetation were undertaken, GHG emissions intensity would reduce by 0.56 t CO_2-e/t MS and overall emissions would decrease by 81.6 tCO_2-e/annum.

Figures have been calculated using the Dairy Greenhouse Gas Abatement Strategy or DGAS. The calculator can be downloaded at www.dairyingfortomorrow.com

This information was prepared by Marguerite White, Dairy Australia Consultant- Land, Water & Carbon (NSW) for the Profitable Dairying in a Carbon Constrained Future project funded by Dairy Australia and the Australian Government. January 2016.