Science to Policy

A New Zealand example

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Science to Policy – some guiding principles

- Enhancing collaboration between scientific and policy makings communities
  - Good policies should be backed by good science. Policy makers shouldn't develop policies in isolation.
  - Regular communication through meetings and workshops.
    - Open and honest.
    - Provide background/explanations. Avoid jargon.
    - Be clear about requirements
    - Listen to each other even if you don't agree.
    - Be respectful of each others expertise.
    - Update and stay in touch
  - Develop summary documents that can easily be referred to
  - Publicly available information

GHG Inventories as an interface for incorporating Science into Policy

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GHG Inventories

- An estimation of a countries greenhouse gases (GHG) emission and removals that have resulted from anthropogenic (human induced) activities.
  - Many people think it is only useful for reporting under the UNFCCC convention and Paris agreement - National communications, BUR, biennial transparency report

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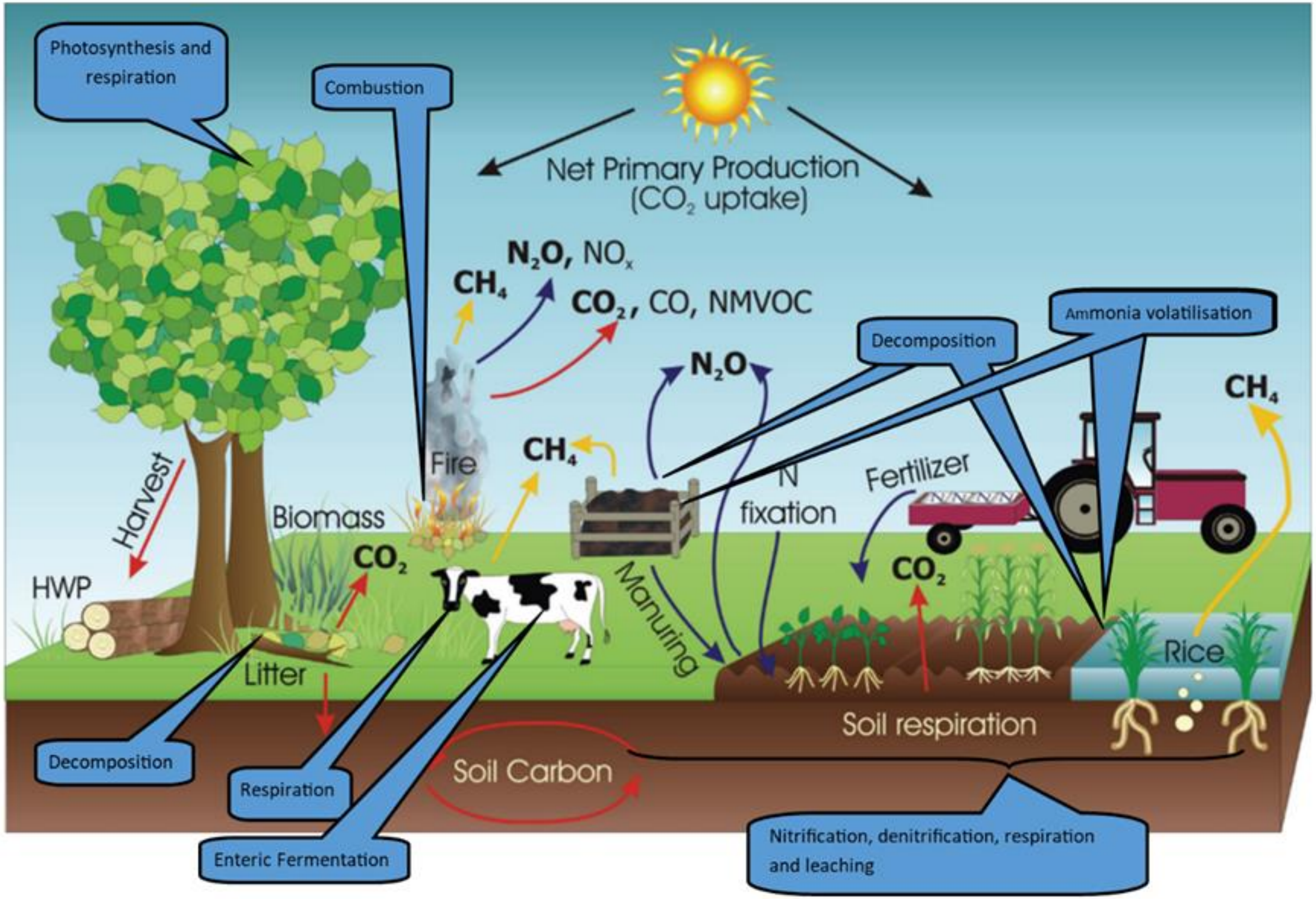

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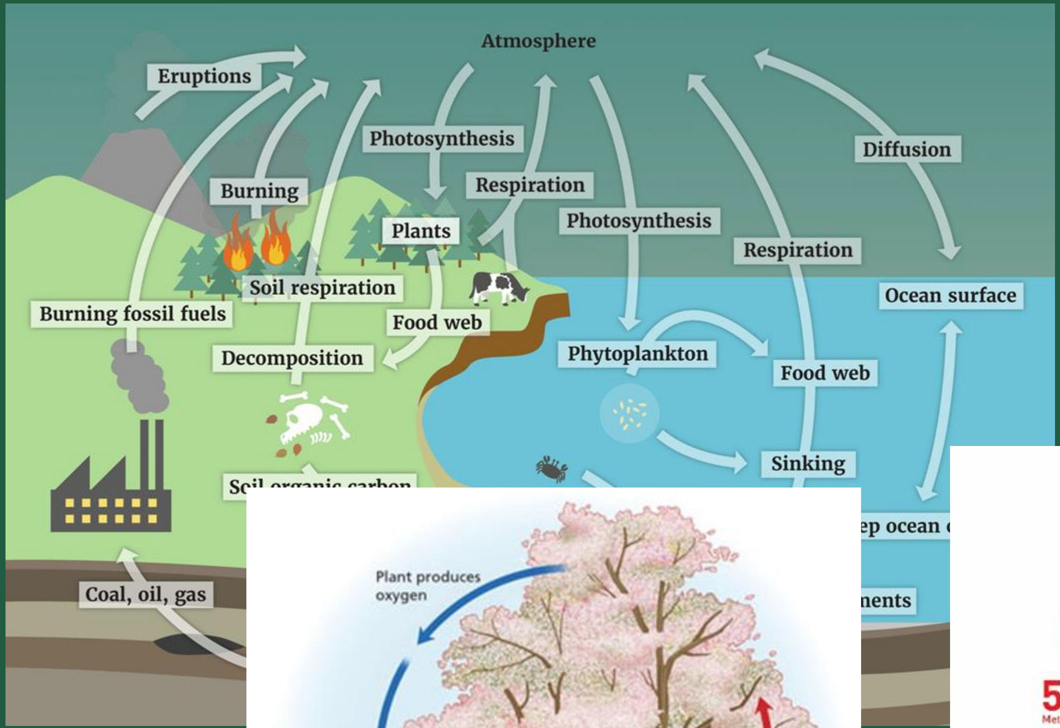
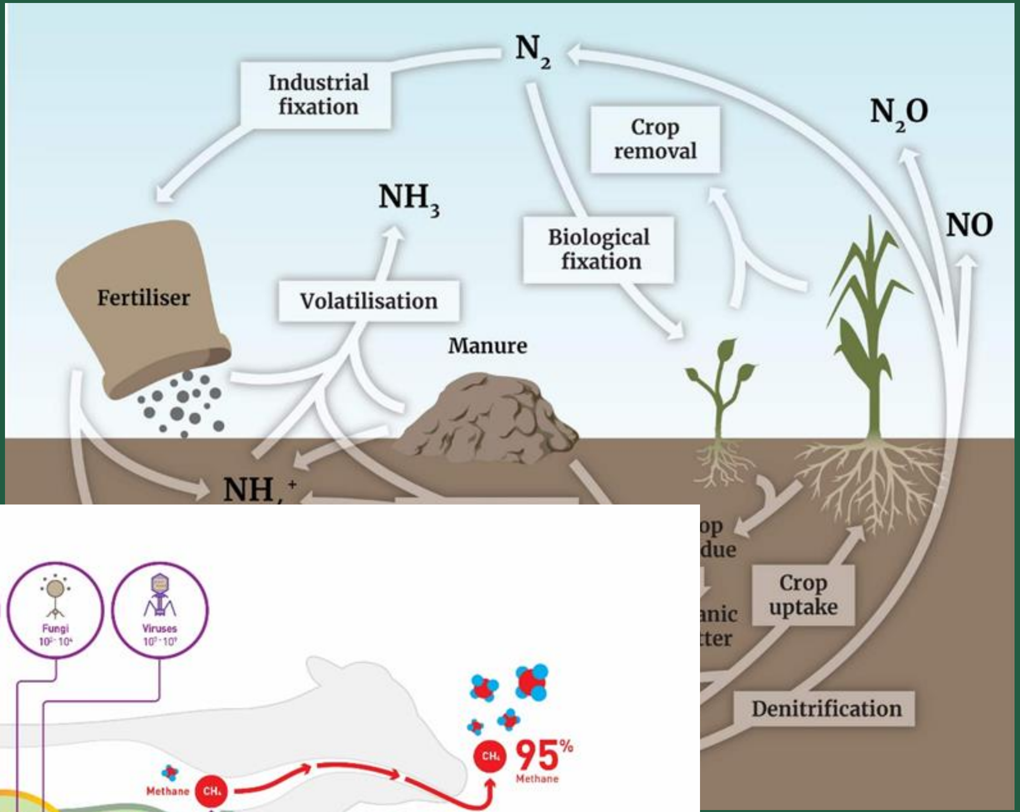
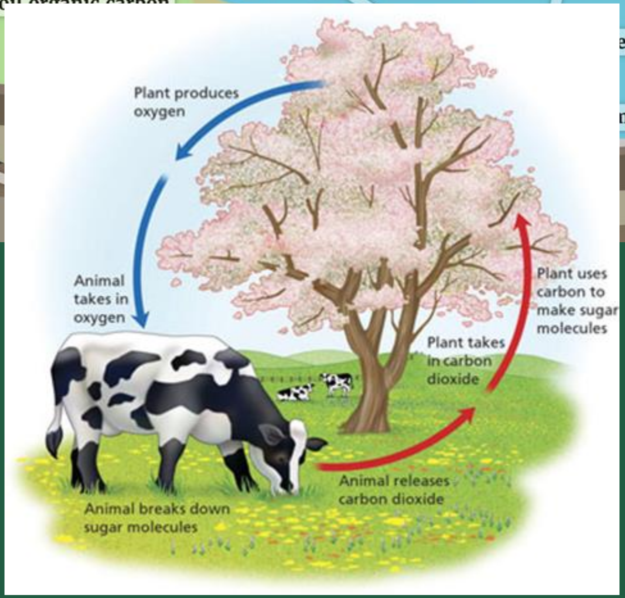
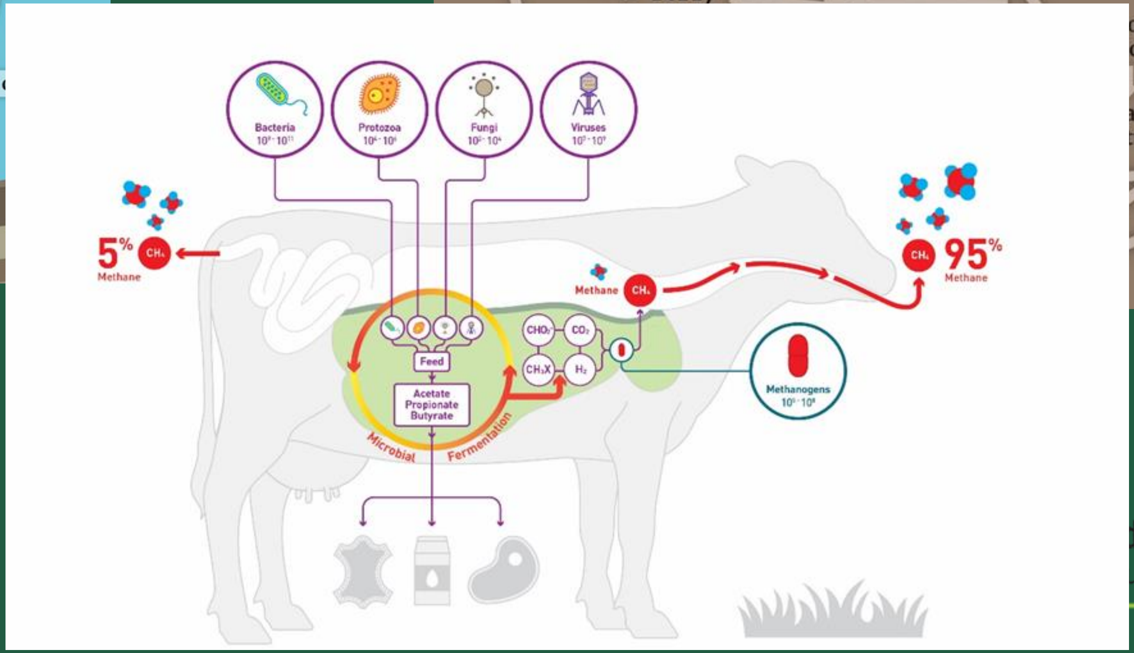
The science behind Agricultural GHG Inventories









Shouldn't just be used for UNFCCC reporting

- Help to determine emissions reduction targets
  - Baseline
  - Policy decisions
  - Scenario analysis
  - Nationally determined contributions (NDCs)
  - Country low emission development and climate change strategies
- Provide information for use in carbon markets
- Focus limited resources and mitigation research

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Benefits of Higher Tier Inventories

- More accurately describe an economies GHG emissions profile and therefore better for policy decision making.

- Provide information
  - Scenario analyses
    - Magnitude of change of specific policy implementation
    - Implications for other areas (food security, livelihoods, other gases)
  - Timeline of emissions
  - Highest sources of emissions
    - Determine which sources of emission reductions should be focussed on
    - Resource allocation
  - Data requirements

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Benefits of Higher Tier Inventories

- Incorporation of Mitigation – demonstrate achievement of NDC's
- Explore synergies between adaptation and mitigation policies
- Ability to incorporate data that is related to actual on-farm practices
  - Landholders become part of the solution
  - More likely for methods/results to be used by industry
- Incorporate, demonstrate impact and investigate synergies of other environmental policies

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Benefits of Higher Tier Inventories

- Data can be used for other purposes
  - Disease reporting and control
  - Animal movement
  - Record of production
  - Sustainability indicators including water
  - Farmer response to Policies/economic drivers
  - Policy advice (to Government and industry), forecasting and management
  - Help inform business decisions
  - Measurement of improvements and actual production

NZ Agricultural GHG Inventory

History of NZ submissions and how the model has evolved

First submission

- Submitted in 1994 (NC1)
- Very short
- Compiled by Ministry for the Environment
- Methane emissions from a paper written in 1991
- Preliminary statistics animal numbers used
- Country specific EF used but not updated
- Was “good enough”

First submission

5.3 Agriculture

5.3.1 Enteric Fermentation

Compared to its human population, New Zealand has large numbers of farm animals. For 1990, the Ministry of Agriculture and Fisheries report animal numbers at an estimated 57.8 million sheep, 4.6 million beef cattle, 3.4 million dairy cattle, 1.0 million deer, and 1.1 million goats.

Methane production by ruminants in New Zealand (sheep, beef cattle, dairy cattle, goats, and deer) has been estimated at 1500 Gg. This was done using a mathematical model of rumen digestion interfaced with estimates of livestock numbers (Ulyatt *et al.*, 1991). The estimates of livestock numbers took into account the fluctuations in herd sizes over the year and is more representative of the true situation than a single year-end statistic. The model required input of diet composition and feed intake. The IPCC default methodology was not used to calculate methane production by New Zealand ruminants as it is considered that a model which more closely reflects the New Zealand situation provides a more accurate assessment.

To do the calculation:

- New Zealand was divided into climatic regions that contained similar pasture species, growth patterns, and thus pasture composition.
- Each region was classified into improved, unimproved, and tussock grasslands, and livestock was allocated to these in line with acceptable stocking rates.
- Models of livestock movements within a year were developed for each animal and land class.
- Food dry matter intake for each class of livestock was calculated from estimates of feed requirements and diet digestibility.

5.3.2 Animal Wastes

Estimates have been made for the maximum methane emissions from animal wastes (<118 Gg). Included in this total are emission maxima from ruminant faecal deposits on pasture (Joblin and Waghorn, 1994) and in feedlots, plus emissions from pig and poultry farming (Campbell, 1994). The actual emissions from this source are expected to be substantially lower than the maximum presented here.

5.3.3 Agricultural Soils

Soil Carbon

The inventory table does not contain an estimate of carbon loss/gain in New Zealand soils. These soils are estimated to contain large amounts of carbon. Soils under pasture do not tend to be disturbed by normal New Zealand pastoral agriculture practice (i.e. soils used for pasture are generally not ploughed). Land used for cropping and horticulture is, however, cultivated annually, and there are large tracts of severely eroded land. Extensive soil disturbance associated with forest harvest is discouraged under the Resource Management Act (see Section 6.2).

The estimation of changes in soil carbon is difficult. Results from recent New Zealand studies indicate that changes to soil carbon (except under intensive cropping) take place slowly (decades to centuries) in response to land use changes. Process based predictive models which will assist in addressing the issue of soil carbon changes are under development. (See Annex 1 for details.)

Nitrous Oxide

Between 1 and 37 Gg of nitrous oxide are estimated to have been emitted from New Zealand soils in 1990 (Carran *et al.*, 1993). Nitrous oxide emissions from agricultural soils in New Zealand generally do not come from the application of nitrogenous fertilizer. The predominant use of legume-based pastures makes fertilizer nitrogen a relatively small consideration for nitrous oxide emissions compared to the complex interaction between soil type and climatological factors such as rainfall and temperature. Grazing animals can locally enhance nitrous oxide emissions via urine deposited on the soil, and through hoof traffic causing surface damage and poor aeration in wet soils.

Nitrous oxide emissions from agricultural soils are represented as a range. A partial inventory of nitrous oxide emissions has been made using an approach based on classifying soils according to drainage class, rainfall, and temperature. Emissions data from sites of known class have been used to make broader estimates of nitrous oxide emissions.

The range is large because extensive areas of the South Island show negative (i.e. sink) to low emission ranges, and in the North Island high emission ranges make a significant contribution from a small proportion of the total land area.

5.4 Land Use Change and Forestry

Major planting of exotic forests began in the 1920s. The amount of planting has fluctuated widely since then. As most exotic planting was, until recently, mainly by the State, New Zealand has very good records of commercial planting. Planting is basically (90%) of one species (*Pinus radiata*). Research in forestry (particularly by the government body, the Forest Research Institute (FRI)) has been well developed, over many years. This combination of factors means that New Zealand has been able to develop very reliable carbon sequestration models and data.

New Zealand has developed a method (Hollinger *et al.*, 1993) to quantify carbon sequestration by managed forests based on calculating a 'carbon inventory' at two points in time and identifying the difference. This difference represents the net sequestration or emission of carbon for this period. Carbon dioxide sequestered by New Zealand forests in the year 1990 is estimated at 16 714 Gg. This figure represents the sequestration which took place in one year (i.e. from 1 April 1990 to 31 March 1991). The methodology is described in more detail in Annex 2.

The estimation of the total amount of carbon dioxide sequestered by New Zealand forests in any one year takes into account:

- the amount of carbon sequestered by planted forests;
- the amount of carbon lost through the harvesting of planted forests;
- carbon lost through the logging of native forests;
- carbon lost through the clearance of shrublands for forest planting; and
- carbon loss through forest and shrubland fires. (Ministry of Forestry pers. comm., 1994; Maclaren *et al.*, 1994).

No estimates are available of the net level of vegetation clearance for land uses other than forest. Reversion to shrubland of marginally economic hill pastures, mainly in the North Island has been particularly evident since the restructuring of the New Zealand economy saw agricultural assistance to farmers fall from an average 25% of the value of agricultural production in the period 1979-86, to 3% in 1992. Thus it is probable that more land is reverting to shrubland cover than is being cleared of such vegetation.

Soil carbon changes as a result of grassland conversion and the abandonment of managed lands are discussed in Annex 1.

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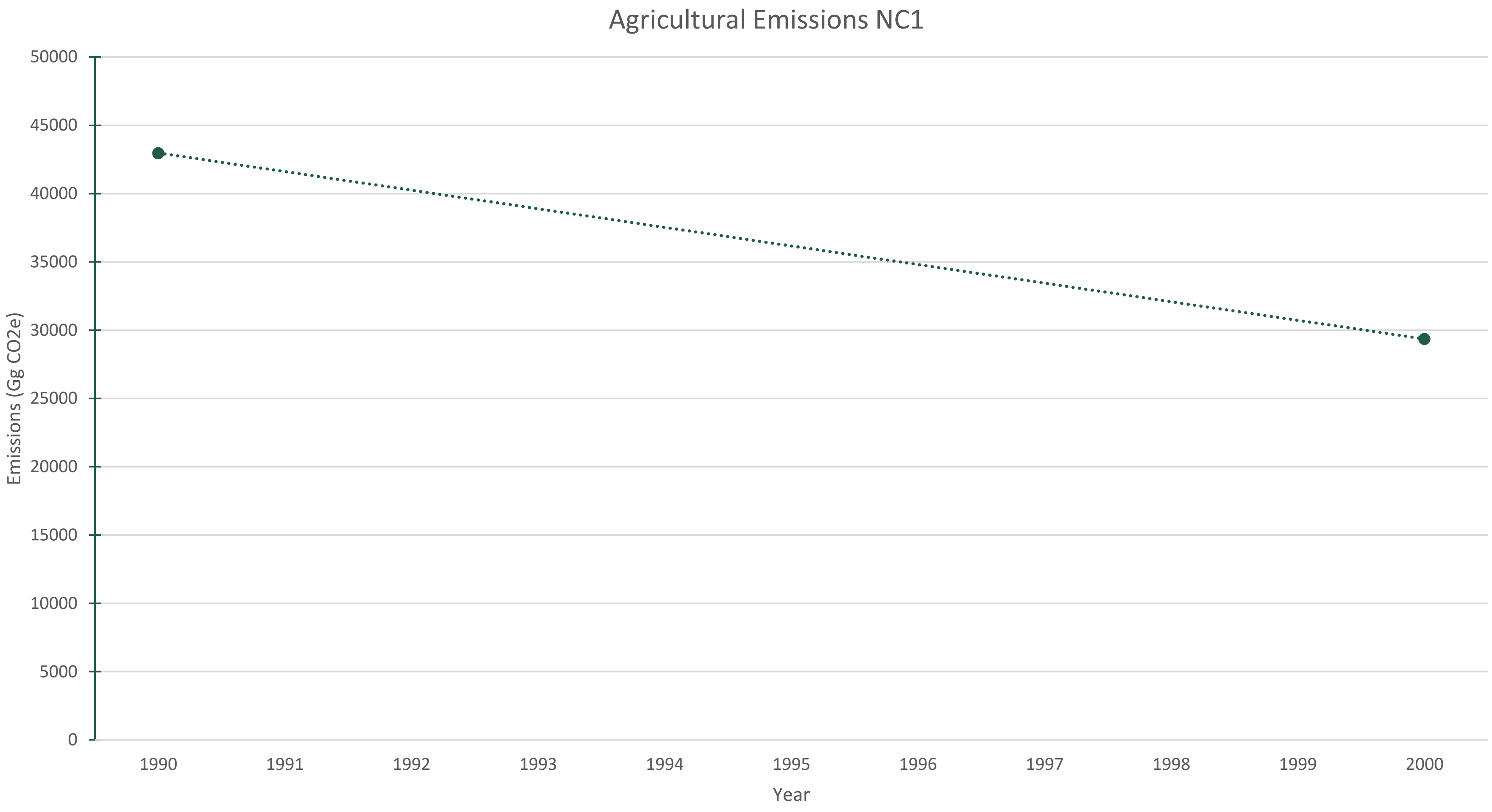

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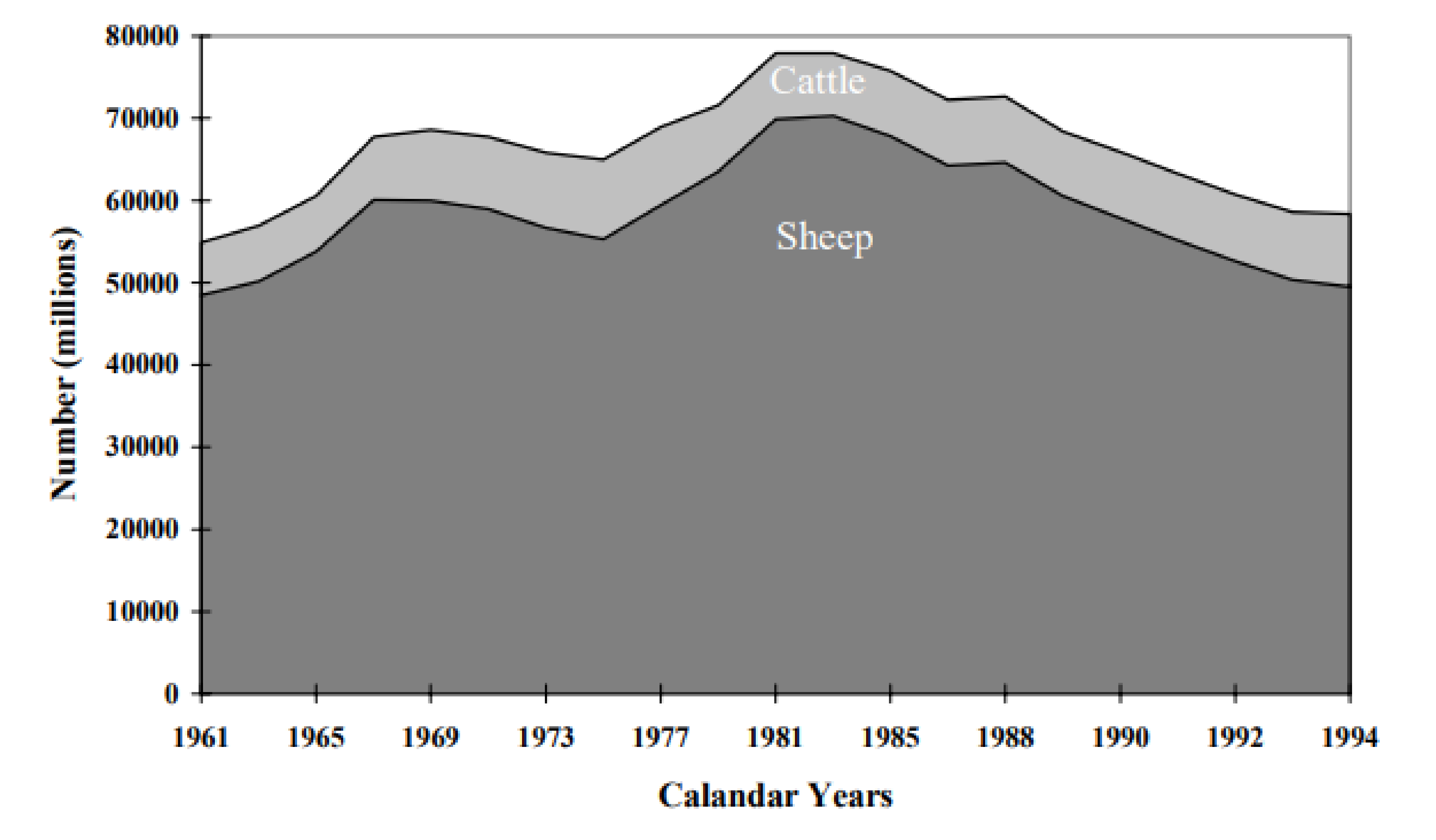
2nd NC 1997



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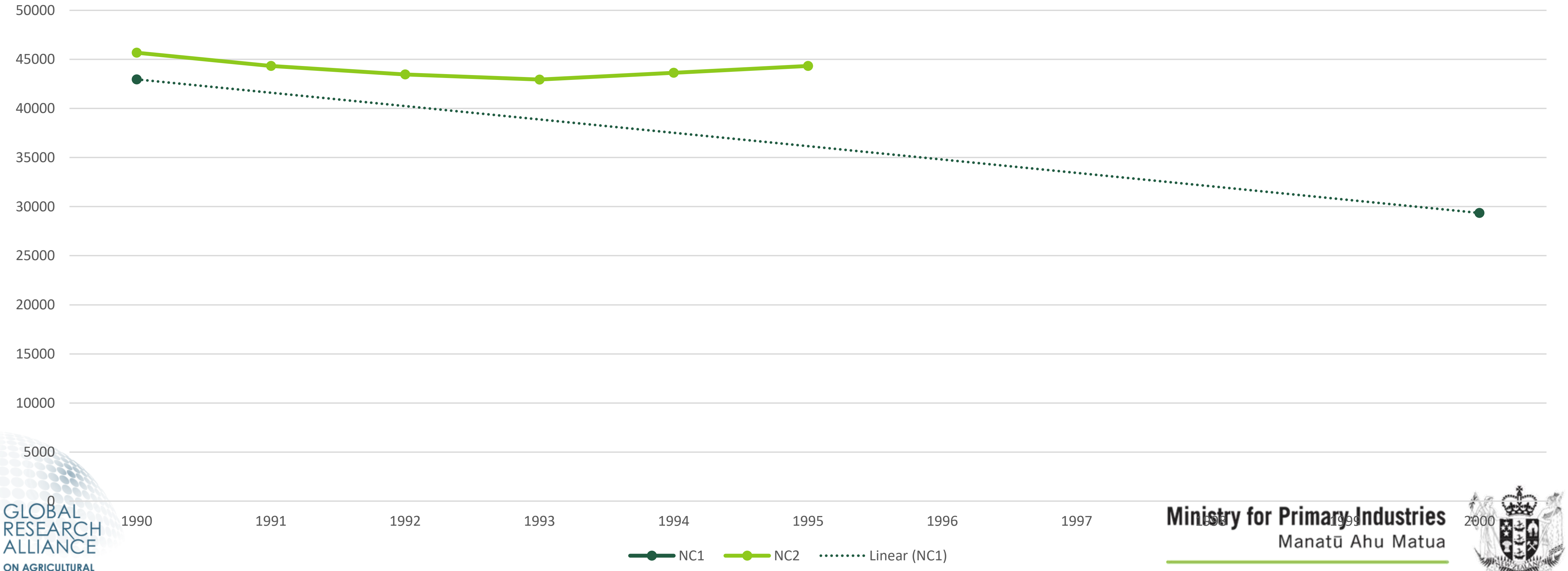
Agricultural Emissions NC1 and NC2



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2nd NC 1997

1996 IPCC Guidelines now available

Table 7.10: Projected methane emissions from livestock and their waste 1996 - 2000

	1990	1996	1997	1998	1999	2000
Methane emissions (Gg)	1,513	1,412	1,390	1,393	1,391	1,391
% change compared to 1990	0	-7%	-8%	-8%	-8%	-8%

Table 7.11: Projected nitrous oxide emissions from agricultural 1996 - 2000

	1990	1996	1997	1998	1999	2000
Nitrous oxide (Gg)	44.87	43.45	43.11	43.16	43.10	43.05
% change compared to 1990	0%	-4%	-4%	-4%	-4%	-4%

Projections for nitrous oxide emissions from the agricultural sector have not been extended past 2000. These projections could be done, but the resulting information would be almost meaningless as a result of uncertainties in existing inventory data.

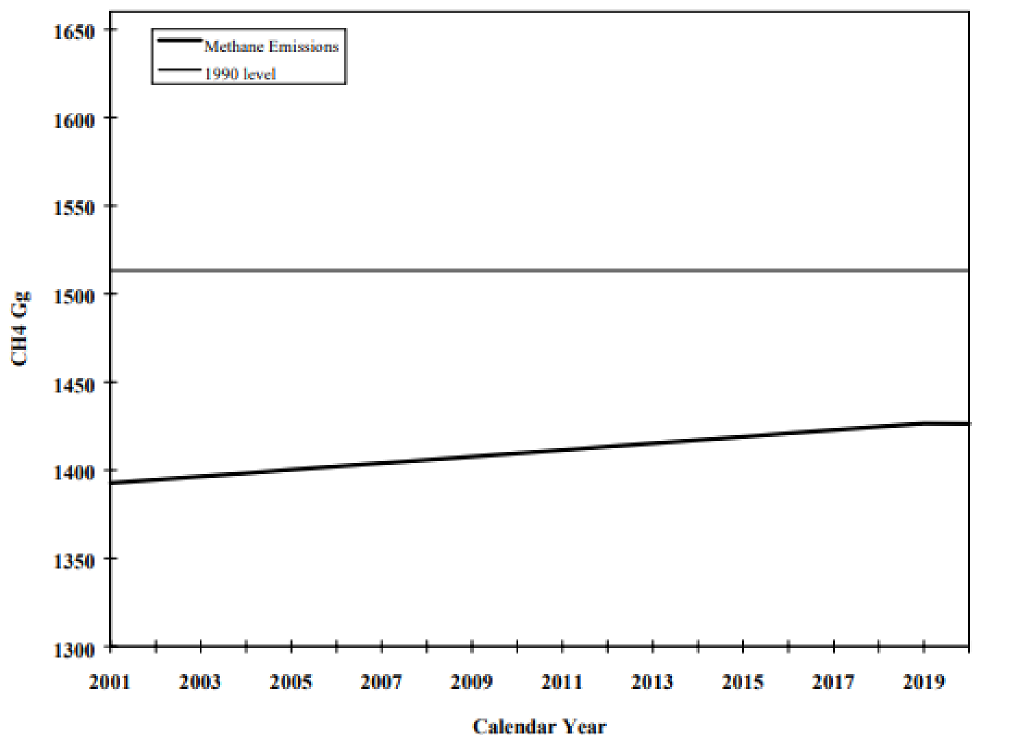

Figure 7.9: Projected methane emissions from ruminants and their wastes 2001 to 2020. Source: Ministry of Agriculture, 1997

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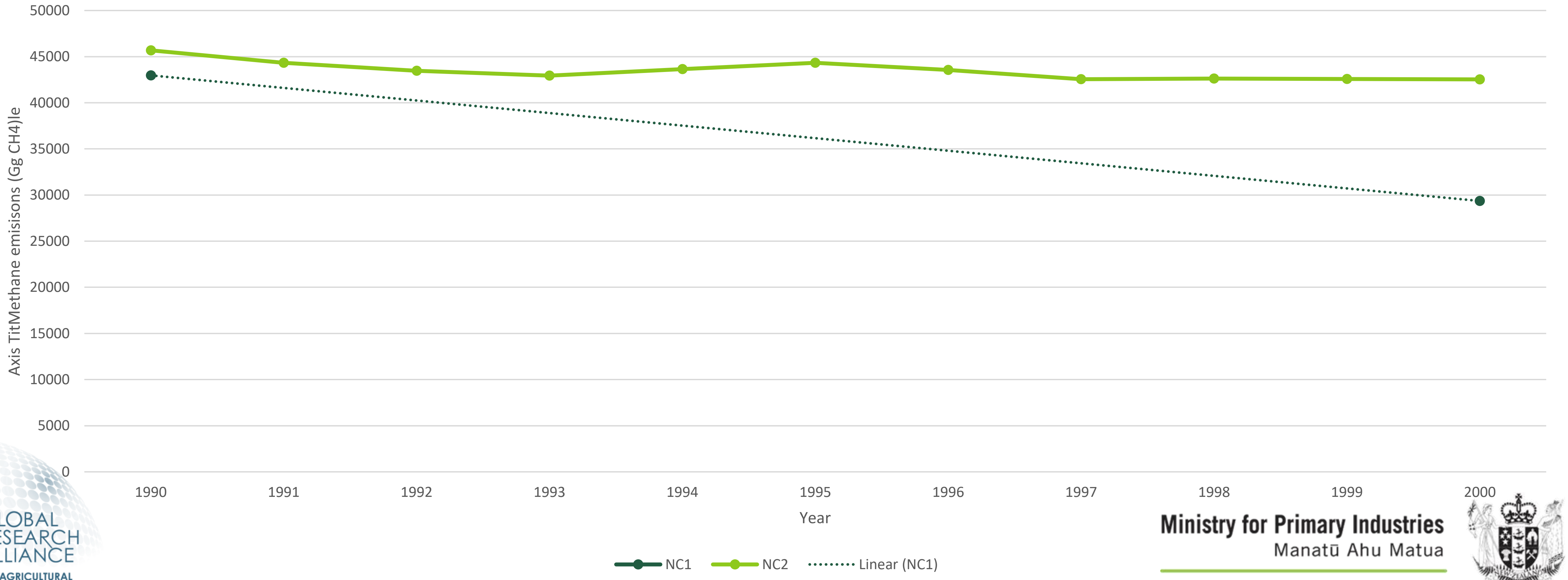
Projections to 2000



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Country specific research had started

During 1994 & 1995, research has been conducted to measure actual methane emissions from ruminant livestock grazing under pastoral conditions in the Manawatu region of New Zealand. These trials deployed a new tracer technique, sulphur hexafluoride, SF_6, to measure emissions directly from grazing ruminants.

Another study has been commissioned with two long-term objectives, one is to provide a scientific basis for assessing New Zealand's anthropogenic emissions of methane (CH_4), a potent greenhouse gas; and the other to provide a basis for investigating both the improved nutritional performance of New Zealand ruminants and a reduction in microbial methane production.

Preliminary results for 40 days of cow methane samples have shown emissions ranged from 229-313 g CH_4/cow/day with a herd mean of 262.8 ± 9.6. This equates to approximately 95 kg CH_4 per head per year. This is more than originally estimated by Ulyatt 1991.

For sheep, mean methane emissions of 20.4 g/day was found. Over a year, this equates to 7.4 kg CH_4 per head per year. This is substantially lower than originally estimated by Ulyatt 1991.

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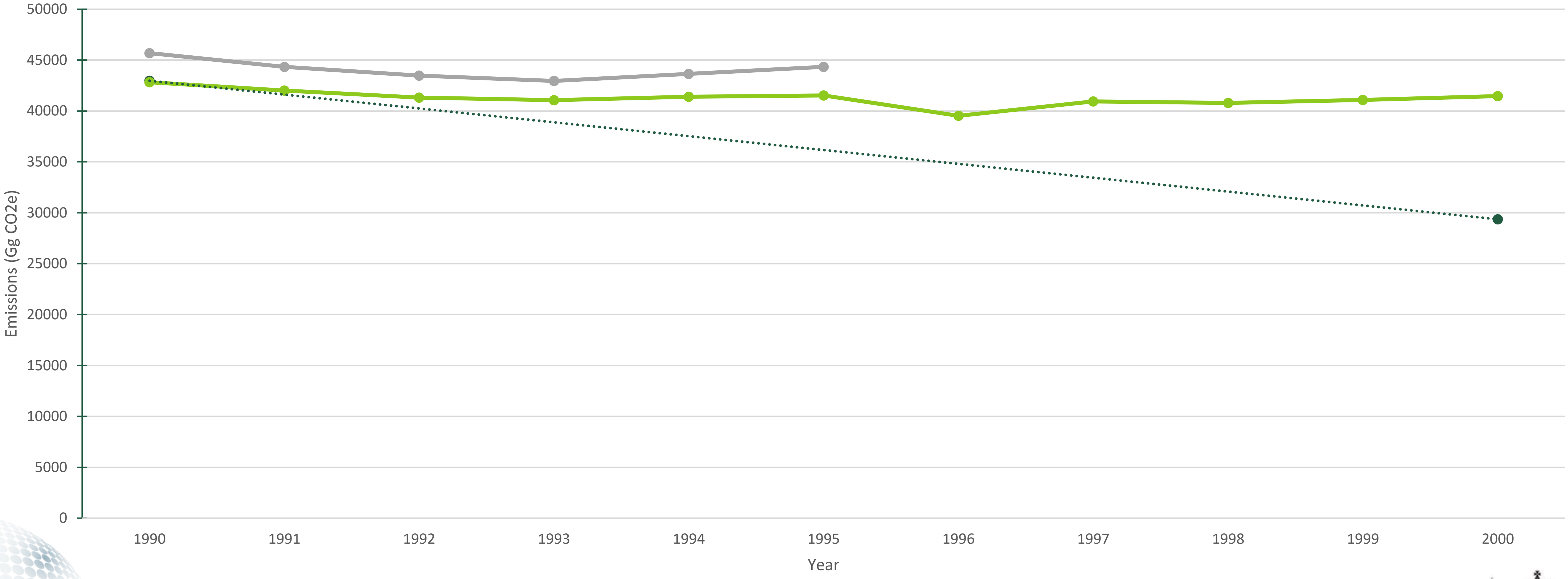
1st NIR Agricultural Emissions



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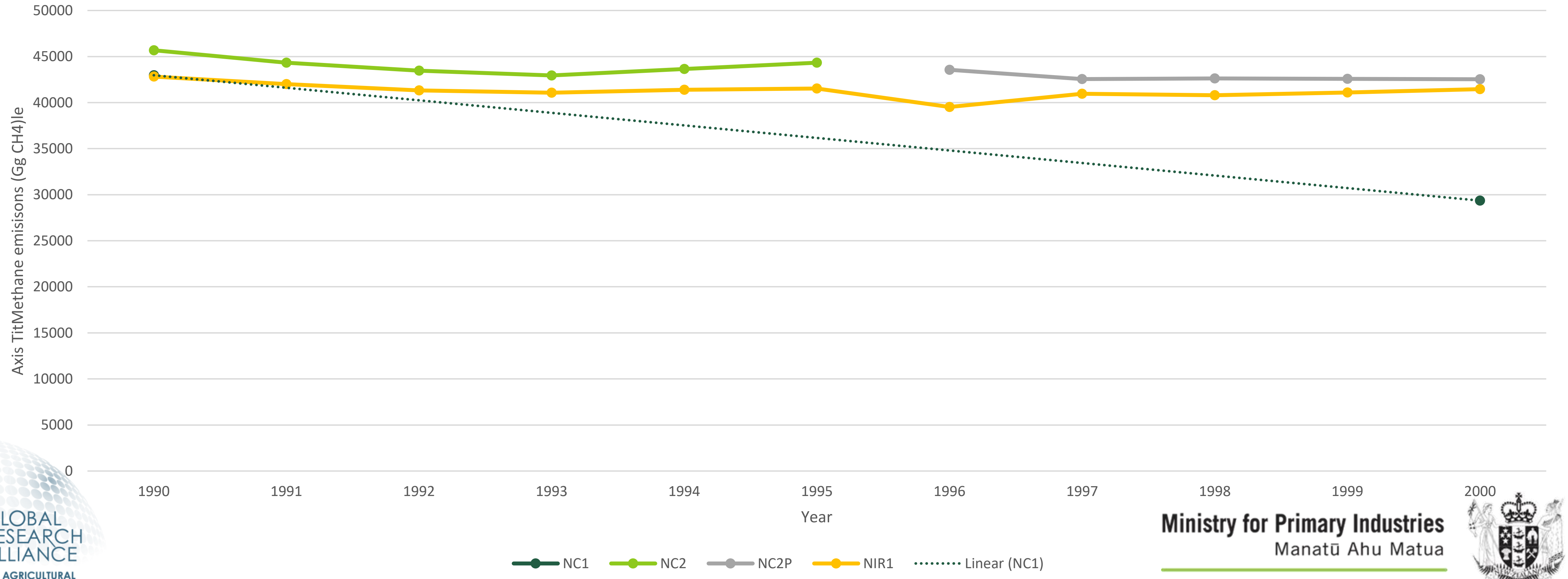
Projections vs "actual"



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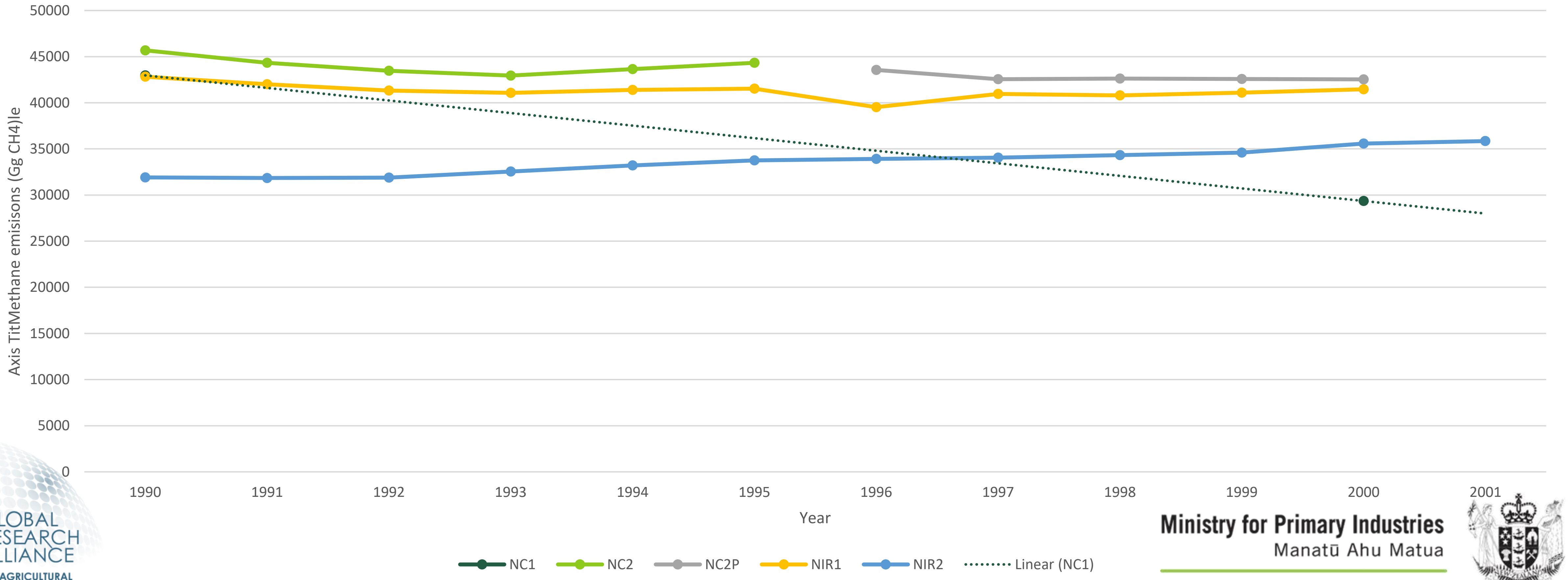
2003 a new Tier 2 model was implemented

2nd NIR – New Model



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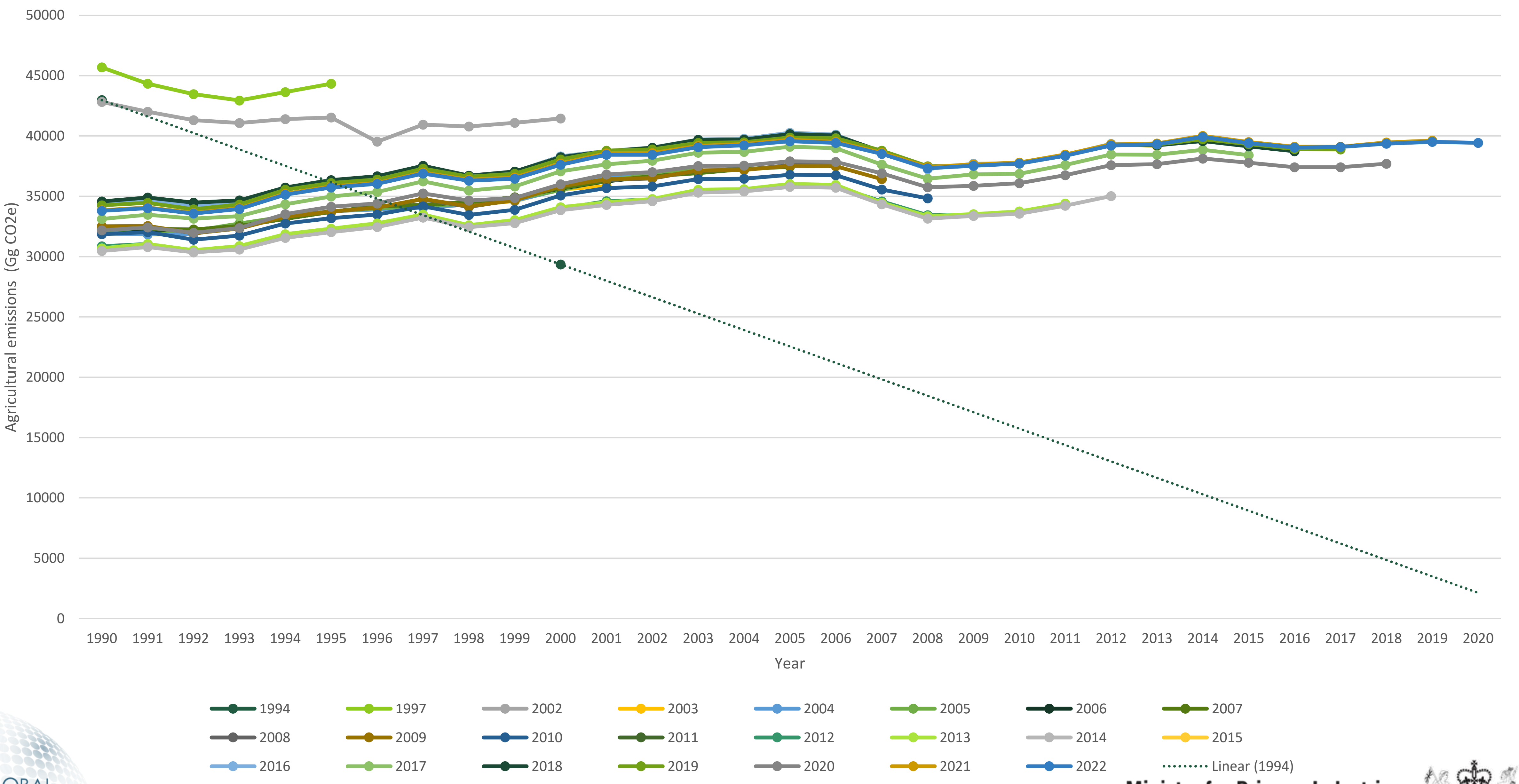

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Science to Inventory

- Good working relationship between Scientists and Policy makers
  - Regular meetings (N_ZONet and MethNet)
  - Clear direction from policy makers on what is needed
  - Regular RFP‘s – retains science expertise

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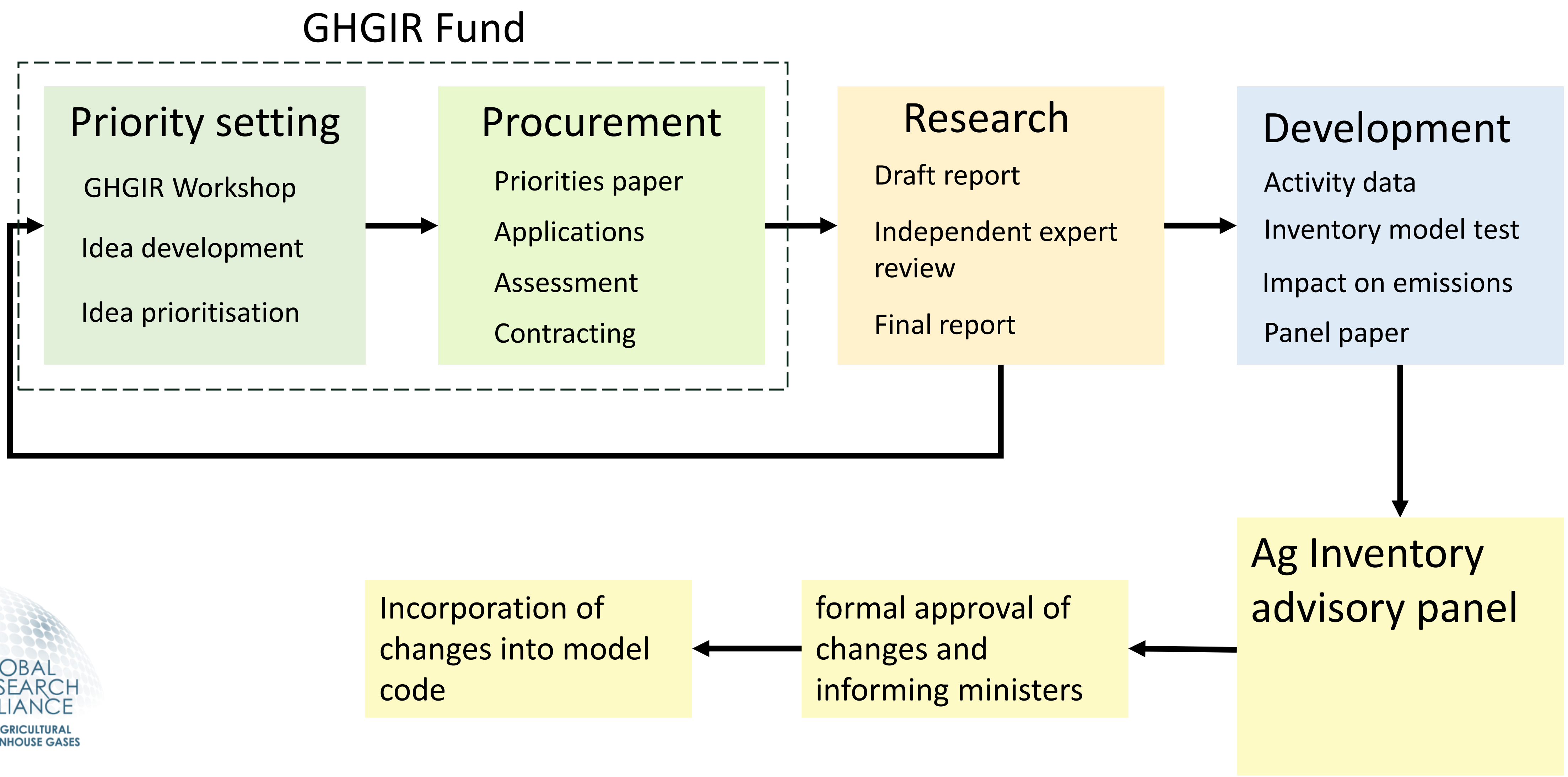
Inventory improvement process



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GHGIR Fund

The Greenhouse Gas Inventory Research Fund supports the reporting of emissions from agriculture, land use, land use change and forestry (LULUCF), by funding research aimed at improving our emissions estimates.

First established in the early 2000s

The GHGIR fund has five objectives:

- International obligations are met with a robust and credible assessment of emissions
- Emissions mitigation is captured in the inventory
- Farm-gate emissions reporting and mitigation are encouraged
- Emissions drivers and trends are understood for better policy
- The implications of accounting rules, including costs and benefits, are understood

GHGIR has funded 106 projects in the last seven years. Most of these have been related to agriculture, although 17 have focused on forestry.

There are 21 GHGIR projects currently underway

Agricultural Inventory Advisory Panel

- The Panel's purpose is to advise the deputy director general of policy and trade on whether changes should be made to the Inventory. The final decision is the DDG's (Policy and Trade).
- Helps ensure all changes to the Inventory are robust, transparent and meet IPCC good practice requirements
- The Panel consists of scientific representatives whose knowledge covers the UNFCCC process and the science of agricultural greenhouse gas emissions and scientific research in general.
- Each year the Inventory team presents proposed changes to the Panel
- The Panel:
  - assesses peer-reviewed reports and papers providing evidence for proposed changes to the inventory
  - advises whether the proposed changes are scientifically robust and meet the reporting guidelines.

Agricultural Inventory Advisory Panel

- https://www.mpi.govt.nz/science/open-data-and-forecasting/greenhouse-gas-reporting/agricultural-inventory-advisory-panel/

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Changes

- 2010
  - regionalisation of dairy
  - country specific $Frac_{GASM}$ and $Frac_{GASF}$
- 2011
  - separation of EF_3 into dung and urine
- 2012
  - nitrous oxide emissions from cultivated histosols
  - poultry methane and nitrous oxide emissions
  - nitrous oxide and methane emission from swine
  - methane and nitrous oxide emissions from crops and tussock burning
  - methane emissions and nitrogen excretion rates for New Zealand goats
  - better estimation of national liveweight of ewes
  - better estimation of national liveweight of beef cows

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Changes

- 2013
  - revisions to the parameters in the national inventory model for New Zealand deer.
- 2014
  - including the urease inhibitor mitigation technology
  - revising the equation to partition nitrogen in excreta between dung and urine.
- 2015
  - N retention changes
    - dairy cattle % crude protein of milk
    - wool
  - deer growth period.

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Changes

- 2016
- 2017
  - new sheep methane equations
  - emission factor estimates for FDE and urea
- 2018
  - new method for calculating the area of barley, oat and wheat crop residues burned
- 2019
  - new method for splitting nitrogen between livestock dung and urine
  - new activity data on dairy effluent management

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Changes

- 2020
  - revised N2O emission factors for livestock excreta
  - a new method for allocating excreta to different hill slopes
  - improvements to equations used to estimate energy efficiency.
  - new activity data on the dairy goat population
- 2021
  - corrections to the sheep nitrogen excretion calculations
  - updated pasture quality data for Tier 2 livestock categories
  - revised changed to the methodology for calculating nitrous oxide emissions on organic soils.
- 2022
  - refinement of nitrogen leaching for cropping systems
  - updated assumption regarding the purity of agricultural lime

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Changes

- 2023
  - updated assumptions on the portion of lambs held over to a second slaughter date
  - improved modelling to estimate within-year beef cattle population and liveweight change

- 2024
  - Nitrous oxide emissions from non-manure organic amendments to soils.
  - Updating emissions calculations for pigs.
  - Updating population estimates for minor livestock categories.
  - Including EcoPond Generation 2 for dairy cattle.
  - Methodology for assigning animals in the deer industry to the production of venison or velvet antler.
  - Seasonality of wool growth.
  - Corrections and data improvements to Inventory Model 2024.
  - Methodology for calculating the impact of low methane sheep genetics in the New Zealand flock.

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