Addressing Emissions in the Dairy Industry

Nicholas Tait – Developer, DairyNZ
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We are not alone...

Agriculture in INDC mitigation targets
- GHG reduction target specifically includes agriculture
- Economy-wide GHG reduction target
- GHG reduction target excludes agriculture
- No INDC

NZ’s Unique Emission Profile

New Zealand’s emissions profile, 2015

- **Transport**: 18%
- **Energy generation**: 22%
- **Waste**: 5%
- **Agriculture**: 48%

- **Carbon dioxide (CO₂)**: 45%
- **Methane (CH₄)**: 43%
- **Nitrous oxide (N₂O)**: 11%

Comparison with typical developed country:
- New Zealand emissions: 11% other, 40% energy/transport, 49% agriculture
- Typical developed country: 9% other, 80% energy/transport, 11% agriculture


Note: Percentages may not add up to 100%, as they are rounded to the nearest percent.
Gases Effect on Climate

Calculated warming following emissions of:
- 1 tonne of methane
- 25 tonnes of carbon dioxide

Years after emission:
0 50 100 150 200 250

Modelled warming following emissions
Zero Carbon Bill Options

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<td>Reduce carbon dioxide</td>
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<td>Reduce nitrous oxide</td>
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<td>Stabilise methane</td>
<td>Reduce methane</td>
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<td>Offset remaining carbon dioxide with new tree planting</td>
<td>Offset remaining carbon dioxide and nitrous oxide with new tree planting</td>
<td>Offset all remaining gases with new tree planting</td>
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*Image source: Dairynz*
Farm Emissions/ha

Mean = 11.22 t/ha
Median = 11.22 t/ha

Percentage of farms (%)

Total GHG emissions per ha (tonnes)
Farm Emissions/ha by Region

- Northland
- Waikato
- BOP
- Taranaki
- LNI
- WC-Tasman
- Marl-Cant
- Otago-Southland
- New Zealand

GHG emissions as carbon dioxide equivalents (tonnes/ha)

- Methane
- Nitrous oxide
- Carbon dioxide
Agriculture’s contribution

The land sector is crucial to helping* countries meet their ambitions:

- Enable removal of CO\textsubscript{2}
  - afforestation, bioenergy, carbon capture & storage
- Reduce pressure from non-CO\textsubscript{2} gases
  - Methane and nitrous oxide

(* in addition to, not instead of, stringent reductions of CO\textsubscript{2} emissions by other sectors)
Inventory
NZ Inventory (2016)

- Agriculture’s make up 49.2% of NZ’s emissions
- Dairy farming makes up 46.5% of agricultural emissions
- Dairy farming makes up 22.9% of NZ’s emissions
Agriculture Emissions
Methane Emissions

Methane Emissions from Agriculture (kt CO2e)

- 6% Increase
- 128% Increase
- -41% Decrease
- -9% Decrease
- 25% Increase

Agricultures Efficiency

- New Zealand farmers have consistently made improvements in farming systems since 1990.
- Between 1990 and 2015, the emissions intensity of milk solids decreased by 29%.
- Without these improvements, agricultural emissions would have increased by almost 40%.

Source: MfE
The Carbon Cycle

Sources: NZAGRC
How Methane is Produced

RUMEN

95% Methane

Energy for milk

5% Metha

CH₄, Glc

CO₂ + H₂

Acetate

Propionate

Butyrate

CH₄

oesophagus

feed

methanogens

H₂

CO₂

bacteria

protozoa

fungi

VFAs

animal

remainder of the digestive tract

residual feed + microbes

95% Methane
Current Methane Research

1. Low CH$_4$ feeds (approx. 25% reduction with forage rape)
Current Methane Research

Low methane feeds

- Forage rape reduces CH$_4$ emission by 20-30% in sheep (limited cattle studies)
- Fodder beet (ongoing)
- High cereal diets (>80% of total diet)
- Maize silage (inconsistent response)
- Plants with tannins (e.g. birdsfoot, trefoil, sulla)
Current Methane Research

1. Low CH$_4$ feeds (approx. 25% reduction with forage rape)
2. Low CH$_4$ animals (approx. 4-6% reduction in grazing sheep)
Breeding: Selection of low emitters

- Trails mainly in sheep
- Sheep selected for divergent CH$_4$ yield on Lucerne pellets also express the same trait when fed fresh pasture
- Trails underway to establish traits in cows
Current Methane Research

1. Low CH$_4$ feeds (approx. 25% reduction with forage rape)
2. Low CH$_4$ animals (approx. 4-6% reduction in grazing sheep)
3. CH$_4$ inhibitors (approx. 30% for lead inhibitors)
4. CH$_4$ vaccine (targeting 30% reduction in wide range of systems)
How $\text{N}_2\text{O}$ is Produced
Low $N_2O$ feeds – early results

**Fodder beet**
39% lower emissions than kale.

| Fodder beet | 3.9 kg N$_2$O-N/ha | 6.4 kg N$_2$O-N/ha |

**Plantain monocultures**
28% lower emissions than ryegrass monocultures.

| Plantain monocultures | 1.6 kg N$_2$O-N/ha | 2.2 kg N$_2$O-N/ha |
Mitigation
Dairy Farm Mitigation

Methane Mitigation
- Methanogens
- Hydrogen + Volatile fatty acids → Methane
- Animal products

Manage dry matter intake

Nitrous Oxide Mitigation
- Nitrous oxide
- Nitrate → Ammonium → Urea

Manage nitrogen surplus
Managing dry matter intake

- Increase per cow performance/lower stocking rate
  - Increased genetic merit/breeding worth
  - Improve animal health
  - Improve reproduction
- Once-a-day milking
- Reduce replacement rates
- Improve pasture quality
- Change pastoral land to forestry
Reduce Replacement Rate

- Current rate 22-23%

- Modelling and farmlet trials suggest reducing rate to ~18% with improved breeding management can reduce GHG emissions by 2-11%
Managing N Surplus

• Optimise fertiliser and effluent use
  – Timing and rates
• Substitute N applications for low-N feed
  – Reduce overall intake
• Use low Nitrogen feeds
  – Fodder Beet/Plantain
• Stand-off/housing systems
  – Avoid urine deposition at risky times of year
• Urease Inhibitors
  – Limit volatilisation of ammonia
• There are co-benefits for water quality
Stand-off/housing systems

• Avoid urine deposition at risky times of year
  – Late autumn, early spring

• Keep animals off the paddock during wet season
  – Winter stand-off pad or animal shelters

• Potential unintended consequences….
  – Increase in other gaseous emissions e.g. methane? → ‘Pollution swapping’
  – Increase cow numbers to re-coup investment
What are we doing?
BERG, NZAGRC, PGGRC

Biological Emissions Reference Group
- Joint industry-government group
- Build an agreed evidence base on what the agricultural sector can do on-farm to reduce emissions, now and in the future,
- The costs and opportunities of doing so.
- Synthesis report of their research shortly.

NZ Agricultural Greenhouse Gas Research Centre
- MPI funded

Pastoral Greenhouse Gas Research Consortium
- Industry and MBIE funded
Dairy Action for Climate Change
2017-2018

“To address on farm dairy greenhouse gas emissions in the context of a profitable and sustainable dairy industry”
1. Building the Foundation

- RP GHG 101 roadshows to build awareness and provide the mitigation options currently available
  - 450 attendee over 9 roadshows in September 2017
- Train 60 RP’s at the Massey GHG courses
  - December 2017 & May 2018
- Building awareness and capability amongst the Dairy Environment Leaders and create climate ambassadors.
  - 9 DEL workshops on policy options and position
- Selected 15 climate change ambassadors
- Farmer Climate Change roadshow
  - 330 attendees over 8 workshops in June 18
Climate Change Ambassadors

- Selected from DEL farmers at the policy workshops
- Two-day training in Wellington with DairyNZ, MPI, MfE, AgR
- Aim to help other farmers understand the challenge of climate change
- Media representation

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<td>Aidan Bichan</td>
<td>Wairarapa</td>
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<td>Andrew Booth</td>
<td>Northland</td>
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<td>Dean Alexander</td>
<td>Southland</td>
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<td>Devon Slee</td>
<td>Canterbury</td>
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<td>Earle Wright</td>
<td>North Auckland</td>
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<td>Fraser McGougan</td>
<td>Bay of Plenty</td>
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<td>George Moss</td>
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<td>Jacqui Hahn</td>
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<td>John Hayward</td>
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<td>Keith Riley</td>
<td>Dannevirke</td>
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<td>Kevin Hall</td>
<td>Southland</td>
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<td>Theona Blom</td>
<td>Canterbury</td>
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<td>Trish Rankin</td>
<td>Taranaki</td>
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<td>Vern Brasell</td>
<td>Wairarapa</td>
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<td>Wayne Langford</td>
<td>Golden Bay</td>
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2. Steps to a Lower Emission Dairy Sector

- Characterise and implement farm system changes which have the potential to reduce biological emissions on dairy farms
- Establish 10 partnership farms across a range of farm systems throughout New Zealand.
Partnership Farm Objectives

‘This project will partner with farmers, scientists, rural professionals, and government to demonstrate the feasibility and practicality of implementing mitigation strategies to address greenhouse gas emissions and nitrate leaching from farm systems.’

• Set up ten GHG partnership farms across the country on a range of different farm systems
• To demonstrate the potential biological emissions reduction on dairy farms through farm system changes and to quantify the effect on production and productivity
• To ground-truth the farm system changes with dairy farmers
• To educate dairy farmers, rural professionals, and the wider sector of farm systems changes which may be possible and the implications of these changes.
Partnership Farm Project

TOR
- Expectations defined

Methodology
- Methodology and modelling protocol defined
- Measurement data defined

Selection criteria
- Good data
- Want to be leaders
- Ready to change to meet N leaching requirements
- Farms who have already made a changes

Case study
- WFA-team
- Define N and GHG baselines
- Mitigations selected
- Model scenarios

Community of interest

Partner farm
- Implement on farm (if applicable)

Dairynz
3. On-Farm Recording

• Undertake a GHG on-farm recording pilot involving up to 100 Fonterra suppliers which provides each farmer with a GHG report which includes methane as part of environmental performance reporting they already receive from Fonterra.

• Reporting the GHG profile of 100 dairy farms from their nitrogen reporting pages
  • against the national inventory methodology
  • and a life-cycle assessment method.
Lessons Learnt...

1. Still climate change deniers out there that influence farmers.
2. Wide range of feedback on policy options from our Dairy Environment Leaders.
3. We need to ensure rural professionals working with farmers understand the issue and the options to mitigate emissions on-farm.
4. Modelling emissions reductions is difficult as Overseer has limitations.
5. Accuracy of data from farmers historically can be hard to obtain.
6. Consistency of inputs to modelling and accounting. i.e. farm boundary/lease/contracted grazing.
7. Fairness of reductions across regions.
8. Time it takes. Farmers must understand issues before changes are accepted.
Dairy Action for Climate Change 2019-2020, Draft

Dairy Tomorrow Commitment 1.2:
‘Lead efforts on agriculture’s contribution to meeting New Zealand’s climate change goals through identifying and implementing strategies to reduce or offset greenhouse gas emissions from dairy farming.’

Overall objective to fulfil the strategy and build of the current DACC, including all MS companies with the support of MPI and MfE
Areas include;
1. Leading efforts on climate change action
2. Measuring our emissions
3. Contributing to emissions reductions
Thank You