THE STRUCTURE OF

AGRICULTURAL GREENHOUSE GAS RESEARCH FUNDING IN NEW ZEALAND

NEW ZEALAND AGRICULTURAL GREENHOUSE GAS Research Centre

PGgRc® PASTORAL GREENHOUSE GAS RESEARCH CONSORTIUM

WORKING TOGETHER

HOW IS AGRICULTURAL GREENHOUSE GAS RESEARCH FUNDED IN NEW ZEALAND?

Agricultural greenhouse gas (GHG) mitigation research funding comes from multiple sources. The growing appreciation of the need to tackle climate change, and the diversity of the challenges that agricultural GHGs present, means there are a range of different funding entry points from fundamental science through to applied research and commercial production. Different funders have different interests and are looking for specific solutions to issues facing their farm, organisation, industry or government ministry.

Given the variety of interests and approaches, there are several different funding streams that seek to service those different needs. As a result, the organisation and funding of agricultural GHG mitigation research in New Zealand can appear complex. This is a simple guide to the system and the way the funds work in partnership to grow New Zealand's understanding and global contribution to real solutions to tackle climate change.

THE FUNDS

The largest slice of New Zealand's GHG emissions comes from agriculture (49%), and we know it's a sector for which fewer options exist compared to other sectors to substantially reduce emissions without limiting production. Agriculture is a critical part of New Zealand's economy, creating around 40% of our merchandisable export earnings. Pastoral industries will also be directly affected by climate change in the form of increasing extreme weather conditions such as droughts, changing pasture productivity and pest prevalence. Adaptability and contributing to the international commitment to limit temperature rise to no more than 2 degree Celsius means we have to continue to invest in high quality science and support systems to help New Zealand farming continue to thrive.

There are two components to reducing agricultural GHGs without constraining total production – improving efficiency on-farm and researching novel solutions to support mitigation. Without efficiency gains, New Zealand would be looking at total agricultural emissions being almost 40% higher than the current 15% increase in total emissions relative to 1990 (due to increased industry production). However, while the improved productivity achieved by New Zealand farmers is addressing a significant portion of the emissions problem, it's not enough to counter the extra GHGs being produced overall.

All of New Zealand's agricultural GHG research funds were initiated through a specific action and continue to perform a function individually. However, it's the New Zealand "cogged approach" to GHG research that is resulting in better research, accelerated development of practical solutions and new ideas to help solve New Zealand's GHG emissions problem.

The following are an overview of some of the main research funds in operation in New Zealand, their aims and their partnerships with other funds.

A BRIEF HISTORY OF FUNDS AND INTERNATIONAL AGREEMENTS

1990-2000 Exploratory research on GHGs from livestock (noting that GHG emissions reduction as a co-benefit of productivity improvements is signalled in research from the 1950s)

1994 The United Nations Framework Convention on Climate Change (UNFCCC) is comes into effect (agreed in 1992 in Rio)

1994-1998 New Zealand's Greenhouse Gas Inventory is developed. NZ's first national communication to UNFCCC in 1994; in 1998, NZ's produced its first annual inventory update.

1997 Kyoto Protocol agreed (NZ ratified this agreement in 2002 with target for New Zealand's net emissions for 2008-2012 to be lowered to the level of absolute emissions in 1990).

2002 The Pastoral Greenhouse Gas Research Consortium (PGgRc) is formed under the Government's Research Consortia initiative to increase rates of innovation and private sector R&D investment and commences funding methane and nitrous oxide mitigation research.

A strategy for inventory research is developed to strengthen New Zealand's Greenhouse Gas Inventory annual update and national communication.

2003 Independent government report on mitigation research funding and priorities released (O'Hara et al, 2003).

New Zealand agricultural emissions research levy proposed to fund research to help move towards target in the Kyoto Protocol.

2004 New Zealand livestock industry confirms it will continue to invest and coordinate mitigation research through the PGgRc in partnership with the NZ Government. An MOU is signed.

2005 Kyoto Protocol comes into effect.

2007 The Sustainable Land Management and Climate Change Plan of Action announced by MPI including a dedicated research fund (SLMACC) covering adaptation, mitigation, forestry sinks and cross-cutting issues relevant to agriculture and forestry industries.

2009 The New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC) is formed as a research coordination centre to further New Zealand's emissions research working in partnership with the PGgRc. The NZAGRC is intended to complement the work from the PGgRc especially on gases other than methane and provide a strategic direction to overall mitigation research.

The Global Research Alliance on Agricultural Greenhouse Gases (GRA) is established to find global solutions to mitigate agricultural GHG emissions.

Global climate conference in Copenhagen fails to reach post-Kyoto agreement but provides a pathway for further negotiations to reach a new global agreement.

2010 The New Zealand Government established a dedicated fund to support New Zealand's contribution to the GRA.

2014 NZAGRC and PGgRc develop a single research programme for New Zealand agricultural ruminant methane emissions research.

2015 The PGgRc and the Crown agree that the PGgRc will commercialise all intellectual property generated by enteric methane vaccine and inhibitor research.

New Zealand Government commits an additional $20 million funding to its contribution to the GRA.

The Paris Agreement sets a global target for limiting temperature increase to well below 2 degrees Celsius. As at 22 February 2017, 132 Parties of 197 Parties to the Convention have ratified the agreement – New Zealand signed 5/10/16. New Zealand has pledged to reduce emissions in 2030 by 30% below 2005 emissions (11% below 1990).

There is widespread acceptance that achieving the goals set out in the Paris Agreement that net long-lived GHG emissions will have to be reduced to zero before 2100 and mitigation is necessary from all sectors and gases to achieve the overall temperature goal.

In 2016, an international paper (Wollenberg et al, 2016) details how the world can address the targets set in Paris and finds that global GHG emissions from agriculture should be reduced by 1 gigatonne in 2030 but less than half of this is possible with current options.

Organisation / programme	PGgRc	NZAGRC	GRA	SLMACC	Inventory	Industry
Funder	Industry / MBIE	MPI (PGP fund)	MPI (NZ GRA fund)	MPI	MPI	Various (including government partnerships)
How funds distributed	Negotiated	Negotiated	Negotiated & competitive	Competitive	Competitive	Negotiated & competitive
Funding scope	CH_4, N_2O	CH_4, N_2O, soil carbon and farm systems	CH_4, N_2O, soil carbon and farm systems	CH_4, N_2O, soil carbon, cross-cutting, models, social science	CH_4, N_2O and soil carbon	Productivity, N leaching, N efficiency
How funding decisions are made	PGgRc Board decision guided by General Manager's recommendation	Director recommends to NZAGRC Steering Group	External Technical Advisory Panel recommends to DG & MPI officials recommend to DG	External advisory panel recommends to MPI DG	MPI officials recommend to MPI DG	Varied
How priorities are set	Developed and signaled in 7 year plan, which is reviewed throughout by independent science and commercial advisory panels	Signalled in 5 year science plan	Grand Challenges set by an international panel; alignment with other multi-lateral funds; targeted investment based on advice from NZAGRC and GRA Livestock Research Group	Annually by officials advised by experts and MPI staff	Annually by MPI and MfE officials advised by external panels (NZoNet, Methanet and inventory expert advisory panel)	Dependent on research interests. Efficiency and production are key concerns, with GHG reductions as co-benefit of efficiency/ productivity gains
Funding 2000-2020 ($m approx.)	2004-2012: $37m 2013-2019: $37.8m (funded 50/50 by industry/government)	2009-2019: $48.5m	2010-2020: $65m This is direct research funding + provision of funding for other international funds/initiatives and secretariat support	Varying. Currently $2.5m per year	Varying. Currently $1.9m pear year	Funding from industry and government in support of industry objectives significantly exceeds $50m per year
Key linkages between the funding streams Note: MPI provides cohesion across NZ Government funded initiatives	PGgRc and NZAGRC co-invest in CH_4 programme; PGgRc bids into SLMACC on a 1:1 co-funded basis; NZAGRC Director observer on Board; PGgRc Manager sits on NZAGRC Steering Group & on SLMACC advisory group. PGgRc leads commercialisation of work on behalf of PGgRc and MPI investment.	As signalled under PGgRc + NZAGRC Director and Deputy Director provide advice for SLMACC, Inventory and GRA.	NZAGRC input into technical advisory panel & priority setting. NZAGRC leads NZ input into all GRA Research Groups. NZAGRC contracts most and reports on all research activities.	NZAGRC and PGgRc input. GHG projects need to align with PGgRc and NZAGRC strategies.	NZAGRC input into advisory panels.	Industry input into PGgRc – co-funder, advisors to various other funds.

PASTORAL GREENHOUSE GAS RESEARCH CONSORTIUM

Funded by industry & MBIE,
governed by Board of Directors

The PGgRc is a consortium of agricultural industry organisations that invest their funds and levies to develop mitigation solutions through research, in partnership with the New Zealand Government. The currently PGgRc invests $5.4 million annually via a 50/50 funding partnership with the Ministry of Business, Innovation and Employment (MBIE).

The research funded through the PGgRc has been largely dedicated to technologies that reduce ruminant methane production through enteric fermentation but previously has also invested in nitrous oxide research. The PGgRc aims to deliver knowledge and economically viable mitigation practices or products that will help New Zealand farmers manage GHG emissions, while increasing productivity.

The PGgRc leads the commercialisation of the methane vaccine and inhibitor mitigations through an agreement with the New Zealand Government via MPI assigning them intellectual property, and requiring them to act in both parties interests.

The PGgRc is funded in partnership with MBIE by:

Fonterra

Dairy NZ

Beef+Lamb New Zealand

DEEResearch

AgResearch

and has the following non-contributing participants:

Fertiliser Association

PGG Wrightson

Landcorp Farming

NEW ZEALAND AGRICULTURAL GREENHOUSE GAS RESEARCH CENTRE

Funded by MPI, managed by MPI

The NZAGRC is funded by the Ministry for Primary Industries (MPI) via its Primary Growth Partnership fund and is a partnership (non-financial) of nine New Zealand research organisations: AgResearch, DairyNZ, Landcare Research, Lincoln University, Massey University, NIWA, PGgRc, Plant & Food Research, Scion.

The NZAGRC investment is $4.8 million per year and is dedicated to developing agricultural emissions-reducing technologies and practices across the full suite of GHGs generated by agriculture, encompassing methane from both enteric fermentation and manure management, nitrous oxide from agricultural soils, and the management of soil carbon[6]. It also works to co-ordinate New Zealand's research into agricultural GHG emissions mitigation and be a key authoritative source of technical advice and support on agricultural GHG emissions and soil carbon sinks.

Apart from focusing on developing new solutions, the NZAGRC also devotes significant effort to developing young scientists at postgraduate (Honours, Masters and PhD) and postdoctoral levels to ensure the on-going capacity of the New Zealand research community to deliver against these challenges.

The NZAGRC leads New Zealand's science input into the Global Research Alliance on Agricultural Greenhouse Gases, which is New Zealand's main way of fostering international collaboration and helping build capacity in other countries to tackle their own GHG emissions.

LINKAGES & PARTNERSHIPS BETWEEN FUNDS

The New Zealand Ministry for Primary Industries (MPI) has close involvement with all the GHG emissions mitigation funds and programmes, and ensures that all the mitigation research is co-ordinated efficiently without duplication of science effort.

The NZAGRC and PGgRc work together to facilitate closely aligned research into methane mitigation, which is carried out in science institutions around the country, often in collaboration with international research partners. Initially, both parties generated plans to guide the direction of the research they fund, while actively co-ordinating and exchanging information between themselves and with MPI. This coordination occurred through informal communication as well as formally through representatives on their respective boards and steering groups.

Since 2014 the NZAGRC and PGgRc have had a single research programme and contracting mechanism for research into enteric methane to reduce administration costs and eliminate any risk of duplication while allowing the most focused investment in priority areas.

The PGgRc provide a critical link to the New Zealand agricultural industry. Through its investment partners, the research conducted maintains its relevance to industry, ensuring any solutions to reduce

[6]See NZAGRC-PGgRc fact sheet: Reducing New Zealand's agricultural greenhouse gases: What we are doing

GLOBAL RESEARCH ALLIANCE ON AGRICULTURAL GREENHOUSE GASES

Funded by MPI (New Zealand funding), managed by MPI & NZAGRC

The Global Research Alliance on Agricultural Greenhouse Gases (GRA) was launched in December 2009 and now has 47 member countries from all regions of the world. The New Zealand Government initiated the global initiative to increase research collaboration between countries to find ways of reducing GHG emissions from agriculture without jeopardising global food security.The GRA provides a framework to bring together research and investment into mitigation practices and technologies from around the world. It covers paddy rice, cropping and livestock industries, and across these industries looks at integrated systems including soil carbon, nitrogen cycling, and inventory and measurement.

The GRA has a dedicated research group for livestock focused on reducing the emissions intensity of livestock production systems and increasing the quantity of carbon stored in soils supporting those systems.

The New Zealand Government has committed research funds to support the Livestock Research Group to accelerate global research in mitigating GHG emissions from pastoral livestock. All work funded via this fund has a strong New Zealand relevance but will aid and draw on international work on understanding GHGs and provide science and policy links around the world.

Additionally, New Zealand holds the secretariat position for the GRA and provides key inputs into scientific and capability building activities.

Financially, New Zealand has allocated a total of $65 million to the GRA, and other alliance member countries provide additional, significant cash or in-kind funding to shared activities. The most recent financial boost to the GRA came at the Paris COP21 climate forum in 2015, where New Zealand announced that it would provide a further $20 million in support of the GRA in addition to the original allocation of $45 million. These investments by New Zealand are in addition to its domestic research programmes and funds outlined above.

Wherever possible, the GRA seeks to align with other international funders and institutions.

emissions can maintain or increase production levels while meeting the environmental concerns of international trading partners.

The NZAGRC has an administration contract with the New Zealand Government to oversee the management of funded projects from its Global Research Alliance investment. This provides a critical link back to the domestic programme of work and helps identify new investment opportunities for New Zealand's own research programme.

Several research programmes are now in place that aim to reduce agriculture's environmental impacts such as Pastoral 21 (partnership between MBIE, AgResearch, and Dairy and Meat industry organisations), Land and Environment Plans being offered by Beef + Lamb NZ, and DairyNZ research into forages that reduce nitrate leaching. These mainly focus on nitrates and water quality but many achieve emissions reductions as co-benefits.

The NZAGRC's Integrated Farming Systems theme works with industry in some of these programmes to measure and demonstrate the extent to which more efficient farms also have lower GHG emissions.

There are also links through joint Primary Growth Partnership and industry funded programmes, which have GHG training, monitoring and mitigation components within them.

SUSTAINABLE LAND MANAGEMENT AND CLIMATE CHANGE

Funded by MPI, managed by MPI

The SLMACC Research Programme was formed in 2007 after the announcement of the New Zealand Emissions Trading Scheme to help the agriculture and forestry sectors understand and reolve the challenges arising from climate change.

The SLMACC Research Programme is a policy needs-driven fund, investing in targeted basic, applied and policy research, including the impacts of climate change and adaptation to climate change, mitigation of agricultural and forestry GHG emissions, cross-cutting issues, including economic analysis, life-cycle analysis, farm, catchment and systems analysis and social impacts, and policy research to address targeted policy questions.

Apart from addressing direct policy-relevant questions, this fund is often used to test the feasibility of new areas of mitigation research that show potential. Promising results are then funded and progressed by other means, such as through the NZAGRC/PGgRc or Global Research Alliance.

NEW ZEALAND INVENTORY

Funded by MPI,
managed by MPI in consultation with MfE

New Zealand is required to maintain an inventory of its GHG emissions as part of its obligations under the United Nations Framework Convention on Climate Change (UNFCCC). The inventory is an annual report of all human-induced emissions and removals of GHGs in NZ. The first formal inventory was submitted in 1994 as part of New Zealand's first national communication to the UNFCCC, and annual reporting started in 1998. The inventory is coordinated by the Ministry for the Environment (MfE), while MPI produce estimates of agricultural GHG emissions and supports forestry sink estimates particularly from planted forests. While a national inventory uses some assumptions and generalisations to estimate emissions from different sources, it is designed to reflect as much as possible the eventual emissions reductions in agriculture that could arise from current mitigation research.

For more information about estimating emissions for a national inventory, see the NZAGRC-PGgRc factsheet: Reducing New Zealand's agricultural greenhouse gas emissions: How we measure emissions pages 11-14.

There is funding to support research on agricultural greenhouse gas emissions reporting, and projections of future emissions from land use. Direct investment in inventory projects comes from MPI and all projects have a domestic focus to ensure New Zealand can continue to comply with UNFCCC rules.

INDUSTRY

A variety of industry and private backing is provided to the New Zealand GHG emissions mitigation research effort. The industry provides significant funding in partnership with government via the PGgRc (see PGgRc) to further enteric methane mitigation research.

A far greater proportion of industry funding is provided to increase the productivity and efficiency of the New Zealand farming industry. The emissions reductions brought about by these efficiency gains are a co-benefit of these intensive research programmes.

The requirement for increased productivity and efficiency is mainly driven by the need for New Zealand farmers to remain economically viable in a global market, but domestic and international expectations around improved environmental practices, in particular water quality form part of the decisions.

Given the mix of private and commercial investment in productivity and efficiency it is difficult to estimate the total investment. However, conservative estimates are that more than $50 million per year is invested into this type of research from both private and government sources, which is significantly more than direct GHG mitigation research funding.

For a summary of how New Zealand farms having become more efficient, and the direct impact on New Zealand's emissions, see the NZAGRC-PGgRc factsheet: Reducing New Zealand's agricultural greenhouse gas emissions: How we are getting there

OTHER FUNDS AND INITIATIVES

Various other private and government funds and initiatives have added to our knowledge of GHG emissions and mitigation options. For example, the Sustainable Farming Fund (SFF) from MPI, and various industry led initiatives have looked at carbon footprinting of dairy, sheep and beef farming in New Zealand, the Primary Growth Partnership (PGP) fund has several programmes that look at emissions reductions as well as others with a strong focus on productivity enhancement, and MPI's Maori Agribusiness Pathways to Increased Productivity helps Maori landholders achieve their land's production potential.

HOW THE FUNDS WORK TOGETHER: A WELL OILED MACHINE

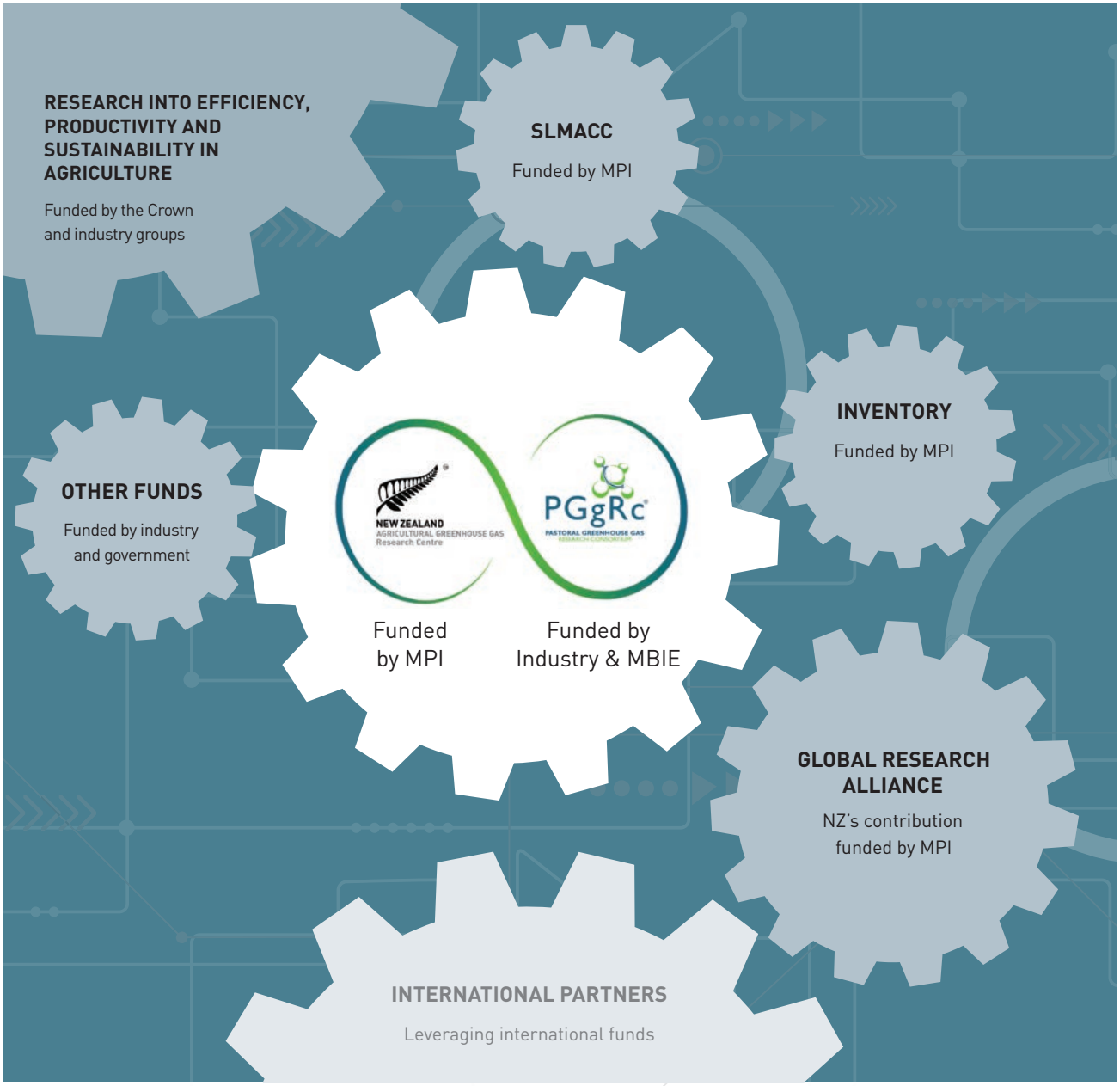
New Zealand's agricultural GHG emissions mitigation research funding works together like a set of cogs, a well-oiled machine rather than individual funds working in isolation.

The PGgRc and NZAGRC are a central cog moving together to provide an overall push forward for targetted GHG mitigation research in New Zealand. These two research funds work with all sectors – government, science and industry – while other funds contribute individual, focussed research outcomes to improve New Zealand's overall knowledge of how we can do more to improve efficiency and productivity, and introduce new mitigation strategies on farm. It's also important that all this work links closely to improving New Zealand's GHG inventory accounting methods both on farm and nationally, as well as drawing as much as possible on international expertise and collaborations, and contributing to expanding and accelerating the global search for GHG mitigation solutions.

There are many advantages in this approach to funding. New Zealand is able to support targeted work to address both international and national priorities. For example, meeting UNFCCC requirements as well as national targets for mitigation of biological emissions.

A multi-faceted approach allows New Zealand to cover a broad scope of work including the integration of agricultural mitigation research with impacts, adaptation and enhancement of forest sinks.

This approach enables flexibility of resource input to cover a broad range of solution options - from very basic to very applied - while still maintaining the ability to direct focus to the most promising solution areas.



WHICH MICROBES LIVE IN THE RUMEN?

Research funded by the PGgRc laid the groundwork for what is now a comprehensive understanding of rumen microbiology. A key part of this was sequencing the first genome of a methanogen (the microbes that produce methane in the rumen). Now, with a boost provided by joint funding from the NZAGRC, the genomes of 11 different methanogen species have been sequenced. The genomic approach has enabled researchers to develop ways of selectively targeting methanogens without affecting the wide variety of other microbes that are essential for the functioning of the rumen. This new knowledge has been fundamental to several subsequent strands of research funded by the PGgRc and NZAGRC, the GRA and SLMACC. These include the identification and testing of methane inhibitors that block the enzyme pathways of methanogens and the development of a vaccine against methanogens.

PGGRC

Sequenced first methanogen genome

PGGRC-NZAGRC

11 methanogen genomes (currently) sequenced

PGGRC-NZAGRC

Identifying molecular targets to selectively supress methane generating microbes

Research on identifying and testing inhibitors

Research on methanogen vaccine effective in live animals

GRA

Accelerating methodologies for discovery and testing of potential inhibitors

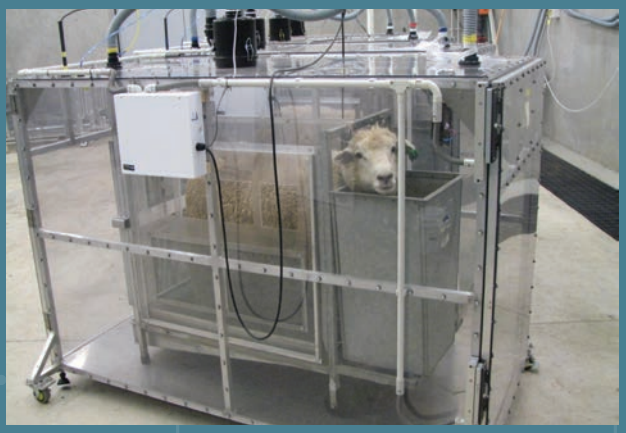
Adjuvants for an anti-methanogen vaccine

Global Rumen Census: a global survey of rumen microbial populations in different species and feeds

Hungate 1000: a global genetic reference catalogue of key rumen microbes

BREEDING ANIMALS FOR REDUCED METHANE EMISSION

In the early 2000s, researchers first became interested in the question of whether there is any natural variation between individual animals in the amount of methane they produce. Initially, PGgRc funded a major programme with the dairy industry initiative BoviQuest to measure emissions from 700 individual dairy cows. This trial showed large differences in emissions between animals. Subsequent work in sheep, funded by SLMACC, established that some animals naturally produce up to 10% less methane than others. Using New Zealand's strength in breeding sheep, the PGgRc then funded a larger research project that established that methane production is heritable meaning that the difference between low and high emitting animals can be passed through the generations. Having demonstrated feasibility, the work now forms a major ongoing project that is jointly funded by the PGgRc and the NZAGRC to identify genetic markers and rapid measurement techniques that allow these differences to be exploited as part of standard industry breeding programmes. Additional investment through the Government's GRA fund further allowed New Zealand researchers to connect their work with that conducted in other countries, to share experiences with measurement methods and to establish measurement and reporting protocols to increase the global genetic information and allow intercomparisons on low-emissions traits.



SLMACC-PGGRC

Naturally occurring lower methane emitters

PGGRC

Establish heritability of methane production

PGGRC-NZAGRC

Identify genomic and phenotypic traits of low-emitting animals

Test for correlations with productivity and disease resistance

INVENTORY

Develop comprehensive emissions factors for cattle and sheep and a robust methodology developed to capture these emissions reductions in New Zealand's international accounting

GRA-NZAGRC

Rapid methane measurement techniques

GRA

Establishing international protocols to allow intercomparison

Identify differences in rumen microbial communities of low and high methane emitting animals

A GLOBAL RUMEN MICROBES CENSUS

The power of global collaboration was shown in the ability to do a global rumen microbes census. New Zealand scientists wondered how typical the rumen microbes found in New Zealand ruminants are globally – a key question if New Zealand hopes to market new solutions it may develop to reduce methane emissions from enteric fermentation. Through the Global Research Alliance, New Zealand scientists led a global project to compare rumen samples from around the world. They received over 700 contributions from 35 countries, including not only goats, sheep and cattle, but species such as reindeer, giraffes and camels. They found that despite some differences related to feed and species, methanogens are surprisingly similar everywhere. This means that strategies to inhibit dominant methanogens, such as through methane inhibitors being developed by the PGgRc and

NZAGRC, are likely to be applicable in grazing based systems globally. This gives further direction and impetus to the domestically funded research and development work.

NZAGRC-PGGRC

Finding provides important context to support the development and commercial potential of anti-methanogen inhibitors and vaccines developed to be effective globally

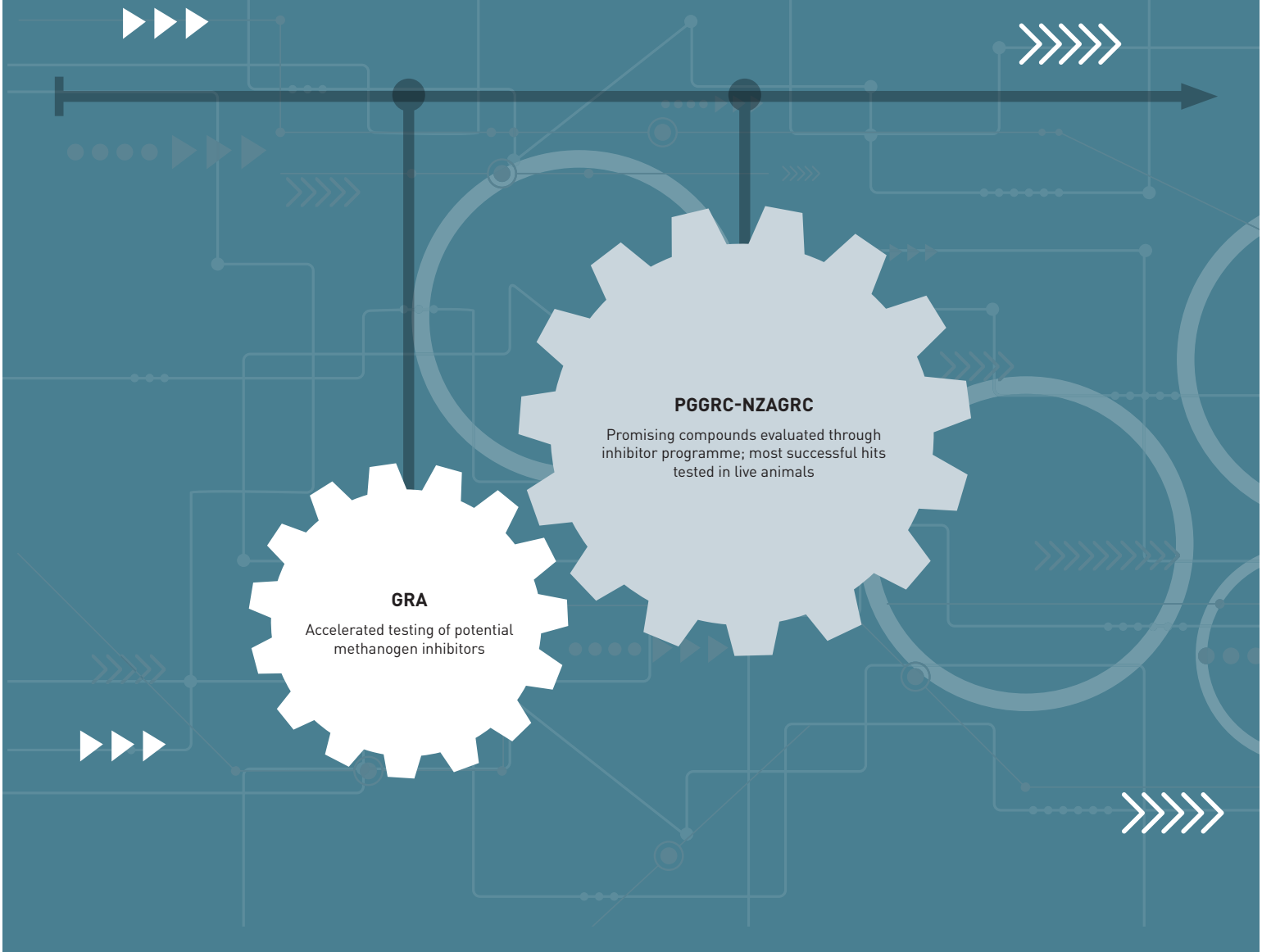
GRA

Global Rumen Census shows that a core group of rumen microbes is very similar across species and feeds

FREEING A METHANOGEN-BUSTING BOTTLENECK

Sometimes the most valuable advances occur at methodological levels. An example of this is a new laboratory technique that allows faster assessment of potential methane inhibiting compounds.

Possible compounds are initially identified using a computerised process known as chemogenomics. This allows a rapid scan of many thousands of compounds to identify any that in theory should be able to inhibit the function of methanogens. But the next crucial step is that promising compounds need to be tested in a laboratory, by pipetting the compounds onto plates that contain methanogens, and seeing whether they actually affect the methanogen's function. The most promising and animal-safe compounds can then be tested in simulated rumen fluids and ultimately in live animals. This initial laboratory testing was a time-consuming technique, until a team led by local scientists, assisted by international GRA scientists and New Zealand GRA funding, devised a new method. The new technique keeps methanogens, which live in anaerobic conditions, alive in the lab on multi-well plates that allow much higher-throughput testing of many compounds at any time. This has greatly accelerated the ability to test potential methanogen inhibitors, and has identified several promising compounds that are now being taken further in the methane inhibitor programme funded by the PGgRc and NZAGRC.



NITROUS OXIDE AND SOIL MOISTURE

On-farm measurements of nitrous oxide that were made to inform New Zealand's Greenhouse Gas Inventory revealed that waterlogged pastures produce more nitrous oxide. This led to research funded by New Zealand in support of the Global Research Alliance to find out whether nitrous oxide production could be reduced by providing farmers with advice on when animals should be taken off pastures during wet conditions, which would not only reduce emissions but also nitrate leaching and limit pasture damage. This work was carried out using farm data and measurements from New Zealand, Ireland and the United Kingdom. The results from this study highlighted that the benefits and feasibility of managing stock on waterlogged pastures can differ significantly between countries and soil types, emphasising the need for a national and even region-specific approach to mitigate GHG emissions.

INVENTORY

Multiple field measurements of nitrous oxide emissions, indicating that emissions depend on soil wetness

GRA

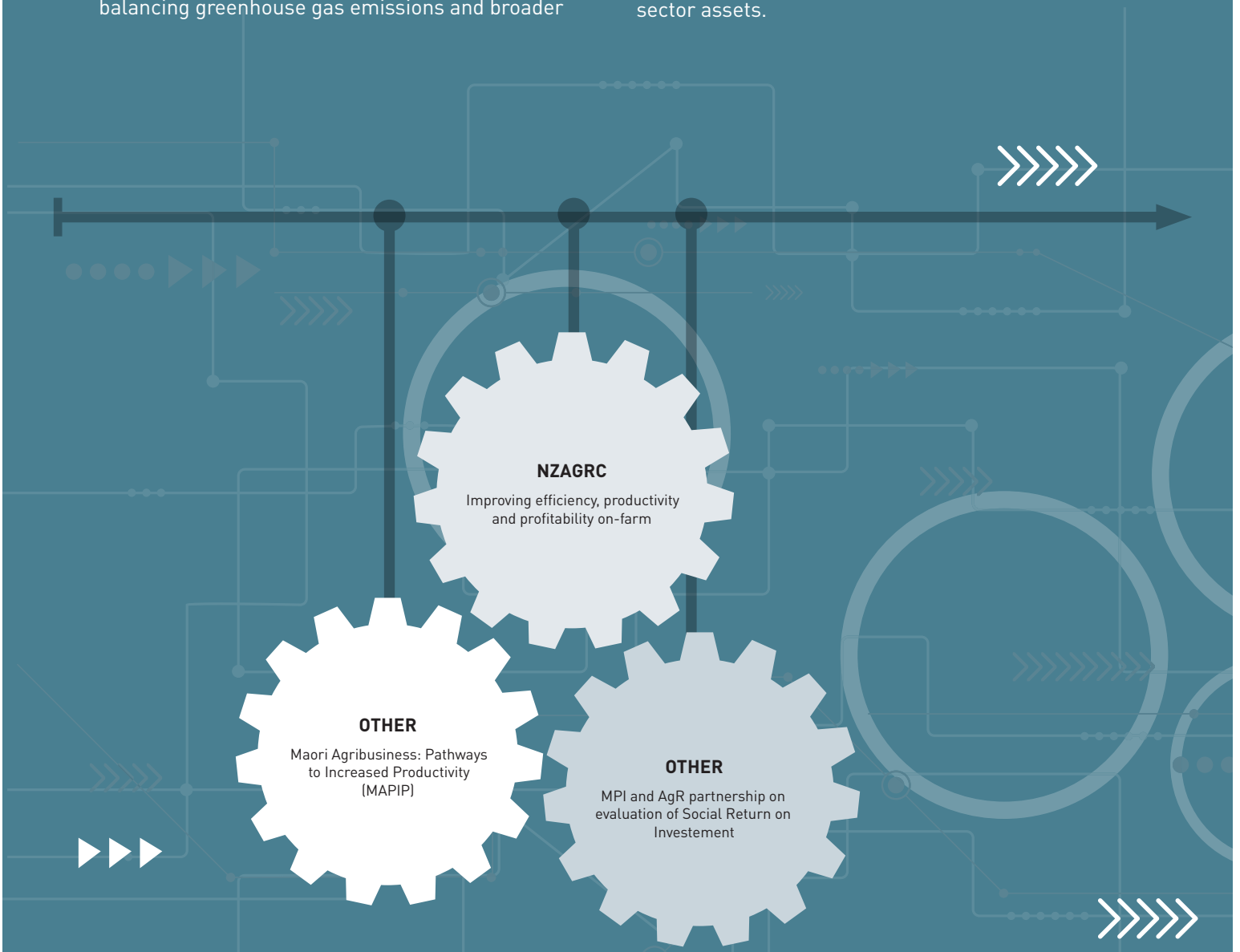
Testing the feasibility of a decision-making tool to remove stock from wet pastures to reduce emissions, nitrate leaching and pasture damage

NZAGRC

Integrated systems work programme

MĀORI FARMING: HIGHER PRODUCTION WITHOUT HIGHER EMISSIONS

Māori farms have specific social, economic and cultural purposes, which must be considered when balancing greenhouse gas emissions and broader development goals. The NZAGRC is undertaking a large, three year project with 29 Māori farms nationwide that integrate forestry and livestock. The aim is to assist the Māori pastoral sector to identify ways of improving its efficiency, productivity and profitability while reducing greenhouse gas emissions. Four focus farms serve as sites to identify specific emissions mitigation approaches that would also serve the wider social, economic and cultural goals driving the long-term development of those farms. This project supplements a range of other initiatives that assist Māori agribusiness development, such as the Social Return on Investment evaluation tool implemented by AgResearch and funded by MPI, and MPI's Pathway to Increased Productivity programme, which assists Māori landowners to grow and protect their primary sector assets.



FURTHER READING

Pastoral Greenhouse Gas Research Consortium (PGgRC)
pggrc.co.nz

New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC) nzagrc.org.nz

Global Research Alliance on Agricultural Greenhouse Gases (GRA)
globalresearchalliance.org

Sustainable Land Management and Climate Change Research Programme (SLMACC)
mpi.govt.nz/funding-and-programmes/farming/sustainable-land-management-and-climate-change-research-programme/

New Zealand's Greenhouse Gas Inventory
mfe.govt.nz/climate-change/reporting-greenhouse-gas-emissions/nzs-greenhouse-gas-inventory

Transition to a Low-Carbon Economy for New Zealand
royalsociety.org.nz/expert-advice/papers/yr2016/mitigation-options-for-new-zealand/

Climate change and agriculture: Understanding the biological greenhouse gases pce.parliament.nz/publications/climate-change-and-agriculture-understanding-the-biological-greenhouse-gases

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Reducing emissions from agriculture to meet the 2 °C target. (Wollenberg, E., Richards, M., Smith, P., Havlík, P., Obersteiner, M., Tubiello, F. N., Herold, M., Gerber, P., Carter, S., Reisinger, A., van Vuuren, D. P., Dickie, A., Neufeldt, H., Sander, B. O., Wassmann, R., Sommer, R., Amonette, J. E., Falcucci, A., Herrero, M., Opio, C., Roman-Cuesta, R. M., Stehfest, E., Westhoek, H., Ortiz-Monasterio, I., Sapkota, T., Rufino, M. C., Thornton, P. K., Verchot, L., West, P. C., Soussana, J.-F., Baedeker, T., Sadler, M., Vermeulen, S. and Campbell, B. M. 2016)
onlinelibrary.wiley.com/doi/10.1111/gcb.13340/full

Reducing New Zealand's agricultural greenhouse gas emissions: How we are getting there
nzagrc.org.nz/fact-sheets,listing,177,what-we-are-doing.html

Reducing New Zealand's agricultural greenhouse gas emissions: How we measure emissions
nzagrc.org.nz/fact-sheets,listing,176,reducing-new-zealands-agricultural-emissions-how-we-measure-emissions-edition-2.html

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WORKING TOGETHER