Solutions for Reducing Agricultural Emissions

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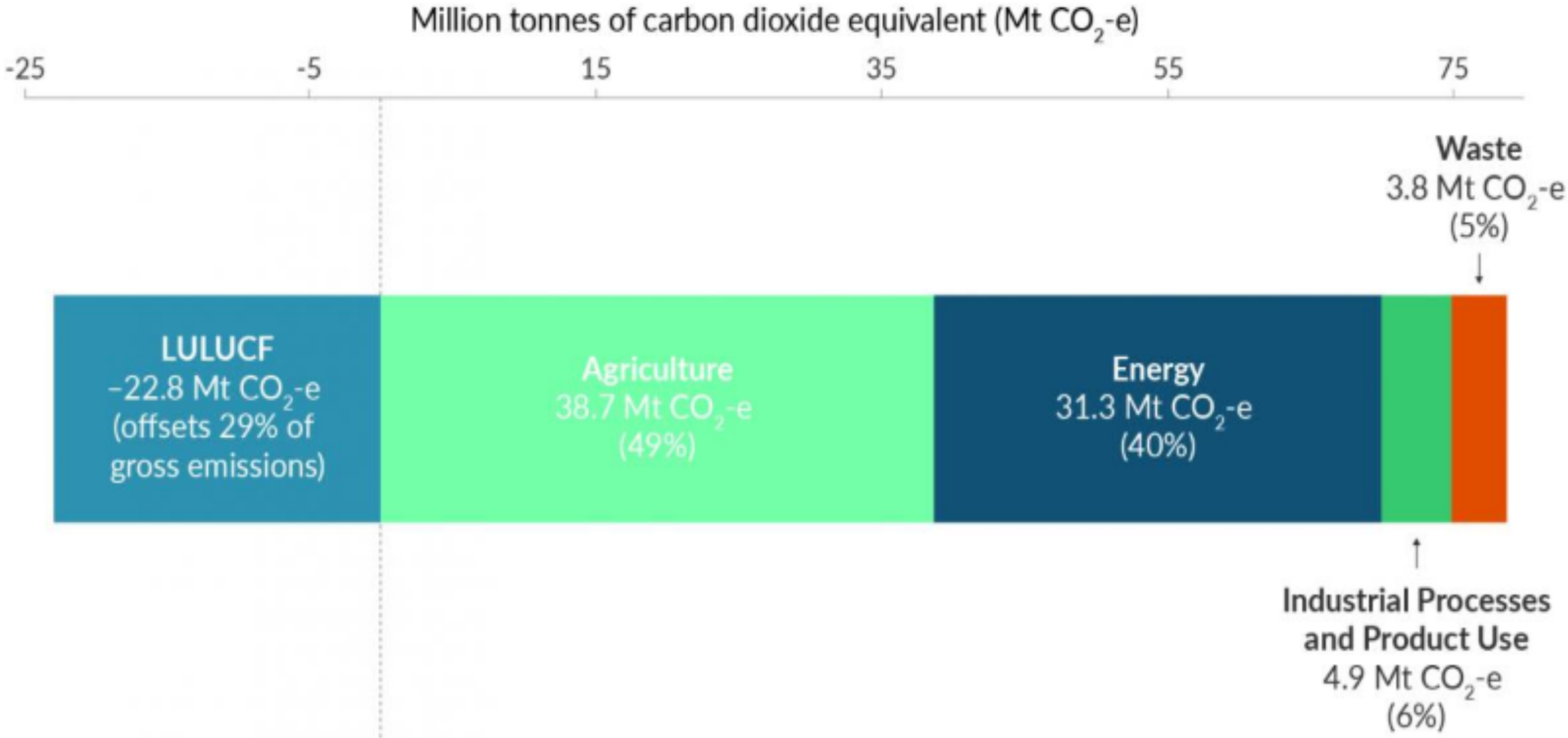
History of Economic Subsidies for New Zealand Agriculture

- New Zealand farm reforms began in the 1980s
  - NZ government faced budget crisis
  - Removed agricultural subsidies and export incentives
- Farmers were devastated by reforms
  - Relied heavily on subsidies for income
- "Prior to the 1984 reforms, subsidies stifled farm productivity by distorting market signals and blocking innovation. Many farmers were farming for the sake of the subsidies. For example, nearly 40 percent of the average New Zealand sheep and beef farmer's gross income came from government aid."
- Removal of subsidies created a free market
  - Motivated by supply and demand
  - Improved productivity

History of Economic Subsidies for New Zealand Agriculture

- Tough transition periods but did not eliminate farmers
  - Only 1% of farmers could not withstand the elimination of subsidies
  - Forced farmers to become entrepreneurial and explore other streams of revenue
- Farmers became more efficient and innovative
  - Developed new products, cut costs, and became more efficient with their land (less fertilizer)
  - Subsidies suppressed innovation due to lack of incentives (farmers were getting paid either way)
- Now, 5% of New Zealand's GDP
  - 15% from other farming derivatives (processing of milk, meat, and wool)



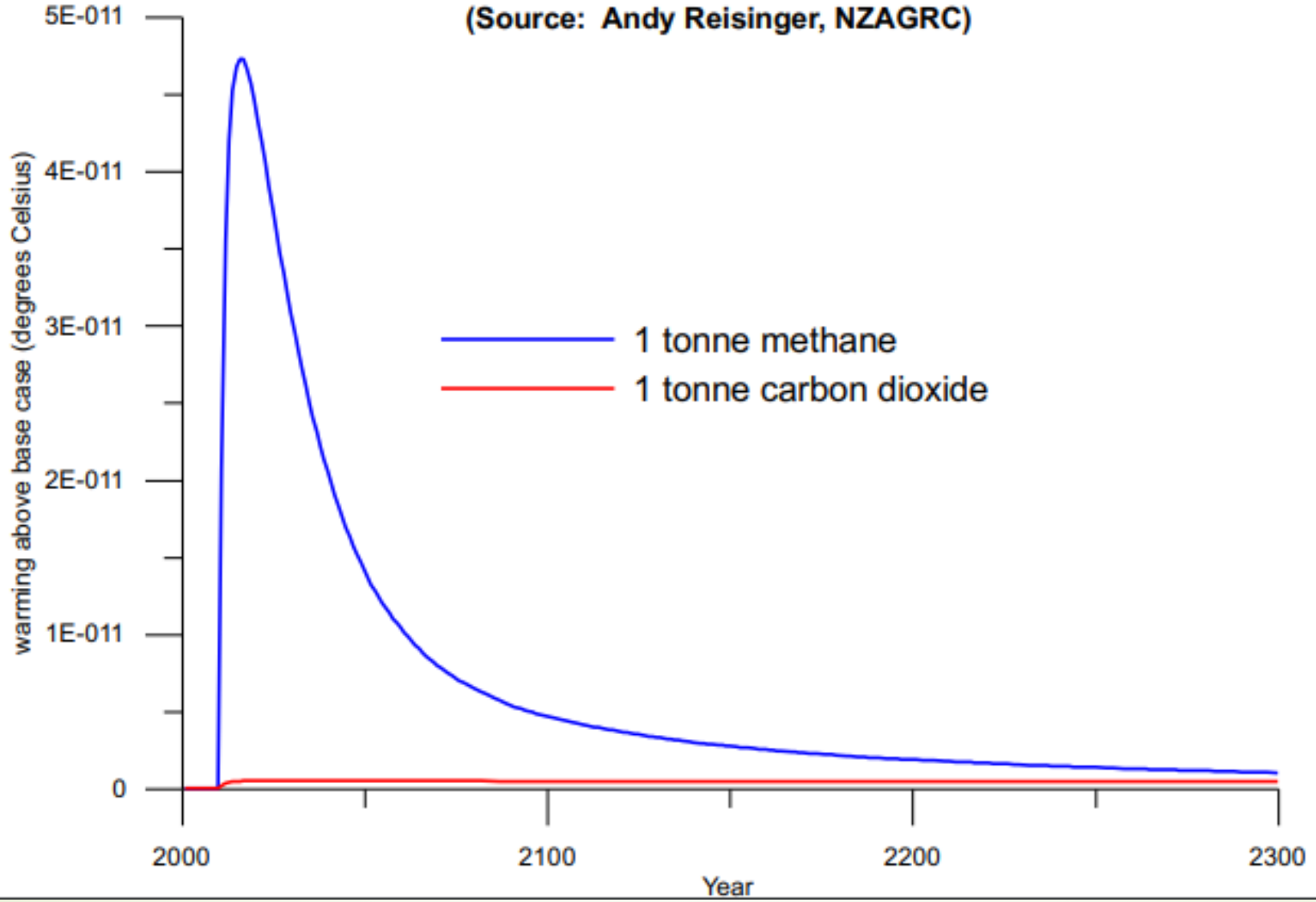
Note: The Land Use, Land-Use Change and Forestry (LULUCF) sector removes more carbon dioxide than it emits, so the net emissions from this sector are expressed as a negative number.

New Zealand's Agricultural Emissions Problem

- CO2 emissions from agriculture accounts for 49% of NZ's greenhouse gas emissions
  - Equivalent to 38.7 Million tons of CO2 emissions (Mt CO_2 –e)
- Methane emissions from ruminants have increased by 10 % since 1990
  - "Per capita, New Zealand has the largest methane emission rate (0.6 t per person per year)—six times the global average"
  - "primarily from enteric [intestinal] fermentation in ruminant [sheep, cattle, etc.] livestock, and sheep are the greatest single source"
- Nitrous oxide emissions from agricultural soils by 25 %

Modelled warming caused by 1 tonne of emissions

(Source: Andy Reisinger, NZAGRC)



Solutions for New Zealand's Ag Emissions

- Ministry for Primary Industries reported of animal compounds "that can reduce methane emissions from sheep & cattle by up to 90 per cent"
  - Other methods include methane inhibitors, exploiting natural plant properties, and increasing amount of carbon stored in pastoral soil
- Scientists have researched using vaccines and breeding techniques as well
- Streamlining communication between research scientists and farmers and giving farmers access to these new innovations will only help implement these methods faster

Solutions for New Zealand's Ag Emissions

- Additives to cow feed can help inhibit methane
  - Alexander Hristov, a researcher at Penn State University
    - Reduced methane emissions by 30% using 3-nitrooxypropanol (3NOP)
    - Basically, salted ruminant feed
  - Ermias Kebreab, an animal scientist at UC Davis
    - Believes using seaweed cuts methane emissions by 50%
    - Use *Asparagopsis,* a type of algae, mixed with molasses
- Seaweed farming for cow feed presents a massive economic opportunity for New Zealand
  - Surrounded by water
  - Have been investments in seaweed farming for biofuels

Solutions for New Zealand's Ag Emissions

- Participating in the LULCF under the Kyoto Protocol
- *An economic assessment of potential agricultural emission-reduction in the LULUCF sector* (University of Vienna)
  - Emissions mitigation depends on the land-use intensity
  - Land management to reduce emissions also reduces farmers' income (income forgone)
  - IF (LU) = VA (t = 0) -VA (t = 1)
  - VA = Value added expressed by GMMC resp. PCGMHT, t(time) : t=0 :Status quo, t = 1: after implementation
  - GMMC and PCGMHT represent the basic values to calculate plot-specific income forgone due to management changes
- "Our results show that CO2emissions in the LULUCF sector of single countries can be significantly decreased by applying specific changes of agricultural land-use practices. The calculation of abatement costs of promising mitigation measures – via contrasting income forgone with emission-reductions achievable – gives hints for identifying the most cost-efficient changes of management-strategies"

Intensity of Land-Use

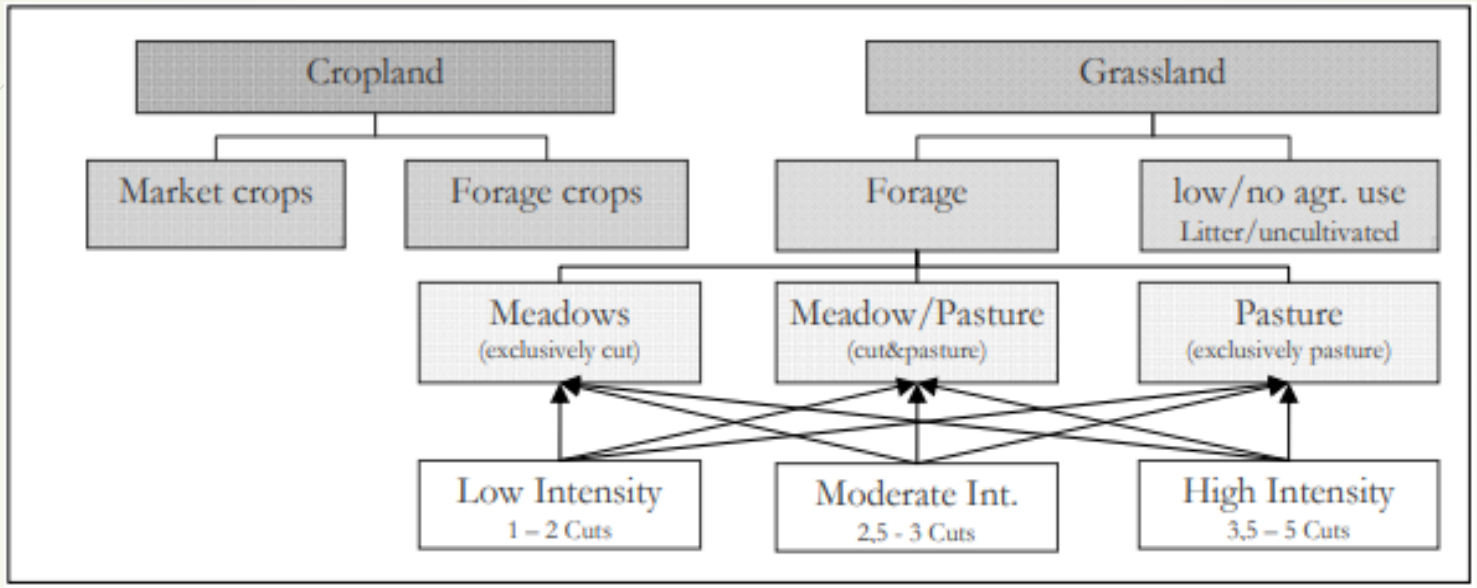


Table 2: Recommended land-use changes implying relevant GHG mitigation potentials

	Initial land use	Target land use	GWP Mitigation Potential
(I)	Arable land	Grassland (Intensity high or medium)	+
(II) (a) (b)	Arable land / High intensive grassland	Low intensive grassland [(a) agric. use: 1 to 2 cuts or low intensive grazing; (b) maintenance]	++
(III)	Arable land / High intensive grassland	Restoration (Abandonment of land use, average annual water table at 10cm below surface)	+++

Cost-Efficiency of Emissions Reduction

$$Costs / tCO_2 equiv.^{-ha*a} = \frac{IF_{ha}(LU)}{\text{t } CO_2 \text{ - C equiv.}^{-ha*a}}$$

- Measures the cost reducing emissions
  - Depending on the type of land use and water table level (can hold more emissions)
- Pastures were the main use for farm land in New Zealand
  - Most intensive
  - Highest Global Warming
- New Zealand government can offer tax breaks to farmers that offset the forgone income from making their land more efficient
- The combination

Conclusion

- New Zealand government can offer tax breaks to farmers that offset the forgone income from making their land more efficient
- The combination of feed substitutes/additives
  - Economic opportunity in seaweed farming
  - Reduce methane emissions