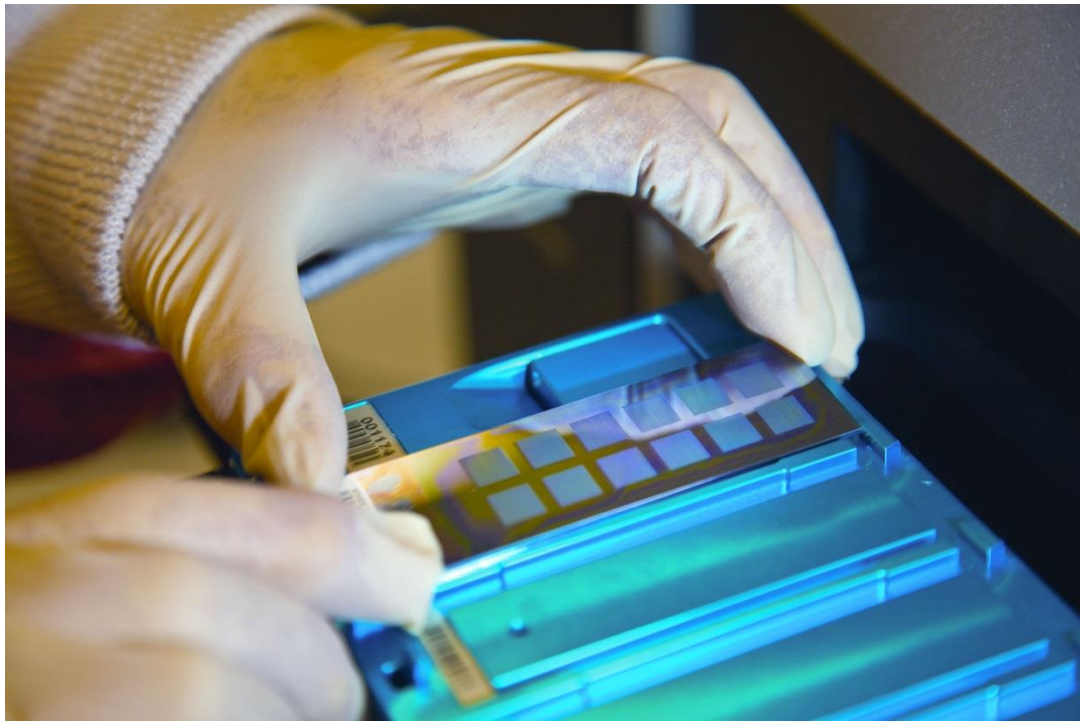
NEW ZEALAND
AGRICULTURAL GREENHOUSE GAS
Research Centre

The New Zealand Agriculture Greenhouse Gases Research Centre



Annual Report 2013 V2

Centre Summary & Achievements

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About Us

The NZAGRC ("the Centre") is funded by the Ministry of Primary Industries (MPI) through its Primary Growth Partnership Fund. It is a core component of the New Zealand Government's approach for addressing the reduction of greenhouse gas (GHG) emissions from agriculture. This includes New Zealand becoming: (a) a major investor in agricultural GHG mitigation research, (b) a world leader in finding solutions to agricultural GHG emissions via its domestic investment programme, and (c) a leader in international initiatives to advance the search for mitigation solutions and help ensure international treaties address agricultural GHG emissions in an appropriate manner. The Centre is a science funder, has additional responsibilities for strategic research coordination, capacity building and leads New Zealand science input into international activities and policy processes in the agricultural GHG area.

The Centre is a partnership between New Zealand's leading research providers working in the agricultural greenhouse gas area and the Pastoral Greenhouse Gas Research Consortium (PGgRc). Partner logos are listed in the figure below. The Centre is a "virtual" centre where the research commissioned by NZAGRC is carried out by teams of researchers working within and across a range of research providers. The Centre is physically hosted by AgResearch at its Grasslands campus in Palmerston North.

Staff

Centre Staff: (L to R) Kate Parlane, Victoria Hatton, Harry Clark, Heather Went and Andy Reisinger.

Insert:

Lora Hagemann (L), Ayesha Hehir (R)

Name	Role	Location
Dr Harry Clark	Director	Palmerston North
Dr Andy Reisinger	Deputy Director (International)	Wellington
Dr Heather Went	Operations Manager *maternity leave for 12 months from Feb 2013	Palmerston North
Dr Victoria Hatton	Operations Manager (International)	Palmerston North
Miss Kate Parlane	Administrator	Palmerston North
Mrs Ayesha Hehir	Administrator	Palmerston North
Dr Lora Hagemann	Contractor *contracted for 15 months from Oct 2012	Hamilton

Contact details

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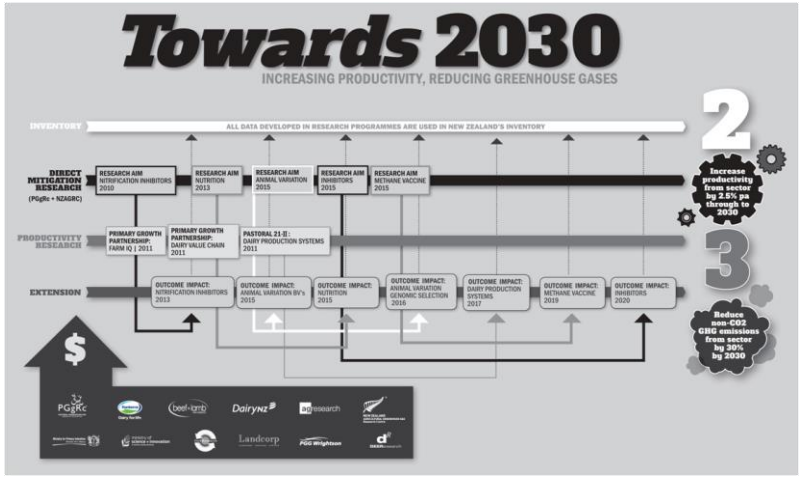
The Chair's Report

Agriculture plays a critical role in the New Zealand's economy, but nearly half of New Zealand's greenhouse gas (GHG) emissions come from agriculture. Although New Zealand has not signed up to a second commitment period under the Kyoto Protocol and deferred the entry of agriculture into the Emissions Trading Scheme (ETS) in 2012, reducing GHG emissions is still a priority and the Centre continues to be central to the national effort to reducing agricultural emissions while increasing agriculture output.

With a growing affluent world population, New Zealand aims to increase its agriculture production to meet an export opportunity. But, the environment in which our farmers operate has become increasingly complex with consumers, policy makers and society demanding safe, high quality and ethically produced food that doesn't degrade our natural capital or pollute our water and air. While production efficiency gains over the past 20 years have reduced GHG emission intensity (i.e. "emissions/unit product"), total emissions from agriculture have increased to 12% above their 1990 level. Unless effective technical solutions are found to reduce agricultural emissions, New Zealand's economic growth could be constrained and our image as a producer of high quality produce with high environmental integrity tarnished.

The Centre has a strong coordinating role as part of its Mission. This year, the Centre more formally aligned with the Pastoral Greenhouse Gas Research Consortium (PGgRc) by adopting a single research strategy with shared advisory groups and administrative processes – a move that was very positively received by both Government and Industry. The Centre also jointly developed the "Towards 2030", a "NZ Inc" approach to GHG mitigation activities which ensures the Centre's investments are coordinated with other interested parties in the GHG space.



Likewise, the Centre has been working more closely with its Māori Advisory Group (established in early 2012) to ensure all New Zealanders are beneficiaries of the research outcomes from the Centre. Through its national and international roles and responsibilities – particularly through its active involvement in the Global Research Alliance on Agricultural Greenhouse Gases (GRA), the Centre continues to build its reputation as an important source of clear and unbiased advice on the science behind agricultural greenhouse gases and their mitigation options.

This year, the Centre also underwent two formal reviews including a science review by the International Science Advisory Group and a contract review by MBIE. Both reviews returned very positive outcomes and the Steering Group and Centre Director will be working closely with MPI in the coming year to implement suggested improvements to the science and business direction.

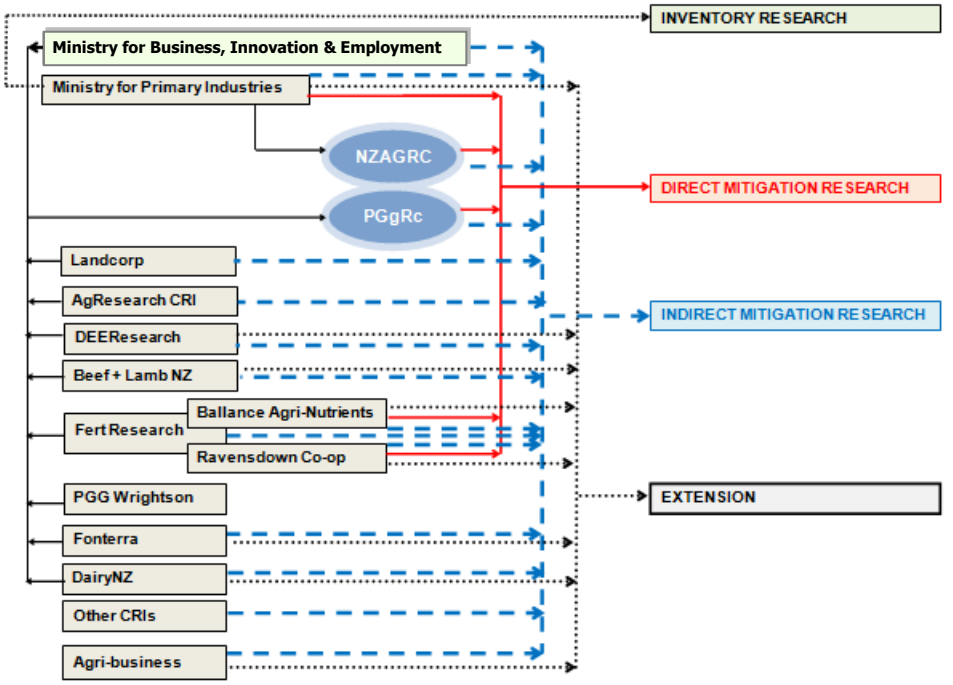
Professor Warren McNabb * Steering Group Chair
August 2013

The Director's Report

The 2012-13 financial year has been another busy one for the Centre. I am pleased to say that the science programmes are progressing well, milestones are being achieved and usable results, outputs and publications are emerging from the research.

Considerable effort this year has been put into aligning ourselves with the PGgRc. Once the PGgRc received renewed funding from MBIE Partnership Fund for a further seven years (assuming a positive mid-term review), the Centre Steering Group and the PGgRc Board agreed to continue as separate entities, but aligned under a single science strategy. This makes sense as our two organisations represent the interests of both Industry and Government and the lion's share of investment in methane mitigation research within New Zealand (see figure upper right showing all the investors in agriculture GHG-related activities with which the Centre coordinates its investments).

The two organisations already share advisory groups and the closer relationship gives the Centre a stronger conduit to its next-users/end-users and pathways to protect and commercialise IP and transfer new knowledge, technologies, products and practices. Another significant event for the Centre this year was the mid-term science review by the International Science Advisory Group (ISAG) in February 2013. The outcome of the review was very positive and the ISAG strongly endorsed the current research direction. The ISAG were very complimentary of the expertise of our researchers, the quality and relevance of the R&D undertaken and the level of capability development the Centre is able to achieve. One area the ISAG highlighted for improvement was that of



publication of research findings, noting that in some areas we were below the standard required if we were to be seen as a leading international research centre. This is something we will be working with the scientists we contract over the coming months. The Centre also completed an MBIE mid-term contract review in May 2013. Overall, the outcome of this review was also positive and the Centre, along with the Steering Group, will be working closely with MPI in the months ahead to implement some of the recommendations that were made by the review panel. Particular attention will be focussed on the need to be strongly relevant to, and in close communication with, the farming community. I'd like to thank all of the Centre scientists and Centre staff for their time and valuable contributions to these reviews; both review panels complemented the

Centre on the quality of the material they received which was a great credit to all involved.

Both of the external reviews and the closer alignment with the PGgRc mean that there is a need to refresh our Science Strategy and Science Plan early in 2013-14. We will look to ensure that investments continue to link closely with MPI's Sustainable Land Management and Climate Change funded work (SLMACC) and those of the New Zealand Global Research Alliance fund, and to strengthen our portfolio of applied research and technology transfer activities. The robust and unbiased information the Centre staff and researchers contribute to policy decision-making continue to be a recognised and respected role of the Centre.

The Centre continues to take an actively role in supporting MPI with the Global Research Alliance (GRA) both nationally and internationally. An independent review commissioned by MPI considered the GRA a major New Zealand success, contributing to New Zealand being seen as a thought and science leader in the agriculture GHG space. In addition to leading New Zealand's science input into the GRA and administering the LEARN and GRASS fellowship schemes this year the Centre has taken on a larger role in contracting, monitoring and reporting a range of projects funded out of the New Zealand Global Partnerships in Livestock Emissions Research which was set up as part of the New Zealand contribution to the GRA.

These are only a few of the highlights of a very busy year. More achievements by the Centre staff and researchers are conveyed throughout the rest of this annual report.

Particular highlights for the Centre staff this year include a second son for Centre Operations Manager, Heather Went, born in February. Heather is taking 12 months maternity leave and in her place, the Centre has hired business consultant, Lora Hagemann, to fulfil some of Heather's normal duties. Heather's absence and the additional GRA commitments has also allowed Centre Administrator, Kate Parlane, to step into a wider role as Project Analyst and we have employed Ayesha Hehir as Centre Administrator, to work closely with Kate. Early in 2013, Victoria Hatton, Operations Manager (International) was seconded to MPI on a part-time basis for four months. Victoria survived the daily commute to Wellington from Palmerston North and both she and her MPI colleagues found the exchange extremely valuable. We hope to similarly host an MPI staff person to the Centre in the near future to deepen our close working relationship with MPI.

I would like to express my thanks to all of our Advisory Groups, and particularly to the Steering Group, for their dedication to the Centre and the knowledgeable advice that they have provided throughout the last year.

Dr Harry Clark *NZAGRC Director
August 2013

2012-13 Summary Activities and Achievements

The need for research to find cost-effective practices, tools and technologies to reduce agricultural GHG emissions that are consistent with New Zealand's pastoral farming base is as important as ever. Consequently, the Centre's vision and mission (see below) remain highly relevant in the change context in which it operates.

The Centre's Vision and Mission

Vision:

To be an internationally renowned centre for research and development into agricultural greenhouse gas mitigation solutions*

Mission:

To provide knowledge, technologies and practices which grow agriculture's ability to create wealth for New Zealand in a carbon-constrained world*

*from the NZARGC 2010-2015 Strategic Plan

The Centre has made substantial progress towards achieving its Vision and Mission through its on-going achievements in five major business goals (each discussed in more detail below).

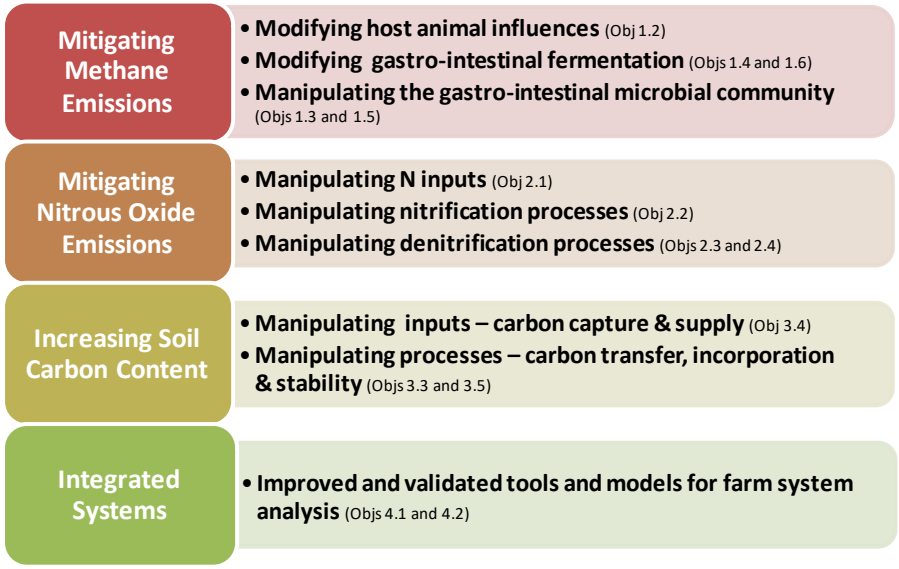
In 2012-13, particular achievements include:

- Acting as a focal point for New Zealand research activities in agricultural GHG mitigation and becoming internationally recognised for the quality of its research (see 2013 Science Review, p16).
- Running an efficient organisation with sound governance and financial control.
- Developing a very close alignment with the PGgRc, and through this relationship, improved its connectivity to commercial pathways for the science progress (see Goals 2 and 5, pp 9 and 14).
- Enhancing its engagement with Māori, including working with the Māori Advisory Group (MAG) and commissioning a Māori agriculture-related scoping study (see Goal 2, p10);
- Actively contributing to the success of the Global Research Alliance (GRA; see Goal 5, p13) and coordinating New Zealand's science input to the GRA.
- Actively contributing to policy – e.g. through advice on GRA and Sustainable Land Management and Climate Change (SLMACC) fund investments, ETS and Methanet Intergovernmental Panel on Climate Change (IPCC) committees, commissioning soil carbon and DCD research (see Goals 3 and 5, pp 12 and 13).
- Continuing to build international partnerships via the GRA and the European Union Framework 7 'Animal Change' programme (see Goal 5, p13).
- Actively contributing to the development and retention of scientific capability (see see Goal 4, p13).

Goal 1: Advance knowledge and understanding

Science Themes

The Centre supports four Science Programmes in alignment with other agencies and private investors.



Increasing alignment with the PGgRc meant that the Centre worked closely with PGgRc to prepare a new MBIE Partnership bid in August 2012. This bid was approved in December 2012 and renews a total of $37m for a further seven years in Government and Industry matched investment in direct methane mitigation R&D. As a consequence, the Centre and PGgRc will work to a joint science plan for the Methane area from 2013-14 onwards (see Goal 5).

In January 2013, international regulatory issues regarding residues from nitrogen inhibitor DCD use led to it being withdrawn from sale in New Zealand. Research in the Centre's nitrous oxide programme has helped prove the efficacy of DCD but emphasis is now being switched to providing the information needed to support efforts to get the product back onto the market. This redirection is likely to continue throughout 2013-14 and will be reflected in revised contracts with the provider organisations.

In February 2013, the Centre's programmes underwent a formal mid-term review by the Centre's International Science Advisory Group (ISAG) which, on the whole, found the science to be high quality and relevant. Implementation of key recommendations intended to improve/maintain the Centre's science programmes are in progress and will continue through 2013-14 as current objectives come off contract (see Major Reviews).

In 2012-13, key science achievements included:

- Analysis of host genotypes using 50K SNP chips identified several regions of the host genome that may be associated with methane emission and provided evidence that genomic selection will be possible. Similarly, rumen samples indicate consistent differences between divergent animals in their rumen microbial communities.
- Demonstrated via the sequencing of AbM4 that the whole order of Methanobacteriales can be inhibited by targeting the same conserved genes.
- Demonstrated that animals vaccinated with a mixture of two potential vaccine antigens, SecE and GT2, produced antibodies against these targets in saliva and these antibodies were detected in the rumen. All vaccinated animals produced antibodies against the antigens but not in sufficient quantities to reduce methane.

- Identified ammonia oxidising bacteria rather than ammonia oxidising bacteria as the target for inhibition when developing/evaluating new nitrification inhibitor technologies.
- Untangled the role of fertiliser nitrogen input and stocking policies to explain measured changes in soil carbon and nitrogen under drystock and milking dairy cows. Increased stocking rate results in nitrogen being 'mined' from soil and leads to a run down in soil carbon.
- Completed measurements suggesting fine textured soils may be under-saturated with carbon and there may be potential to stabilise additional carbon in these soils.
- Found at a single site in the Waikato that the soil carbon lost from soil cultivation prior to re-seeding is quickly regained.

More detailed information regarding science progress during 2012-13 can be found in the following document associated with this Executive Summary **2013 Annual Report_Programme Summaries and Outputs.pdf.**

Goal 1 metrics

Measure	Progress in 2012-13
Peer-reviewed scientific journal papers	15 peer reviewed journal papers published; 22 manuscripts submitted, not yet published; 29 other publications
Scientific conference papers	18 presentations
Patents relating to agricultural GHG emission mitigation technologies	Patenting decisions are the joint responsibility of MPI and PGgRc (not the Centre directly); new IP protected and managed as commercial (in confidence) IP or shared freely as public-good information.
Practical on-farm mitigation practices and technologies identified and being promoted	4 fact sheets published; a further 4 new fact sheets in progress.

Goal 2: Enhance awareness among stakeholders

PGgRc Alignment

From 2002-2012, the PGgRc has invested more than $37m in GHG (mainly methane) mitigation research. During 2012-13, PGgRc successfully renewed its Partnership funding with MBIE for a further $37m over seven years. This renewal triggered a move for the Centre to develop a much closer working relationship with the PGgRc.

Close cooperation with the PGgRc is a key pathway for the Centre to interact with industry stakeholders, assist MPI to manage IP and enable knowledge transfer through commercialisation of new tools, technologies and practices. Current industry co-investors within PGgRc are: Fonterra, DairyNZ, Beef+Lamb NZ, Landcorp, Deer Research and PGG Wrightson. AgResearch is the CRI member. Since February 2013, the Centre Steering Group members have been meeting jointly with the PGgRc Board members to monitor progress on joint initiatives and funded R&D. The Centre Director is an observer on the PGgRc Board.

Other key joint initiatives in 2012-13 with the PGgRc included:

- Developing a set of principles for a new aligned relationship between the two organisations.
- Actively supporting MPI and PGgRc to develop formal agreements for co-ownership and co-manage of IP and decision-making processes for IP commercialisation (particularly in the methane area).
- Discussing a single contracting and reporting process for jointly-funded research programmes. Subject to MPI/MBIE approval, these processes will be put in place for the 2013-14 financial year.
- Actively participating with the research teams to prepare successful PGgRc-led SLMACC and MBIE Partnership Fund bids.

- Jointly sponsoring the Greenhouse Gases from Animal Agriculture (GGAA) Conference in 2013.

Other Stakeholder Engagement

Although the PGgRc provides a robust pathway for the Centre to link with industry stakeholders, the Centre continues to maintain direct links with a broad range of other stakeholders, including policy makers, end-users, the science community and the wider public.

The indefinite delay in the agricultural ETS and lack of a carbon price provides no financial incentives (or penalties) for Industry to take a priority interest in mitigating GHGs. Meaningful engagement is very difficult unless mitigation options provides a production or profitability benefits as a by-product. This is made more difficult given that the Centre has focussed much of its investment in discovery science and early stage R&D of mitigation technologies. To address this issue the Centre will be looking to establish in 2013-14 improved methods to positively engage with its stakeholders and better connect with their end-users, especially in the methane and nitrous oxide areas.

In its on-going support of knowledge transfer and commercialisation activities in collaboration with other entities such as the PGgRc, the Centre was involved in key activities in 2012-13 that included:

- Actively developing, with the PGgRc, the "Towards 2030" strategy, an "NZ Inc" approach to mitigating agriculture GHG emissions.
- Hosting meetings with farmer groups and individual companies and organisations (e.g. Fonterra, Ballance, Ravensdown, Phizer, DSM, DairyNZ) and giving presentations at farmer forums.
- Presenting at conferences where industry is well represented (e.g. New Zealand Grasslands Association Conference).
- Publishing dedicated publications (e.g. quarterly newsletters and fact sheets) and articles in farming and general press and presenting on television and radio.
- Active Involvement in industry training (e.g. Massey GHG course,).
- Being a member of MPI industry-related advisory groups (e.g. SLMACC, Methanet, Agricultural Inventory Advisory Panel, Agricultural ETS Panel).
- Presenting directly to government officials and hosting science workshops for researchers in conjunction with the 2013 ISAG Review.

Māori Engagement

One challenge for the Centre in 2012-13 has been achieving meaningful Māori engagement to identify specific needs of Māori in relation to understanding and mitigating agricultural GHGs. To address this, the Centre established towards the end of 2011-12 a dedicated Māori Advisory Group (MAG) comprising farming, science and policy representatives, building on a Māori Strategy developed earlier that year.

The MAG initiated its work by requesting the Centre to commission a stocktake of the Centre Members own contacts and activities with Māori, to provide a good baseline for new initiatives. The MAG then held a workshop to further scope potential work by the NZAGRC in relation to Māori farming. The workshop, which comprised Māori business managers from Centre partners as well as a range of stakeholders, recommended that the Centre commission a second scoping study to better define and understand the contribution of the Māori sector to agricultural GHG emissions, and to assess specific mitigation opportunities and constraints on decision-making, including those related to Māori-specific ownership structures, priorities and business models (see figure below).

Scoping Study on the Māori Pastoral Sector

- **What is Māori farming and who are Māori farmers?**
- **What is the Māori contribution (product and emissions) to the pastoral sectors?**
- **What are the options for and impacts of emission mitigation strategies on Māori farmers and the Māori sector?**

This second study has just been completed (approval of the final report pending) and its recommendations are expected to inform a substantial investment (target of $250k per annum) on Māori issues related to agricultural GHG mitigation from the 2013/14 FY onwards (see **2013 Annual Report_Programme Summaries and Outputs.pdf)**.

Communications and media

In 2012-13, the Centre has continued to communicate with its stakeholders through a range of visual and print media and presentations to next-user/end-user groups and Centre visitors.

The Centre produced its first four scientific fact sheets which were published on-line to the Centre's website in October 2012. A further four fact sheets are planned for 2013-14.

The new closer alignment between the NZAGRC and the PGgRc will impact current branding policies and practices. A particular challenge is for the two organisations to demonstrate that they are closely aligned both scientifically and administratively while ensuring that the key stakeholders in each organisation are achieving full recognition for their contribution. An appropriate strategy is currently under consideration and will be implemented in 2013-14.

At the same time, the Centre will take the opportunity to review and refresh its current communication plan in order to developed additional and improved methods for communicating – likely in collaboration with its partner organisations and researchers -- with is most important stakeholders, the New Zealand farmers.

Goal 2 metrics

Measure	Progress in 2012-13
Page views of Centre's website	30,071 page views
Senior Centre staff presentations to meetings of New Zealand industry and policy stakeholders	27 presentations to New Zealand industry and policy stakeholders
Centre funded scientist presentations to the farming community and general public	4 presentations to farming community/general public

Goal 3: Contribute to policy

Policy Advice

A key aim of the Centre is to be a trusted and independent source of knowledge -- particularly to policy agencies – to enable sound, evidence-based policy development. The Centre's relationship with MPI (and other government departments in general) has continued to grow stronger and deeper in 2012-13, particularly as a result of its increased role in the GRA. Likewise, MPI policy staff appreciate robust scientific input and have encouraged and fostered a culture of trust and open engagement.

A current issue that the Centre is working closely with MPI on is to ascertain how best its resources can be used to assist MPI and Industry to obtain the data needed to overcome the current regulatory hurdles efforts to get the nitrification inhibitor DCD back onto the market. The Centre's on-going inputs into the GRA and to the agricultural ETS Advisory Committee are other prime examples of activities that the Centre engaged in 2012-13 related to this goal.

Other activities by the Centre in 2012-13 include:

- Secondment of a Centre staff member (Victoria Hatton) to MPI for four months (February to May 2013).
- Centre Director and Deputy Director acting as lead and coordinating lead authors, respectively, on IPCC AR5.
- Director and Deputy Director are members of MPI's Agricultural Inventory Advisory Board and have both contributed to the MBIE-led KBBE initiative with the EU.
- Director as Chair of MPI Methanet (science grouping advising MPI on methane inventory development).
- Deputy Director as Chair of SLMACC science assessment committee and the NZ representative on the FACCE-JPI Call Steering Committee.
- Director is a member of the Australian Filling the Research Gap Technical Advisory Panel at MPI's request. He is also a member of the Australian Action on the Ground Technical Assessment panel.
- Director member of the FACCE-JPI Science Advisory Board and Chair of the FACCE-JPI GHG Mitigation call International Advisory Committee.
- The NZAGRC ensuring its science programme has direct policy relevance (e.g. development of novel and more robust methods for estimating NZ's soil carbon stocks in support of United Nations Framework Convention on Climate Change reporting requirements).
- NZAGRC hosting important international visitors (e.g. Chief Climate Change negotiators from China and the USA).

Goal 3 metrics

Measure	Progress in 2012-13
Senior Centre staff presentations to meetings of New Zealand government policy staff	14 presentations to New Zealand government policy staff
Written reports prepared for government policy makers	1 reports prepared for government policy staff
Centre's science contributions directly influence and reflected in government policy.	Additional technical advisory roles

Goal 4: Develop science capability

Students

In 2012-13, the Centre continued to fund undergraduate students through the dedicated funds it provides to Massey and Lincoln Universities.

For the first time the programme was extended the University of Waikato where a highly promising student spent three months on work experience with AgResearch.

New PhD stipends were given in the 2012-13 financial year bringing the total number supported to 11.

Goal 4 metrics

Measure	Progress in 2012-13
PhD students studying and graduated	11 PhD students
Post-doctoral researchers completed 2-year projects	7 Post-doctoral fellows
FTEs of professional researchers working on NZAGRC research programmes	106 researchers (27.7 FTE) contributing to the Centre's research programmes

Goal 5: Develop science and commercial partnerships

International

The Global Research Alliance on Agricultural Greenhouse Gases, initiated by the New Zealand Government, continues to be a key pillar in New Zealand's international science and policy engagement in climate change and agriculture. Being essentially a political initiative, leadership of New Zealand's engagement in the Alliance rests with MPI. The Centre plays key supporting roles by providing science leadership in the Alliance's research groups, monitoring and administering research contracts in support of the Alliance on behalf of MPI, and providing strategic advice to MPI on collaborative funding opportunities, capacity building initiatives and linking of research projects with existing international initiatives.

The core focus of New Zealand's engagement, other than providing the Alliance Secretariat and supporting the development and activities of the Alliance Council through MPI, is the leadership of the Alliance's Livestock Research Group (LRG). The Centre Director co-chairs this group together with his colleague from Wageningen UR (Netherlands), and the Centre Deputy Director acts as New Zealand's representative on the LRG. The Deputy Director and the Operations Manager (International) support the co-chairs in developing and monitoring the LRG's work plan, circulating a quarterly newsletter for a global audience, ensuring appropriate LRG presence at international events, and identifying opportunities for further engagement with existing research programmes, science institutions, international organisations and the private sector.

An important activity related to the Alliance in 2012-13 was the Greenhouse Gases and Animal Agriculture (GGAA) Conference held 23-26 June 2013 in Dublin, Ireland. This major international scientific

conference provided a suitable focus for a range of LRG-related meetings in its margins. This included the annual meeting of the LRG itself, measurement workshops where guidance documents developed for the LRG were presented, a series of meetings of targeted research networks set up under the LRG, and a joint workshop between LRG scientists and the Sustainable Agriculture Initiative (SAI) Platform, which represents some of the world's largest food and beverage producing companies.

Building on these workshops and satellite meetings, the LRG agreed to several new initiatives involving key partner organisations such as the Food and Agriculture Organisation (FAO), International Livestock Research Institute (ILRI), and the SAI Platform. An updated work plan for the LRG will be made available in August on the Alliance website, and more details on LRG activities can be founded in a dedicated annual report prepared by the Centre for MPI.

During 2012-13, the Centre also administered on MPI's behalf >$10m in research contracts that directly support the goals of the Alliance, usually drawing on extensive international collaborations. These projects, which were identified either through direct negotiation, targeted RfPs, or provider-led competitive proposals, span basic to applied research and generally seek to extend and build on domestic research currently funded through the NZAGRC, PGgRc or SLMACC.

A further key activity of the Centre in support of the Alliance covers capacity building initiatives in developing countries. New Zealand helped organise and/or contributed to international workshops in Thailand, Indonesia, Ghana, Nairobi, Costa Rica and Vietnam to identify knowledge needs and research opportunities in other world regions, and to lay the ground for targeted research programmes that can advance collaboration and expertise in agricultural GHG emissions.

The Centre also ran an inaugural GHG measurement training workshop in New Zealand in January 2013, and administers the LEARN/GRASS awards scheme to upskill researchers from developing countries and foster exchanges and extension for senior scientists from Alliance member countries. The LEARN/GRASS awards programme supported the training and exchange of a total of eight technicians and scientists involving eight countries in 2012/13.

Other activities by the Centre in 2012-13 included:

- Ensuring appropriate representation of New Zealand on other Research and Cross-Cutting Groups of the Alliance.
- Facilitating the collaboration between the LRG and the UNEP Climate and Clean Air Coalition initiative.
- Supporting MPI in prioritising New Zealand applications to the FACCE-JPI Fund and Australia's Filling the Research Gap Fund (FtRG).
- Advising MPI on the consistency and value-added of Alliance research proposals with New Zealand's domestic research programme, especially for proposals under the MPI-administered Global Partnerships in Livestock Emissions Research fund.
- Hosting delegations from the UK, US, China and other countries related to research collaboration and Alliance activities.

IP and knowledge management

The Centre does not own IP generated from its science investments and patenting and commercialisation decisions are the direct responsibility of MPI/PGgRc. The Centre's role is simply advisory. Thus far, only the methane mitigation area has clearly identified products (e.g. methanogen

inhibitors, anti-methanogen vaccines and low emitting sheep), with clearly identified commercial potential. In October 2012, the Centre moved from an email/paper-based to an on-line Release Of Information (ROI) process to keep track of the number and type of publications/presentations and ensure that new IP is appropriately protected and managed. Design of this new system was a collaboration between the Centre staff and the science programme Principal Investigators and once implemented was extremely well received as it significantly reduced compliance and increased business efficiency. The system is now also being used for approval and tracking of PGgRc and GRA outputs as well. Incremental improvement is planned for 2013-14 consideration is being given to similarly design and implement an on-line reporting and progress management system for science contracts.

Goal 5 metrics

Measure	Progress in 2012-13
Leadership of science input into Global Research Alliance and coordination of Livestock Research Group with the Netherlands	Active NZAGRC input into Alliance during year including GGAA Conference
Visiting fellows from overseas research organisations hosted	2 exchanges funded by LEARN/GRASS Fellowships 1 other visiting fellow hosted
Memoranda of understanding covering research collaborations agreed with research centres around the world	Agreements with national and international research centres on-going and productive
Confidentiality agreements with companies to discuss information related to agricultural GHG mitigation technologies	Confidentiality agreements with interested companies is the joint responsibility of MPI and PGgRc (not the Centre directly)
Licenses to companies to sell agricultural GHG emission mitigation technologies that the NZAGRC or its partners have developed or imported and implemented to suit NZ requirements	Licensing arrangements with interested companies is the joint responsibility of MPI and PGgRc (not the Centre directly)

Major Centre Reviews

2013 Science Review

The Centre completed its first formal science review of its research programmes during the week of 18 -22 February. The review was conducted by the Centre's International Science Advisory Group (ISAG) and included work funded by both the Centre and PGgRc.

Overall, the review went well and four of the 12 areas presented during the review received a "strong" or "benchmark" rating for Science quality and five of the 12 areas received a "strong" or "benchmark" rating for Research impact. In a few areas (e.g. Methane and DCD development), the ISAG considered the work being undertaken as truly world-leading. In a number of other areas, the work is of sound international standard, or close to that. The ISAG also commended the Centre for their enthusiastic and effective incorporation of students and post docs in the programme.

The ISAG also provided recommendations to further improve the programmes. These have been discussed with MPI, the Steering Group and the programmes' Principal Investigators and research teams. An action plan to implement the recommendations is currently underway.

In summary, the ISAG complimented the Centre on its progress – it is becoming successful and is striving to achieve high quality and relevant research that fits its aims and vision. The ISAG strongly recommend that the Centre continues to be supported and, indeed, that it grows

The ISAG wrote in their report:

"Within New Zealand, the Centre is recognised as a leader in funding/commissioning high quality and relevant GHG research for the benefit of New Zealand and New Zealand's international recognition and standing. The Centre has established a well-balanced portfolio of fundamental and applied research, and the ISAG encourage the Centre to maintain this. The Centre should also be commended for continuing to develop a "NZ Inc" approach by encouraging strong collaborations among the New Zealand research community."

ISAG Review Panel and Support:
(Back row, left to right) Keith Smith , Jamie Newbold, Keith Goulding, Richard Eckard, Ian Ferguson, Mark Morrison, Lora Hagemann.
(Front row, left to right) Frank O'Mara, Pete Smith, Tim McAllister, Peter Kuikman.

2013 Contract Review

The Centre underwent a mid-term contract review conducted by MBIE in late May. The review panel included Drs Tricia Harris (chair) and Ian Ferguson (MPI), Mr Andy Fox (Beef+LambNZ) and Mr David Miller (Consultant). The review panel's confidential report was received in late June. The report was overall positive but included several recommendations for improving the governance and impact the Centre has. MPI and the Centre's Steering Group and Director are currently formulating responses. Any ensuing actions to address the recommendations will take place in 2013-14.

Progress towards Solutions

Identifying mitigation solutions is a key component of the Centre's Vision and Mission. The complexity of the problem means that identifying solutions is a long term goal. Success in the short term is better judged by the Centre being viewed as an organisation conducting world class science within a clear and well-articulated strategy that will advance the search for solutions.

Successfully reducing GHG emissions below a 1990 baseline within the New Zealand context of an expanding agricultural sector will require progress in both direct and indirect mitigation options. Direct mitigations are those solutions that reduce absolute emissions per unit of substrate (e.g. feed, nitrogen). Indirect mitigations are those that arise as a result of general improvements in the efficiency of production (for example by improved animal genetics and feeding practices which will reduce emissions per unit of product but not reduce absolute emissions).

Practical direct mitigation options for methane emissions from grazing animals have not been conclusively demonstrated at the field scale. To date, the *Mitigating Methane Emissions Programme*, which is jointly funded in association with the PGgRc and MPI investment through SLMACC, has shown in small, short-term trials only, that diets with fresh forage concentrates or alternative feeds (e.g. palm kernel, maize silage) have no effect on methane production in sheep and cattle compared to rye-grass fed control animals. However, diets based on 100% forage brassicas can reduce emissions per unit feed from sheep by as much as 30%. A major constraint to the uptake of these latter findings is that feeding a sole diet of forage brassicas is not currently practical within the New Zealand pastoral farming system, but the information will contribute towards the evidence needed for brassica acceptances as a mitigation technology within the national methane inventory. Developing a genetic solution to methane production is possible as it has now been demonstrated that emissions per unit intake is a heritable and repeatable trait and one that so far has not been negatively correlated with any production traits. Divergent lines of high and low methane emitting sheep have been developed and the search is now on for a genomic marker that will allow the rapid identification of low emitting phenotypes.

Technologies for direct nitrous oxide mitigation (in particular, nitrification inhibitors) exist, but presently their combined effects are estimated to be low level reduction in total emissions at a single farm level. The recent withdrawal of DCD from the market has removed the main mitigation tool available to farmers. If this withdrawal is permanent a major re-think will be needed around the approach to nitrous oxide mitigation. The Centre's current *Mitigating Nitrous Oxide Emissions Programme* is contributing towards improving the rate of nitrification inhibition by: (a) better understanding the environmental conditions in which DCD can work most effectively and efficiently, and (b) developing new and improved inhibitors. The latter may well become more important now that DCD has been withdrawn from the market although the DCD issue raises important issues as to the acceptability of any type of nitrification inhibitor since DCD is a very safe product. The programme is also trying to better understand denitrification processes in order to discover novel mitigation technologies, but this work is at a very early stage.

Since such large quantities of carbon are stored in soils (150-200 t/ha), even small changes in the rate at which it accumulates can substantially offset emissions of GHGs. A potential barrier in New Zealand is that our soils are so high in soil carbon that they have little scope to store any

more. Work in the Centre's programme has confirmed that some soil types may be close to carbon saturation but that fine textured soils may be under-saturated with carbon and there may be potential to stabilise additional carbon in these soils. The challenge is exploiting this potential. Ploughing leads to a loss of soil carbon but work in the Waikato suggests that soil carbon losses due to infrequent ploughing in grasslands, especially if carried out when soils are dry, are rapidly reversed once a new sward is established. Centre supported work on biochar addition to soil does demonstrate it can increase the amount of long-term stable carbon but the practicalities and economic viability of this approach are unproven. Earthworms play an important role in carbon cycling and initial studies under controlled conditions and in the field suggest that increasing earthworm populations can increase the amount of carbon stored at depth. Whether this leads to a long-term increase in the quantity of soil carbon stored is still to be determined.

Progress to date indicates that the development cost effective mitigation solutions is achievable although they may not have any impact on emissions until post 2020. For example, in the methane area, which is the most advanced area of research since it has been the focus of the PGgRc since 2002; solutions are not expected to be available commercially until 2018-19.

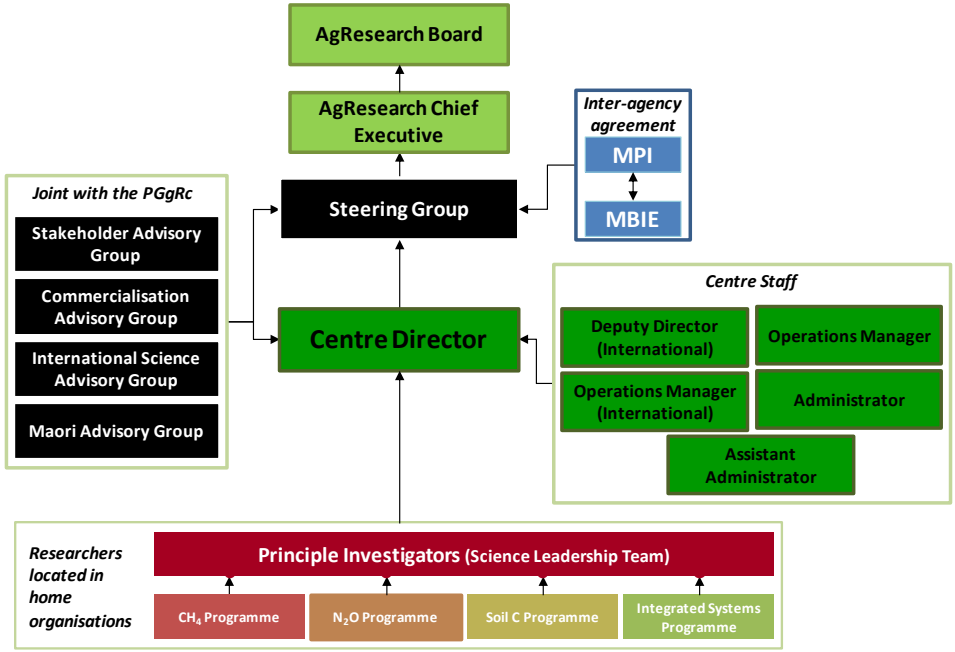
Governance

The Centre has been set up as a unit operating within AgResearch. This means the AgResearch Board and Chief Executive are ultimately responsible for the governance and operations of the Centre, but they seek advice and recommendations from a Steering Group (SG) comprising one representative from each of the partner organisations.

The Centre also seeks advice from:

- Stakeholder Advisory Group (SAG) – joint with the PGgRc, this group will provide advice on alignment and relevance of the Centre's research outcomes to industry needs;
- Commercialisation Advisory Group (CAG) – joint with the PGgRc, this group will provide advice on practical implementation and commercialisation of new mitigation tools, technologies and options;
- International Science Advisory Group (ISAG) – adopted by the PGgRc, this group provides advice on the science quality and strategic direction of the Centre's research programmes science quality and direction of the Centre's research programmes;
- Māori Advisory Group (MAG) – adopted by the PGgRc, this group provides advice on the relevance and accessibility of the Centre's research outcomes to all sectors of New Zealand society.

The Centre's governance structure is depicted in the figure shown above right.



Steering Group

The SG holds quarterly meetings. The 2012/13 SG members are:

Name Role	Representing
Prof Warren McNabb *Chair	AgResearch
Dr Peter John *Deputy Chair	Lincoln University
Dr David Johns *to 02/13 /Dr Rick Pridmore *from 03/13	DairyNZ
Dr Peter Millard	Landcare Research
Prof. Mike Hedley	Massey University
Dr Murray Poulter	NIWA
Mr Warrick Nelson	Plant & Food Research
Mr Mark Aspin	PGgRc

Dr Trevor Stuthridge	Scion
Drs Gerald Rys, Mike Jebson & Andrea Pickering	MPI (Observer)
Drs Max Kennedy & Marc Lubbers	MBIE (Observer)

International Science Advisory Group

The ISAG completed a formal mid-term review of each the Science Programmes in February 2013. The review was chaired by Dr Ian Ferguson, Science Advisor for MPI. The 2012/13 ISAG members are:

Name	Location
Dr Richard Eckard	Melbourne University
Prof Keith Goulding	Rothamsted Research
Dr Peter Kuikman *term completed in February 2013	Alterra Wageningen UR
Dr Tim McAllister	Agriculture & Agri-Food Canada
Dr Mark Morrison *term completed in February 2013	CSIRO
Prof Jamie Newbold	Aberystwyth University
Dr Frank O'Mara	Teagasc
Prof Johan Six *unable to attend in 2013; term completed in February	University of California Davis
Prof Keith Smith *term completed in February 2013	University of Edinburgh
Prof Pete Smith	University of Aberdeen
Dr Jean-Francois Soussana *unable to attend in 2013	INRA

Stakeholder Advisory Group

The inaugural SAG members will be formally confirmed in the first quarter of 2013-14. The Centre and PGgRc intends for the SAG to meet quarterly.

Commercialisation Advisory Group

The inaugural CAG members will be formally confirmed in the first quarter of 2013-14. The Centre and PGgRc intends for the CAG to meet quarterly.

Māori Advisory Group

The MAG met twice in 2012/13. MAG members are:

Name	Affiliation
Ms Lorraine Stephenson *Chair	Farmer
Mr Jamie Tuuta	Māori Trustee
Dr Tanira Kingi	AgResearch
Dr Geoff Taylor	DairyNZ
Dr Marino Tahi	Landcare Research
Prof Hirini Matunga	Lincoln University
Dr Nick Roskruge	Massey University
Dr Charlotte Severne	NIWA
Mr Mark Aspin	PGgRc
Dr Alby Marsh	Plant & Food Research
Mr Peter Bennett	Scion
Ms Erica Gregory	MPI

Financial summary

Summary of research spending in 2012/13 is as follows:

Core research spending	$
Methane	1,087,692
Nitrous Oxide	1,235,000
Soil Carbon	910,000
Integrated systems	480,000
Maori	42,715
Core research total	**3,755,407**

Other research costs	$
Additional Fellowships and Studentships	46,500
Planning, engagement & knowledge transfer	123,807
Policy support	12,875
Special IT and communications	0
Other research costs total	**183,182**

List of Centre Achievements in 2012-13

Items below include those activities and achievements of Centre staff with regards to Goals 2-5. A list of scientific outputs pertinent to Goal 1 (e.g. conference presentations, publications and other) can be found in the associated document **2013 Annual Report_Programme Summaries and Outputs.pdf.**

Meetings and Presentations (New Zealand)

No.	Item
1	Meet Jannke van Wagtendonk (Fonterra / Vialactia) re NZAGRC, Global Research Alliance linkages: 05 July, 2012
2	Harry to meet with Mike, Ants, Richard (Ravensdown); Di, Keith (Lincoln) re "Where next with DCD's" in terms of N2O: 10 July, 2012
3	NZAGRC presentation to AgResearch/Palmerston North based researchers: 17 July, 2012
4	NZAGRC presentation to AgResearch/Dunedin based researchers: 19 July, 2012
5	Meet Rick Pridmore, Eric Hillerton, DairyNZ: 20 July, 2012
6	Meet Tom Richardson, AgResearch: 20 July, 2012
7	NZAGRC presentation to AgResearch/Hamilton based researchers: 20 July, 2012
8	Harry to meet Simon Wear, Peter Ettema, Gerald Rys re Beef Population policy advice: 27 July, 2012
9	NZAGRC Science Leadership Team Meeting: 01 August, 2012
10	NZAGRC presentation to AgResearch/Christchurch based researchers: 02 August, 2012
11	Harry to meet David Whitehead, Landcare Research: 02 August, 2012
12	Harry to meet Bruce McKenzie, Lincoln University: 02 August, 2012
13	Telephone call with Daniel Tisch (PhD candidate), University of Auckland re GHG research in NZ: 24 August, 2012
14	NZAGRC Maori Advisory Group meeting - stocktake report: 03 September, 2012
15	Meeting with Iain Lees-Galloway, Moana Mackey, Megan Woods, Labour: 04 September, 2012
16	Presentation to Crown Research Institute Chairs' meeting: 11 September, 2012
17	Meeting with Brian Elliot, Fiber Fresh: 20 September, 2012
18	Research, Innovation and Technology Transfer Working Group: 21 September, 2012
19	PGGRC IP Workshop: 02 October, 2012
20	8th Ag ETS Advisory Committee meeting: 15 October, 2012

21	Meeting with British High Commission re joint funding for British contingent for science review: 16 October, 2012
22	Presentation/meeting with Massey University re NZAGRC partnership: 18 October, 2012
23	PGgRc workshop: GHG selection in Dairy Animals: 23 October, 2012
24	NZAGRC Māori Advisory Group Workshop: 07 November, 2012
25	Agricultural Inventory Advisory Panel: 13 November, 2012
26	Meeting with Simon Wear, MPI re Dairy Effluent with Massey University: 16 November, 2013
27	Consultation meeting on Grand Science Challenges, hosted by MBIE: 16 November, 2012
28	Maori Advisory Group meeting: 19 November, 2012
29	NZAGRC Science Leadership Team regular meeting: 21 November, 2012
30	Presentation to Iain Lees-Galloway and the Hon. Damien O'Connor re NZAGRC: 22 November, 2012
31	Meeting with Vialactia re methane mitigation: 28 November, 2012
32	Meeting with Amanda Ellis, head of MFAT International Development, on options to engage with Africa: 18 December, 2012
33	Meeting with Warren Parker and Trevor Stuthridge, Scion re NZAGRC partnership: 20 December, 2012
34	NZAGRC Steering Group Meeting: 18 February, 2013
35	NZAGRC ISAG Meeting: 18 February, 2013
36	Workshop: Rapid automated methane measurements for dairy cattle: Research Priorities: 19 February, 2013
37	NZAGRC/PGgRc operational alignment - research contract, communications, reporting: 19 March, 2013
38	NZAGRC Science Leadership Team - Review Week debrief & actions: 21 March, 2013
39	Harry to meet Nancy Golubiewski re soil carbon linkages with MfE: 27 March, 2013
40	Harry to meet Danny Donaghy, Massey University: 27 March, 2013
41	Co-owned IP processes discussion (PGgRC, MPI, NZAGRC): 28 March, 2013
42	Presentation by and meeting with Bill te Brake & Vishwanath Lingappa: 10 April, 2013
43	NZONET AND METHANET MEETING: 15 April, 2013
44	Harry to meet Zac Hanley Chief Scientist at Pastoral Genomics: 07 May, 2013
45	Methane RA2 workshop: 09 May, 2013
46	Landscape mapping of industry-good GHG research with Ben Smith from Fonterra
47	Harry to meet with Interbrand re NZAGRC / PGgRc brand: 13 May, 2013
48	Discussion aligned NZAGRC-PGgRc N2O programme 2013-2017: 15 May, 2013
49	NZAGRC Steering Group Meeting: 23 May, 2013
50	Meeting to discuss Landcare reasearch work on Biofilters using Methanotrophs: 28 May, 2013
51	NZAGRC Steering group meeting: 14 June, 2013
52	Lecture: Biosphere feedback in a warming world (for BIOL325, Global Change Biology, VUW): 21 September, 2012
53	Presentation on GHG metrics to Motu Agriculture Dialogue: 30 November, 2012
54	Invited presentation 'Grand Science Challenges - Fostering collaboration to mitigate agricultural greenhouse gas emissions',: KBBE Meeting: 06 September, 2012
55	Briefing to NZ government officials on the current IPCC 5th Assessment Report process, Ministry for the Environment: 17 May, 2013

Meetings and Presentations (International)

No.	Item
1	Filling the Research Gap: feedback panel: 07 August, 2012
2	FullCAM and Agriculture Inventory Expert Advisory Panel: 07 August, 2012
3	FACCE-JPI SAB Meeting: 11 September, 2013 - 12 September, 2012
4	IPCC AR5 Third Lead Authors Meeting (LAM3): 5 November, 2012 - 9 November, 2012
5	Meeting with Shanghai Jiaotong University: 28 November, 2012
6	Research programs on "Reducing Methane Emission from Ruminants meeting with DSM: 13 February, 2013
7	Filling the Research Gap: assessment panel - full applications: 27 February, 2013 - 1 March, 2013
8	FACCE-JPI SAB Meeting: 12 March, 2013 - 13 March, 2013
9	Harry to teleconference with Mark Manus: 21 March, 2013
10	PIARN - Mitigation Adaptation Workshop June 3-4 : 03 June, 2013
11	IPCC SYR meeting: 10 June, 2013 - 12 June, 2013

International Visitors and Groups

No.	Item
1	Harry to meet Marcos Vinicius da Silva and Luiz Gustavo, EMBRAPA: 11 July, 2012
2	Associate Professor Leluo Guan, University of Alberta: 12 July, 2012
3	Meredith Miles re Farmer adoption of practices to reduce greenhouse gas emissions and climate change adaptation: 12 July, 2012
4	Chinese Academy of Agricultural Sciences re exchange of knowledge and studies on agricultural GHGs: 15 August, 2012
5	Meeting with Dr Jonathan Pershing, US Deputy Special Envoy for Climate Change: 27 August, 2012
6	Presentation to Charles Sturt University (15 students): 02 November, 2012
7	Meeting with MPI and adviser to Chilean Minister for Agriculture: 11 December, 2012

8	Meeting with Chinese delegation to discuss agriculture mitigation research in context of climate policy and ETS, hosted by MPI: 17 December, 2012
9	Meeting with Steve Belton, Scottish Food Quality Certification re soil carbon calculations for livestock products: 19 December, 2012
10	Meeting with Chinese delegation to discuss agriculture mitigation research in context of climate policy and ETS, hosted by MPI: 19 December, 2012
11	Meeting with Secretary of DAFF Australia (Andrew Metcalfe) to discuss agricultural GHG research and international initiatives, with MPI: 22 January, 2013
12	Meeting with Tommy Boland, : 14 February, 2013
13	Meeting with Dr Jamie Bennison, Agrimin Limited: 20 February, 2013
14	Meeting with Dr Bob Rees, SRUC: 22 February, 2013
15	Tour of animal facilities with Phil Garnsworthy: 22 February, 2013
16	Visit by NDRC Vice Chair Xie Zhenhua : 22 March, 2013
17	Harry to meet UK Minister Rt Hon Owen Paterson: 12 April, 2013
18	Harry to meet Chinese Grasslands Delegation: 19 April, 2013
19	Harry to meet John McEwan & Dorian Garrick from Department of Animal Science Iowa State University: 13 May, 2013
20	Meet / Greet with Johann Soelkner (Hans) Professor for Animal Breeding and Genetics from University of Natural Resources and Life Sciences Austria: 15 May, 2013
21	Keynote presentation "Inventory data and mitigation activities from livestock: New Zealand experience": International workshop on GHG emissions from agriculture: 23 April, 2013
22	Presentation 'Grand Science Challenges - Fostering collaboration to mitigate agricultural greenhouse gas emissions', delivered to visiting delegation of the National Development and Reform Commission of the People's Republic of China: 19 December, 2013

Global Research Alliance related interactions

No.	Item
1	Global Research Alliance Capability Building workshop: 5 September, 2012 - 7 September, 2012
2	Global Research Alliance Capability Building workshop: 22 September, 2012 - 26 September, 2012
3	Global Research Alliance Livestock Research Group Meeting Uruguay: 31 October, 2012 - 2 November, 2012
4	Meeting between FONTAGRO Development Bank and MPI to discuss joint funding initiative: 5 February, 2013 - 6 February, 2013
5	Capability Building Workshop, Indonesia: 23 April, 2013 - 25 April, 2013
6	Third Group Co-Chairs meeting with Council Chairs: 02 May, 2013
7	Quarterly tactical meeting: 27 May, 2013
8	Meeting of the Research Group Co-Chairs: 17 June, 2013 - 19 June, 2013
9	Joint workshop with SAI/GRA: 21 June, 2013
10	LRG meeting: 27 June, 2013

Media Interactions

No.	Item
1	Media: Radio NZ interview re ETS: 11 July, 2012
2	Filming re mitigation options for short educational film on agricultural emissions: 23
3	Scoping meeting for TV documentary with John Bates (Prime TV): 04 September, 2012
4	MPI Climate Change Technology Transfer Project – video series: 04 October, 2012
5	Discussion with Lawrence Watt (Topshelf Television Productions) re GHG research and
6	Meeting with Margot Foster (ABC Radio National) re GHG: 27 November, 2012
7	Harry and Peter interviews with John Bates, Environmental Documentary Series: 18
8	Interview with ABC Australia re GHG: 03 June, 2013
9	Interview with Fairfax Rural News: 05 June, 2013
10	Interview with Irish National Radio: 26 June, 2013

Conference Presentations

	Item
1	Invited presentation 'Mitigation of agricultural greenhouse gases - Challenges and opportunities in an uneven world', delivered to ABIC 2012 conference: 03 September, 2012
2	CCRSPI Conference (NZAGRC funded student participation): 27 November, 2012 - 29 November, 2012
3	New Zealand Climate Change Conference (Andy Keynote Address, Harry Chairing mitigation session): 04 June, 2013
4	Keynote address to Climate Change Conference, New Zealand Parliament: 07 June, 2013
5	GGAA 2013: 23 June, 2013 - 26 June, 2013