New Zealand's agricultural GHG emissions – and opportunities

Almost half New Zealand's greenhouse gas emissions come from agriculture. The primary culprits are methane from ruminant livestock and nitrous oxide from agricultural soils. In theory, the carbon cycle involving livestock is closed, as the CO_2 created when methane breaks down may be taken up by plants. In practice, until methane converts to CO_2, there is an excess of GHG emissions in the atmosphere. Emissions have been climbing but there are solutions; from methane vaccinations, to changing feed crops and cutting synthetic nitrogen fertilisers.

LINEAR CARBON DIOXIDE EMISSIONS

Sequestered Coal, Oil, Gas 'soil carbon'

- Machinery
- Transportation
- Fertilizer production
- **Land use changes**

CO_2 TO ATMOSPHERE

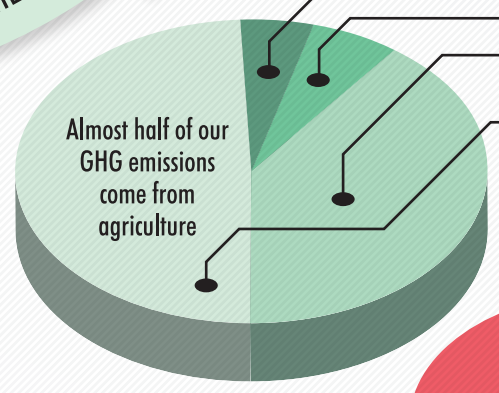
REDUCE FOSSIL CARBON USE

• Creating synthetic nitrogen fertilizers is a GHG-intensive process.

OPPORTUNITIES

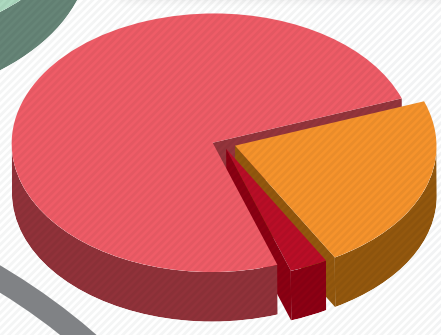
• Transition to lower-input farming methods.
• Shift to electric agricultural machinery.
• Generate electricity on-site using farm waste-streams.
• Reduce "feed-miles" by growing feed for animals locally.

Agricultural GHG emissions in 2016 were **12%** higher than in 1990



NZ TOTAL EMISSIONS

- **4.9%** Waste
- **6.2%** IPPU (Industry)
- **39.8%** Transport energy
- **49.2%** Agriculture
  - Methane CH_4 **74.8%**
  - Nitrous Oxide N_2O **22.4%**
  - Carbon Dioxide CO_2 **2.8%**



CIRCULAR

RENEWABLE CARBON DIOXIDE EMISSIONS

• **Carbon cycling through plants and animals**

CH_4 6-12 YEAR HALF LIFE CO_2 H_2O CO_2

METHANE EMISSIONS

- **Feed production**
- **Manure decomposition**
- **Enteric fermentation from ruminants**

Agricultural sources

Burps! **95%** of methane

Farts! **5%** of methane

REDUCE METHANE (CH_4).

In 2016, CH_4 from ruminants causes 71.7% of our agricultural emissions.

OPPORTUNITIES

• An "anti-burp" vaccine for ruminants is in development.
• Breed livestock and select pasture crops to reduce CH_4 emissions.
• Capture methane pumped into the soil using methanotrophic bacteria.
• Reduce stocking levels.

CH_4 **RUMINANT STOMACH** CH_4

Produces methane under anaerobic conditions

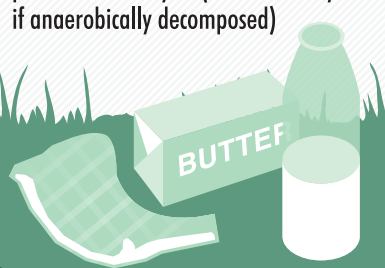
PHOTOSYNTHESIS

In the presence of sunlight, plants create sugars from CO_2 and H_2O, and release O_2

PLANTS TAKE UP CARBON

AGRICULTURAL PRODUCTS

Once eaten, vegetables, meat and dairy join the carbon cycle (or methane cycle if anaerobically decomposed)



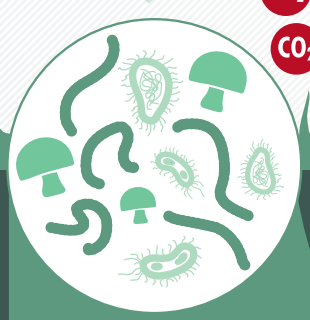
NITROUS OXIDE EMISSIONS

- **Animal excreta deposited during grazing**
- Nitrogen fertilizer

CH_4 N_2O CO_2 N_2O

Poos!

Wees!



SOIL CARBON

Earthworms, fungi and bacteria convert and may sequester carbon in the soil

CO_2 CO_2 CIRCULAR

NITRIFICATION

When soil is wet and compacted, bacteria may convert ammonia to N_2O

INCREASE CARBON

Storing just 0.4% more carbon per year in surface soils globally would stop the rise in atmospheric CO_2.

OPPORTUNITIES

• Avoid practices that lose soil carbon. E.g. over-applying synthetic fertilisers, overgrazing and burning plants after cropping.
• Adopt practices that gain soil carbon. E.g. direct-drill cropping, and deep-rooted perennial pastures.
• Add biochar to carbon-deficient soils.
• Return marginally productive areas to forest.

REDUCE NITROUS OXIDE (N_2O)

N_2O is 298 times more powerful than CO_2 over a 100-year time frame. Most N_2O emissions come from urine patches from livestock. Another source is nitrogen fertilisers.

OPPORTUNITIES

• Minimise conditions, such as compacted wet soils, where soil bacteria convert ammonia in urine to N_2O.
• Precision farming technology can create maps to enable resources to be targeted and reduced.
• Switch to feed crops that reduce N_2O emissions from urine patches.
• Reverse the decline in pasture management skills. E.g. with nitrogen-fixing white clover.
• Target the application of nitrogen transformation inhibitors to urine patches.

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