



REVIEW OF THE
New Zealand Agricultural Greenhouse Gas Research
Centre

16-18 OCTOBER 2018
WELLINGTON, NEW ZEALAND

REPORT

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EXECUTIVE SUMMARY

A panel of New Zealand and Australian experts, and stakeholders reviewed the performance of the New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC). The Centre provided documentation and made verbal presentations regarding their past and current work programme, governance, management and leadership challenges, stakeholder and end user engagement, research outcomes, and outlined insights on future directions. Discussions were also held with Pastoral Greenhouse Gas Research Centre (PGgRC) and Global Research Alliance (GRA) personnel, and a range of stakeholders and end users (see Appendix 1). A summary of the major, high level findings from the review is presented here in terms of, **Progress and Performance** and **Recommendations for the Future**. Detailed findings are provided in the body of the report.

Progress and Performance

Research, innovation, prioritisation, and outputs. Rating: STRONG

- The Centre maintains high quality in its research, publications, collaborative programming, national and international science relationships, personnel expertise, and has built a high quality international profile. In this, it has been very successful in fulfilling its initial brief.
- The research planning and programmes are largely based on robust critiquing and international peer review; the Centre has been very responsive to external scientific advice.
- The actual impact of the science on reducing New Zealand greenhouse gas emissions is still to be realised. There is still a shortfall in feasible and practical mitigation options. This is recognised internationally as a scientifically challenging area for the agriculture sector. The Centre has developed a strong research base for future innovation and adoption. Although we recognise that research in this area is of a long term nature, it is timely to accelerate and strengthen the effort in promoting and adopting options the Centre has in-hand or are available globally.

Stakeholders, end users, engagement, and collaboration. Rating: MODERATE

- Science collaboration and government relationships in terms of policy, advice and information, are very strong.
- The stakeholder/end user engagement could be more effective if expanded beyond the PGgRC relationship, with a wider, more direct reach into industry sectors and with more effective input from stakeholders in co-creation and co-innovation.
- The Centre has very effectively developed new science capability, and could usefully, now be increasing its efforts to identify new resource needs and extension gaps, and work with other science and extension providers to realise mitigation outcomes.

Governance, management, structure, and leadership. Rating: STRONG

- Strong corporate-based processes established from the beginning, in response to the needs of the time, have served their purpose and provided a low cost, transparent and agile management system.
- There is a consensus of views across stakeholders and the science community that confirms the high quality of leadership and management of the Centre.

Recommendations for the Future

- Our discussions with stakeholders and our own views strongly support the need for the research conducted by NZAGRC to continue and to expand significantly, given the scale of the challenge and opportunities. The past investment will be lost if the promising research is not supported into the future.
- There is a need for urgent acceleration in the development and implementation of mitigation options. There are substantial risks for the primary sector from market responses, new policy development and public pressure that must drive future GHG research and product development. This is a stance strongly supported by stakeholders.
- There are a number of aspects of the current model that need to be maintained:
 - the collaborative research model,
 - independence from politics,
 - responsiveness to policy,
 - low cost, agile management,
 - international leadership,
 - a priority on capability building,
 - emphasis on high quality science, and
 - capital investment to fill the needs of agricultural climate change mitigation research in New Zealand.
- The evolution of greenhouse gas research and policy, demands a more integrated research structure that encompasses science, extension and commercialisation. Greenhouse gas research should not be seen in isolation from broader issues within the sector e.g. water, nutrients, diversification, land use decisions, and therefore, future structures should account for this. The Centre could usefully develop wider partnerships and contribute to other programmes that would encourage this more integrated approach.
- We encourage a review of the mix of negotiated and competitive science proposals and programmes, with the potential for a greater component of new science ideas and innovative thinking in the science planning. This should include greater external and independent assessment of new research proposals.

- A leading role in the GRA should continue along with strong support for continuing and increasing international collaboration, profile and contribution to global GHG research efforts.
- Changing circumstances, particularly if there is future growth of the Centre, mean that it will be necessary to move away from a Steering Group which is a representative science body to a skill-based governance model, which covers a range of expertise across the value chain and ensures a more robust separation of governance and management.
- Our discussions, particularly with stakeholders, lead us to suggest that a rebalancing across the four research streams (particularly with regard to a more integrated structure in the future) is necessary, and that this needs to be part of a broader and deeper analysis of scope and goals in future planning.
- The science would benefit from greater stakeholder input in the development of new programmes. Co-creation, co-innovation, and adoption with stakeholders needs to be more firmly embedded in the science programming and stakeholder delivery.
- We recognise that there has been a successful integration of research planning and strategy between PGgRC and NZAGRC. Looking ahead, however, there seems no logic in maintaining separate entities that target the same or closely related climate change issues. A single, integrated entity would better support an effective future in GHG research and mitigation options.
- An integrated structure must have an effective, complete pipeline through to uptake and adoption for the national and global good, and commercialisation. This must include continued industry engagement and co-funding, and a review of IP management, including the potential for partial returns from IP contributing to future Centre research investment. A future organisation must have some accountability for commercialisation and develop a broader set of commercialisation options.

1. BACKGROUND

New Zealand Agricultural Greenhouse Research Centre (NZAGRC)

The NZAGRC was established in 2009 with funding through the Primary Growth Partnership. The NZAGRC has been described as “a partnership between the leading New Zealand research providers working in the agricultural greenhouse gas area and the Pastoral Greenhouse gas Research Consortium (PGgRC)”. The NZAGRC was launched in February 2010, and is hosted by AgResearch. MPI invests \$4.85m per year in the NZAGRC's research programme and the current contract term runs until June 2019, although an extension of this to 2020 has been agreed.

The mission of the NZAGRC is ‘to be an internationally renowned Centre for research and development into agricultural greenhouse gas mitigation solutions’. With the vision of the NZAGRC ‘to provide knowledge, technologies and practices which grow agriculture’s ability to create wealth for New Zealand in a carbon-constrained world’.

The NZAGRC works across five main research programmes (Mitigating Methane Emissions, Mitigating Nitrous Oxide Emissions, Increasing Soil Carbon Content, Integrated Farm Systems and Maori-focussed Research). The combined efforts of these programmes and the collaboration of nine science partners aid the NZAGRC towards its goals to:

1. Advance knowledge and understanding
2. Enhance awareness among stakeholders
3. Contribute to policy
4. Develop science capability
5. Develop science and commercial partnerships

2. PURPOSE, OBJECTIVES AND SCOPE OF THE REVIEW

Purpose

The requirement for a review is provided for in the contract between MPI and the NZAGRC. This review is intended to provide MPI and the partners in the NZAGRC with an independent assessment of how the NZAGRC is tracking towards the outcomes as set out in its contract and modified through subsequent plans/reviews, and to make recommendations as to the NZAGRC's future.

Objectives

The objectives of the review are, to:

- Determine whether the NZAGRC has successfully delivered on their contract's purpose, mission and vision.
- Assess the NZAGRC's progress to date as a whole, as follows:
 - a. Assess the outcomes of the NZAGRC in terms of speed and magnitude of delivery
 - b. Assess whether outcomes are fit-for-purpose in terms of quality of science, and value-for-money
 - c. Identify any unintended consequences (positive or negative), considering internal and external factors, including project management and governance
 - d. Identify any spin-off benefits (including breadth of benefits)
 - e. Identify any key risks and barriers to achieving the NZAGRC's objectives and goals
 - f. Assess the likelihood of the NZAGRC, delivering the expected outcomes, including in collaborative projects with the PGgRC.
- Identify strengths and weaknesses of the existing governance model, including the relationship between the NZAGRC and PGgRC.
- Deliver insights for any future strategy, direction and delivery of the NZAGRC's work

Scope

The original strategy and plan, including subsequent updates, and the Agreement documents for the NZAGRC, provide the scope of enquiry for the review. The review recognised the contractual requirements for the NZAGRC and took these into account during the review.

The review included:

- Key projects undertaken
- Management, structure, governance and reporting systems
- Project resources including contractors, staff and research providers

- Engagement with stakeholders including end users
- Perceptions of stakeholders as to effectiveness adoption readiness and receptivity
- IP identification and advice to MPI
- Monitoring and evaluation framework
- Other internal and external factors affecting the likelihood of success
- Opportunity for collaboration with other Centres.

Out of scope of this review were:

- The original rationale for investment in the NZAGRC
- Consideration of the Global Research Alliance (GRA), except as referred to specifically
- Areas not within science topic scope of each NZAGRC (e.g. adaptation research)
- Policy issues, except where this related to the NZAGRC providing climate change science policy input, as per their contract.

3. REVIEW PROCESS AND PANEL

The Panel undertook discussions with Centre personnel, stakeholders, end users, Government agencies, and collaborators. Input included presentations, documents provided by the Centre, written comments from stakeholders, and telephone interviews. The Panel's findings have been arranged under headings, which cover the objectives of the ToR, and the original contracted high level aims and goals have been rated, and commented upon. Quita Ray-Ili (MPI) assisted in assembling the review, and Debbie Parker (MPI) managed the overall review operations.

Review Panel

Dr Ian Ferguson	NZ Ministry for Primary Industries (Chairman)
Adjunct Assoc. Prof. Beverley Henry	Institute for Future Environments, Queensland University of Technology, Brisbane
Professor Mark Howden	Director, Climate Change Institute, Australian National University, Canberra
David Miller	Director, Vantage Consulting Group, Lower Hutt (governance and management)
Janet Williams	Rural Women New Zealand, Farmer, Waikato
Collier Isaacs	Consultant, ex-CEO Farm ^{IQ} Primary Growth Partnership

4. FINDINGS OF THE PANEL

The domain of greenhouse gas research is not what it was when the Centre was first established. There are significant advances in the science, internationally and in NZ. This goes along with a considerable mind-shift in awareness by the primary sector of the impacts and challenges and consequent need for action. There is also increased public and special interest group pressure for action, and a changing political environment (e.g. Paris Agreement, '2050 carbon neutral' policy). There is a willingness to tackle issues around accountability, sustainable production and environmental impact of our primary sector systems and practices.

The Terms of Reference (ToR) for the Centre at its establishment, with a heavy emphasis on establishing a world leading science Centre, and ways of making progress on mitigation options, is no less valid today. However, because of the research undertaken to date by the Centre and internationally, a new Centre being established today would likely have a wider remit, more stakeholder engagement in its governance structure, and a stronger expectation of short-and long-term outcomes with more rapid uptake and implementation by the sector. All this of course, while maintaining and further developing international science leadership.

The review findings outlined below are about performance, as required by the review ToR, but also with an eye on the future. Many of the issues raised have significant consequences for future planning. The Centre is a scientific success, and future thinking must ensure that science excellence and leadership is supported and maintained, while the work of the Centre moves into a new era with increasing emphasis on urgency in application and implementation.

4.1 Performance and progress to date

Research, innovation, prioritisation, outputs, outcomes and benefits

Research quality and reputation

- The Centre has maintained a high standard of research with a strong focus on underpinning science, in line with the low level of knowledge (worldwide) at the time of initiation of the Centre. This is shown in the quality of research paper outputs, international recognition, and of the lead scientists that it engages. It has been very successful in internationally showcasing its science capability.
- It is an international leader in methane research, and contributes significantly in N₂O and soil carbon science globally. The farming systems stream has greater significance within NZ, and is showing innovation, particularly in relation to Māori agribusiness, which is also a useful model for the broader sector.
- Having established a strong research platform, the Centre would now benefit from additional independent assessment of science ideas and research proposals. Broader calls for new ideas and further evaluation in its internal funding will support innovation and new thinking.

International relationships, perspectives and advice

- External science advice is readily obtained through an effective international science advisory group and the Centre is receptive to such advice, acting on it to modify research directions.
- NZ's global contribution through the science of the Centre is significant beyond its immediate domestic impact. The benefits of this, and contribution to international solutions, needs to be reinforced in future planning.
- The Centre's key role in the GRA both underlines its international leadership role, and helps ensure that there is effective connectivity with international science.
- The expertise in the Centre particularly enables New Zealand to be represented in ongoing international initiatives to improve the accounting for methane, the major contribution to the country's agricultural emissions.

Delivery, outcomes and benefits

- There is a general agreement that, driven by need, the science undertaken by the Centre is long term in nature. Over its time, the Centre has been able to assemble approaches to current farming practices which, when adopted, would lead to greater efficiency and contribute sooner to best practice. Benefits are starting to be evident in the farming systems stream, particularly with more diversified land use inherent in large scale farming and Māori agribusiness.
- There is a general observation from industry stakeholders that the Centre is yet to provide useful mitigations for farmers to use in the short-term. A summary of available approaches, many of which could be seen as farming best practice, indicates they would probably amount to no more than a 10% reduction in emissions at best. Some approaches such as low GHG feeds and low methane sheep are nearing market-ready status, but others with potential high impact such as inhibitors and vaccines have still a way to go.
- With Paris Agreement targets, new policies looming and increasing consumer and environmental pressure, there is a need for urgent acceleration of programmes if the NZ primary sector is to respond as required to remain viable in a low carbon world.
- There is still a need, however, to package and communicate such information and provide a value proposition that includes both productivity gains and environmental benefits. There is some concern that a focus on developing solutions with high levels of efficiency/productivity gains may preclude options with potential highly positive environmental impact that, while currently providing little economic gain, could do so in the future. Noting the significant increase in environmental concerns and awareness, both consumer and regulatory, environmental delivery could be expanded, e.g. through reduced N₂O emissions and nitrate leaching.
- Market forces are important in stimulating wider economic gains, e.g. supporting export growth and advantage in future 'carbon constrained' markets. While considered, these have not always been prioritised in the Centre's strategic thinking, which concentrates heavily on

productivity and efficiency in providing a value proposition for greenhouse gas mitigation. Again, the changing consumer and regulatory focus brings a wider set of drivers into play.

Māori outcomes

- A Māori Advisory Group is established, and the farming systems research stream is particularly relevant to Māori interests. Features of Māori agribusiness, such as intergenerational longevity, diversification, absence of a capital gain focus as part of the economic equation, can inform the primary sector generally. This is recognised in the Centre's work. An assessment of kaupapa and mātauranga Māori as an inherent part of the research thinking should be assessed in future plans.

Taking a wider perspective

- Changes in science, government policy, stakeholder and end user awareness, and the pressures for sustainable yet profitable production systems, suggest that it is timely for the research of the Centre to be more linked up, and show its place in the wider development of multiple land uses and sustainable farming practices. The farming systems research stream is beginning to show this but there is room for further integration of greenhouse gas mitigation strategies with broad environmental outcomes as well as production goals.
- Stakeholders and end users take more of a systems approach and it is timely to demonstrate more explicitly in the research programmes, how, for example, water, nutrients, and greenhouse gases (including sequestration of carbon in soil and trees) fit together and are interdependent.
- Looking ahead, there would be benefits in having a wider discussion of the involvement of social science in Centre research and with other science providers and also with the agricultural sector. This is particularly important in understanding the issues underlying development of the value proposition, research design, uptake and implementation.
- In addition to direct commercialisation partners for technology development, effort could be applied to lifting the understanding to farmers' partners in farm supplies, advice and customers (e.g. meat and dairy companies), to increase solution adoption in the future.
- There is understandably an emphasis on the dairy sector. A wider perspective would focus more on beef and sheep and other pastoral farming systems, and horticulture. Accelerating efforts on cattle and sheep would require a substantial investment in measurement capability.
- There could be more evidence of cross cutting/cross disciplinary capability and activity e.g. modelling that informs all programmes. It was not clear how much interaction there is between the major programme areas.

A systems and pipeline approach

- There is robust thinking around the science and product development and assurance that helps ensure that unintended consequences are minimised.

- There is good evidence for systematic thinking on the adoption pathways (e.g. into industry, policy, or inventory). As the science thinking moves even more into a systems approach, more knowledge gaps appear and there is a need for various parts of the system to link up.
- The model of providing the science for new technological development e.g. inhibitors, has potential success so long as there are the right commercial partnerships. This has been well negotiated with PGgRC around methane, but a more integrated pipeline across all work streams will be necessary for the future.
- There would be advantages in allowing a partial return on IP back to the Centre, to contribute to new investment in the innovation system. There are models for this in other organisations. The Centre doesn't have to own IP to allow this, but it could be captured in commercialisation agreements and with assent of the Government. To date, the Centre hasn't created any substantial IP which would enable a review of how well they have handled it. The more general question of who benefits from IP is a broader one linked to models used for commercialisation pathways, and will require a specific review and associated stakeholder consultations in terms of the future of the Centre.
- Overall, uptake would benefit from extending the current physical and financial outcome modelling that is being done in the farm systems and Māori programmes to look at multiple environmental outcomes and linking with other models e.g. Overseer, Farmax, FIQ, Figured, Cashmanager etc and developing new modules for farmer use as required.

Stakeholders, end users, engagement, and collaboration

Stakeholder and end user engagement and relationships

- There is a general view from stakeholders and end users that the Centre is doing a good job, being seen as independent and authoritative, with significant international standing.
- There would be benefits from more input from stakeholders and end users into the science strategy and in managing the research pipeline to achieve projected outcomes for practical solutions and on-farm adoption. Greater stakeholder involvement in co-innovation, and strategy development across the range of research and policy areas is necessary from this point on.
- The Stakeholder Advisory Group was discontinued in 2013 due to poor attendance and perceived duplication of engagement through the PGgRC. However, there is too much reliance on industry engagement through the PGgRC, which is limiting a wider engagement within the sector across the Centre's activities. A more comprehensive model for stakeholder engagement at all levels of the Centre activity is necessary.
- The Centre recognises that there has been a shift in focus, concerns and awareness of the importance in the issue of greenhouse gas emissions in the primary industries since the

Centre was set up, and is responding to this, for example, through recent employment of a dedicated communications person.

- There would be advantages in targeting entrepreneurial thought leaders in the farming community to help show the benefits of uptake of science products, and not rely just on sector organisations.
- Stakeholders feel that there is a need to review or rebalance the science effort. Looking ahead, there is a need to consider whether the four existing work streams are in danger of becoming entrenched, when a wider, more cross-disciplinary approach might have benefits.

Advice and information; contribution to policy

- The Centre is very accessible to policy makers, providing independent, authoritative and timely advice and information.
- There is widespread recognition that Centre staff have been very willing to provide advice and guidance at various levels within the sector industries. This has been well received.
- The Centre has been successful in maintaining independence while being Government funded and tied closely to policy development and demands. There is a need for on-going vigilance to ensure that science independence is not compromised by this policy-responsive approach. The Centre does notify MPI before public release of information based on a 'no surprises' policy.
- There seems to be no obvious structural accountability beyond governance and management that allows reporting on advice given and the potential political implications. This may reflect the nature of the Steering Group founded upon a funding agreement versus a more conventional Governance Board with clearly defined ownership.
- Communication and public relations resources are inadequate to respond to the level of demand that has evolved since the Centre was set up, resulting in overload for the Director and Deputy Director. These resources need to be expanded.
- There are positive views on information the Centre puts out, although there have been suggestions that it could be packaged in more accessible ways for target audiences.

PGgRC relationship

- There is a close and effective working relationship between the Centre and PGgRC, which has included good working relationships around IP and commercialisation.
- The joint methane programme, including the sheep genetics programme, is a good example of rationalisation of research activity in similar organisations with separate funding instruments.
- There is an external perception that the Centre is all about methane and is perhaps unbalanced in this regard (despite recognition of the proportional distribution of greenhouse gases from NZ agriculture). However, the Centre's own spread of funding is

relatively equal across the four streams, providing the smaller proportion of methane research that is the main focus of the PGgRC. Future planning will need to look at this balance within whatever structure emerges.

- The arrangement with the PGgRC for commercialisation has made sense to date, although there may be lost opportunities if some gains from IP cannot be returned to the Centre for research investment. Any future structure for the Centre must have a more comprehensive and adequately resourced commercialisation pipeline beyond the current one. There are a number of means by which commercialisation could be achieved, including direct involvement, contracting out, or partnerships with commercialisation entities, etc. The key point is that while the Centre may not have to be the active entity, it should have some accountability for commercialisation of new technologies.
- The use of the PGgRC as the primary conduit for stakeholder engagement is not satisfactory. Although most industry bodies are represented, there needs to be a more direct and active engagement with stakeholder groups and individuals by the Centre in its own right. In particular engagement should be structured to allow a greater level of co-creation and co-innovation at the initial stages of science planning, and provide greater ownership and partnership, leading to effective uptake and implementation. Perhaps unlike the past, the current industry environment would support this. Integration of the entities is timely, as noted below.

GRA

- The Centre has more scientists in GRA programmes than through its own funding, indicative of the importance of GRA relationships and collaboration, and the expansion of science across international efforts.
- The GRA relationships have also meant a considerable travel and communication load on the staff, which while positive, also adds to the pressure on staff and the Centre generally. The recent establishment of the role of Special Representative for the GRA appears to be effective, but pressure on key Centre staff should be monitored.

Governance, management, structure, capability development and leadership

Governance and management

- The Centre has had great stability over the years in personnel, structure and funding, contributing to their recognised ability to get the work done. They have had autonomy, particularly from MPI, and the latter's support has been strong.
- The original establishment of corporate-style governance processes has been of great benefit. Although the nature of the Steering Group (founded simply on a funding agreement by MPI)

is less of governance in the traditional sense and more of advice and support, the group has operated at a high standard, and the governance structure has worked well.

- It is worth noting as well, that the governance and management structure is relatively low cost, low in compliance and overheads, and agile. Any future structure must retain these positive features.
- Nevertheless, there is concern that the Steering Group is not skill-based, but representational, with partner organisations self-appointing membership. This limits an appropriate range of governance skills in the Group, and the ever-present possibility of organisational interests over-riding those of the Centre. This has also resulted in supply-side science programming, with scientists determining what gets done. This has served the Centre well in establishing and maintaining its science leadership brief, but at the expense of potential benefits achievable from a greater stakeholder input at the programming level.
- There is also ambiguity in the roles of the Steering Group members, some of whom provide science advice at the managerial and operational level. This emphasises the lack of a clear distinction between governance and management. The role of the observers is also ambiguous. Although non-voting, the level of influence of up to four observers on the Group is not clear.
- There is also a need for more clarity and transparency around financial overview, liability and accountability, the role of the Steering Group and AgResearch Board, and the role of MPI in governance and financial oversight. Having administrative and procedural arrangements provided by AgResearch has been effective in letting the Centre run the science.
- We recommend, especially if the research investment is to increase, that a more independent, skills-based Board, with an independent Chair, be established for the Centre, with clear lines of accountability and roles of governance and management. The skills need to encompass the full value chain from greenhouse gas research to technology uptake, policy implications, commercialisation and on-farm mitigation.
- Optimal ownership, structural, governance and management changes need careful and comprehensive consideration if integration of the NZAGRC and the PGgRC are considered for the future.

Funding and managing programmes

- The Centre has effectively used a collaborative model, providing an integrated science approach, with nine members of the Centre and 13 science providers involved in programmes.
- The negotiated approach to programme development and funding seems sensible given the size of the relevant community and amount of funding. If there is an increase of funding in the future a larger element of competitive funding, independently assessed and allowing for greater opportunities for innovation would help to maintain a position of science leadership.

Consideration could be given to double-blind assessment processes given the small size and highly connected nature of the research community.

- There is an active process of being reasonably agile in changing direction with decision making, on go/no-go points in the programmes. This is helped by the international SSAG.
- There is a need in future planning for a review and management of the balance between low risk science approaches and solutions and high risk 'silver bullet' targets such as vaccines and inhibitors. This should be part of ongoing strategy development.
- There is immediate concern with increasing costs (particularly salaries) in the face of no significant increase in investment. If this persists, critical capability and outputs will decline. GHG mitigation and management is a long term issue that needs addressing in future planning of the Centre's scope and operations. Inflation-adjusted funding should be considered for the future.
- Overall, the Centre has provided very good value-for-money, with relatively minor expenditure leveraging a high level of performance and standing.

Capital investment

- We strongly support continuing the policy of capital investment to fill funding short-falls in key equipment and investments. An entity such as the Centre, has no other way of ensuring that there are the required resources for its contracted activities, and investment to date has provided NZ with key facilities.

Capability development

- There is a strong history of capability development, particularly supporting young researchers into permanent positions, and tracking career pathways.
- Some effort has gone into identifying capability or expertise gaps that could be critical for NZ in a wider perspective. For instance, the Centre supports modelling, soil science and rumen microbiome capability (along with partners) which otherwise might be deficient in the wider science community.
- There is an opportunity in developing involvement in the primary ITO (industry training organisation) curriculum development on climate change in the primary sector.
- Further capability in business development to engage with commercial partners and providers, and development of social science expertise in greenhouse gas response and best practice in farming efficiency would be valuable. This should be done in partnership with the sector.

Succession

- Thought has been given to succession both for leadership and key scientists. The ability to take action on this is always restricted by costs, and finding the right people at the right time for critical roles can be difficult. The Centre is very vulnerable given the current dependence on the activities of the Director, Deputy Director and key scientists. Lead scientists have other responsibilities in their parent organisations. Succession and capability planning must not be done in isolation, and should involve engagement with other science providers in the relevant research fields. A more national approach, where the Centre works with other science providers is necessary.

4.2 Future strategy, direction and delivery

- Our discussions with stakeholders and our views strongly support the need for this research to continue and to expand significantly, because of the scale of both the challenge and the opportunities. The past investment will be lost if the promising research is not supported into the future.
- There are a number of aspects of the current model that need to be maintained;
 - the collaborative research model,
 - independence from politics,
 - responsiveness to policy,
 - low cost, agile management,
 - international leadership,
 - a priority of capability building,
 - emphasis on high quality science, and
 - a role in capital investment to fill the needs of climate change research in New Zealand.
- Any future structure needs to allow for the science providers and science stakeholders to continue to have the ability to collaborate and take ownership of programmes.
- Maintenance and growth of the international leadership, collaboration and critical involvement in the GRA, is essential in future planning for the Centre, and GHG research in New Zealand in general. Global research will increase and we need to be central to that growth.
- The evolution of greenhouse gas research and policy, demands a more integrated research structure that encompasses science, extension and commercialisation. Greenhouse gas research should not be seen in isolation from broader issues within the sector e.g. water, nutrients, diversification, and land use decisions. Therefore, future structures should account for this. The Centre could usefully develop wider partnerships and contribute to other programmes that would encourage this more integrated approach.

- There should be a review of scope, e.g. forestry is currently excluded, and there is little emphasis on horticulture and cropping and other changing land use initiatives. It is difficult to envisage a future greenhouse gas Centre which is not working on, or at least in partnership with others working on forestry, use of trees in farming systems, other plant crops and management systems, initiatives on water and nutrient leaching, and involved in trade-offs and offsets in management practices, etc.
- The Terms of Reference for the review included assessing the relationship between the NZAGRC and the PGgRC. The panel has drawn upon feedback from PGgRC management and an assessment of the collaboration and co-funding achieved by the two entities (the review of course does not extend to a review of the PGgRC). We recognise that there has been a successful integration of research planning and strategy between PGgRC and NZAGRC. Looking ahead however, there seems no logic in maintaining separate entities targeting the same or related climate change issues. Any future structure must ensure there is an effective pipeline through to the adoption for the national and global good and commercialisation. This must include continued industry engagement and co-funding.
- Overall, there is a widespread view from stakeholders that market pressure and policy development suggest that there is substantial risk for the NZ sector if there is no acceleration in bringing GHG mitigation options to the market. This risk includes customers shifting to other more high profile producer nations (e.g. Ireland with Origin Green). A more coordinated governance approach is necessary with both Government and industry working closer together, including integrated governance and a single high level strategy.

5. ACHIEVEMENT OF AIMS AND GOALS

The contract with MPI contains eight high level aims that the Centre is mandated to address, and in addition, five attendant goals (updated 2016/17) that the Centre was contracted to target. We found it useful to rate the performance of the Centre in addressing these aims and achieving the goals, comprising a grading (strong, moderate, needs improvement) and short commentary. This provides an additional assessment of the health and progress of the Centre.

5.1 High level aims:

High level aim	Rating	Comments
Develop agricultural greenhouse gas mitigation options focused on reducing New Zealand's agricultural greenhouse gas emissions and enhancing agricultural soil carbon sinks	Moderate overall	Strong in research which is still in progress, and particularly options for methane e.g. inhibitors, which could have a high impact. But weaker in providing mitigation options to farmers. Have assembled a series of lesser impact options which play into farming systems but these are yet to

		influence markedly GHG emissions on farms. Much of the other research is still in progress. Soil carbon, in terms of outcomes to date, is rated 'needs improvement'. We acknowledge that most of the science areas are very challenging.
Improve coordination of domestic agricultural greenhouse gas emissions research	Strong	Recognised success in integrated programmes across multiple providers domestically, supported by international collaboration and a well-developed working relationship with PGgRC.
Exploit environmental and productivity co-benefits from greenhouse gas emissions research	Moderate	These are clearly identified, however, still very much a work in progress.
Undertake research relevant to the Centre's goals itself or through Members or third parties contracted to perform research activities	Strong	High quality research programmes, outputs and science planning. Very good input from international science advisory group and the Centre responds well to recommendations.
Maximise the potential to deliver practical, value for money greenhouse gas mitigation solutions on-farm to the pastoral, arable and horticultural sectors	Moderate	Certainly created potential solutions for pastoral industry (methane), with lesser outcomes for other sectors. But overall seen by stakeholders as weak in providing mitigation options ready for implementation on-farm.
Engage with the international research community and, when invited by MPI, represent New Zealand in relation to achieving Centre goals	Strong	Very good international reputation and engagement, and input into international initiatives; provides well-recognised international leadership.
Under a separate funding agreement with MPI, to contribute to the further development and implementation of the Global Research Alliance (GRA) through contributing to New Zealand's overall efforts (led by MPI), acting as New Zealand's representative for the Livestock Research Group and contributing to wider GRA group activities	Strong	see above
Ensure the early adoption and use of knowledge and deliverables arising from the Centre's activities excluding Commercialisable Programme Intellectual Property (IP).	Moderate	Still in early stages. Has a good policy for not over-promising and ensuring they have proven science information in progress before they promise delivery of solutions. But stakeholders are calling for acceleration in this area.

5.2 Core goals:

Core goals	Rating	Comments
To be the most important and trusted New Zealand source of scientific knowledge in the field of agricultural greenhouse gas emission mitigation	Strong	Recognised world leader in the field of methane emission reduction from livestock. New Zealand leaders in all fields of agricultural greenhouse gas research.
To be the most important and trusted source of information for New Zealand agricultural stakeholders on agricultural greenhouse gas emission mitigation	Strong	Have maintained independence and authority in providing information to a range of sector and industry groups and leaders including industry, science community, dairy, sheep, deer and beef, fertiliser industry, and Māori. Could be a wider community of stakeholders to interact with, and more specific targeting of end users.
To be the authoritative source of information for the New Zealand Government on agricultural greenhouse gas emission mitigation	Strong	Are providing independent and authoritative advice to the government. Reputation of the Centre has resulted in a very high demand for expert, high quality advice, which the Centre provides. They are seen as apolitical and also play an important role in agricultural diplomacy.
To be the major source of new capability in the field of agricultural greenhouse gas emission mitigation	Strong	Success in developing and nurturing new science capability across the disciplines. However, there is a growing need for a more comprehensive and integrated view of capability and resourcing which the Centre should be a part of e.g. appropriate social science and advisory expertise.
To be a key player in many research and commercial partnerships relating to agricultural greenhouse gas emission mitigation	Moderate	Done very well, particularly with methane, with their research partnerships and collaboration and integrating science. There is now a need for a wider approach to commercial partnerships and extension, including integration of the NZAGRC and PGgRC.

APPENDIX 1

Stakeholders and end users approached for input into the review, most of whom provided responses either at a round table discussion or through letters or telephone interviews.

<i>Organisation</i>
Federated Farmers
Landcorp – Pamu
Beef and Lamb
Dairy NZ
Fonterra
Fertiliser Association
Horticulture NZ
FAR
AgResearch
NIWA
MfE
AgFirst
MPI (Policy)
Primary Sector Council Chair
PGgRC
GRA
NZAGRC Steering Committee