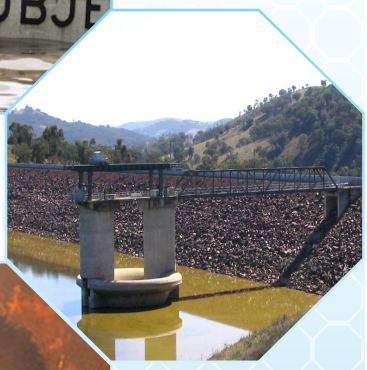

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Response to Productivity Commision Draft Report: Barriers to Effective Climate Change Adaptation

'Leading the Australian Research Community to generate the knowledge decision makers need to adapt to the impacts of climate change'

CONTENTS

OVERVIEW

The Productivity Commission was asked by the Australian Government to assess regulatory and policy barriers to effective adaptation to climate change, and to identify high-priority reforms to address these barriers. The National Climate Change Adaptation Research Facility (NCCARF) made a submission to the Inquiry, and senior management of the Facility met with the Commission in mid-December 2011 to discuss NCCARF activities relevant to the Inquiry.

In this submission we provide in Part I a consideration of knowledge barriers to adaptation:

- What are the knowledge needs for adaptation?
- What are the knowledge gaps?
- How can knowledge be successfully communicated to decision makers?

To address these questions, there is a need for an organisation such as NCCARF. Therefore, in Part II of this submission, we provide information on NCCARF current activities, including:

- foundational research;
- end user engagement;
- capacity building among the research community to develop knowledge and practitioners to use research outputs;
- leveraging of cash and in-kind support for research and engagement activities.

These activities demonstrate the success NCCARF has achieved over its relatively short lifespan, and that the Facility is best positioned to fulfil the role of adaptation knowledge provider.

Arising from this submission, we respectfully request that the Productivity Commission:

- recognises the need for an organisation such as NCCARF to address knowledge barriers to effective adaptation;
- recognises the significant and ongoing contribution that NCCARF has made to climate change adaptation knowledge and capacity in a very short period of time;
- considers the need for NCCARF to be funded for a Next Phase to continue to:
    - develop innovative and relevant knowledge for adaptation and
    - roll out research findings from the First Phase to a broad range of end-users and stakeholders;
- supports the NCCARF Board's approach to funding of a Next Phase of the Facility which includes opportunities for investment from all levels of government, business and industry.

In support of our submission, we include:

- As an Appendix 1, a table identifying NCCARF funded projects that are relevant to various chapters in the draft Productivity Commission Report.
- As an attachment, NCCARF's research portfolio, showing the titles and Principal Investigators of the 140 projects funded through NCCARF together with a short description

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Part I: Addressing knowledge barriers to adaptation

PART I: ADDRESSING KNOWLEDGE BARRIERS TO EFFECTIVE ADAPTATION

1.1 Overview of knowledge needs for adaptation in Australia

In many areas of social, cultural and economic activity in Australia, as well as in the management of biodiversity and ecosystem services, the market will not deliver robust solutions and a nation well-adapted and resilient to climate change (see Part I Section 2). Where this is the case, those charged with decision making to achieve planned adaptation have knowledge needs which equally will not be met by the market. Failure to address these knowledge needs will create barriers to effective adaptation. Knowledge barriers to adaptation have two components:

- Failure to develop and disseminate the required knowledge for successful adaptation;
- Failure to develop capacity - in the research community to generate knowledge for adaptation, and in the practitioner community to specify what knowledge is required, and to apply that knowledge.

Neither knowledge itself, nor the needs for knowledge, is static. Each evolves in response to factors including resourcing, capacity in the research and practitioner communities, policy changes, national priorities, social responsibility and the international context.

1.1.1 The need for knowledge expressed in submissions to the Productivity Commission

Forty-one of the submissions made to the Issues Paper produced by the Productivity Commission[1] make reference to lack of knowledge, or inadequate knowledge, as a barrier to adaptation. Typical quotes include:

> "A common and significant constraint on the efficient operation of markets – and barrier to effective adaptation – is limitations in the availability and precision of information. This includes an incomplete understanding of the vulnerabilities of ecosystems, the likely impacts of climate change on ecosystems, and uncertainty in gauging localised effects across Australia." [DSEWPaC]
>
> "Uncertainty about what constitutes reliable and scientifically based information results in major concerns about legal liability and timidity in decision making" [Coasts and Climate Change Council]
>
> "A lack of information that is relevant to the lived experience of people on low incomes and is accessible to them" [Brotherhood of St Laurence]
>
> "Uncertainties about the extent and timing of climate impacts on physical assets is a significant barrier to investing in adaptation" [Investor Group on Climate Change]
>
> "There is no simple mechanism that tracks and harmonises the research and adaptation efforts across the states and local governments in a manner accessible to the insurance industry" [Insurance Australia Group]
>
> "The lack of consistent and relevant data and guidance is the major barrier to deciding on whether and how to adapt to climate change" [Council of Capital City Lord Mayors]

This clearly demonstrates the need for an organization responsible for building capacity in the research and end-user communities, and for generating and disseminating knowledge on an on-going basis, which is responsive to the changing requirements of decision makers. NCCARF has acted in this capacity since 2008.

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[1] NCCARF thanks Elissa Waters, University of Melbourne, for making this analysis available.

1.1.2 The role of NCCARF

In April 2007, COAG endorsed a National Climate Change Adaptation Framework which identified the need for a Facility which would co-ordinate Australia's research resources to deliver information to support climate change decision makers. NCCARF began operations in 2008. Its role is to generate and communicate the knowledge needed by decision makers to successfully adapt Australia to climate change. NCCARF addresses this role through these activities:

- developing and implementing National Climate Change Adaptation Research Plans (NARPs) which identify critical gaps in the information available to decision-makers and set research priorities;
- running adaptation research networks which link researchers and end-users to build adaptive capacity and promote active and productive communication between the two communities;
- synthesising and integrating existing and emerging national and international research on climate change impacts and adaptation to meet immediate practitioner needs, and
- developing and delivering targeted communication products for stakeholders.

In recognition of the evolving landscape of adaptation, NCCARF is currently carrying out an update of its NARPs to determine whether the originally identified research priorities remain both relevant and timely and an appropriate basis for the next phase of NCCARF.

Over its four years of operation, NCCARF has moved to create a substantial body of knowledge. Indeed, the organisation is the custodian of a body of knowledge related to adaptation which is one of the largest and most comprehensive available in the world today. Because of delays in setting NCCARF up, and the shift in emphasis and responsibilities which took place in response to the Operational Review, NCCARF has completed its research program in accord with the terms of its Funding Agreement, but has not had the opportunity to disseminate that knowledge to the community that needs it. Communication and dissemination of the knowledge that has been generated must be an essential component of NCCARF's activities – if omitted, much of NCCARF's effort and capacity building will have been wasted.

1.1.3 National recognition of NCCARF

An objective measure of NCCARF's penetration into government, the private and third sectors can be obtained by examining the responses to the Productivity Commission Issues Paper on Barriers to Effective Adaptation. The following organisations referred to NCCARF in their submission:

Municipal Association of Victoria
Northern Alliance for Greenhouse Action
Australian Local Government Association
National Farmers Federation
Australian Industry Greenhouse Network
Insurance Australia Group
Australian Petroleum Production and Exploration Association
Queensland Farmers Federation
Property Council of Australia
Australian Institute of Aboriginal and Torres Strait Islander Studies
Victorian Centre for Climate Change Adaptation Research
Australian Conservation Foundation
Good Shepard - Australia New Zealand
Department of Sustainability, Environment, Water, Population, and Communities
Department of Agriculture, Fisheries and Forestry

Department of Climate Change and Energy Efficiency
EcoLogical Water Solutions

Seventeen organisations out of the 71 (24%) which made a submission (excluding submissions from individuals) mention NCCARF's role in the Australian adaptation space – a considerable endorsement of the contribution of the organisation after only four years of operation.

1.1.4 International recognition of NCCARF

There is a failure in Australia to understand how NCCARF sits on the international stage. The Facility has made a considerable contribution to adaptation thinking at the international scale through a range of activities such as the 2010 international conference (1000 participants from 42 countries), membership of the scientific committees of global environmental change programs (PROVIA, IGBP), and organisation of conference sessions at Planet under Pressure and the 2012 Climate Adaptation Futures conference in Tucson, Arizona.

NCCARF, together with its approach to knowledge generation and communication and to capacity building, is seen as an example of excellence in bridging the science-policy interface. NCCARF has driven the international climate change adaptation knowledge sharing agenda by holding the first Climate Adaptation Futures Conference. This event, focussing on the interface between researchers and practitioners, now takes place biennially. NCCARF has been approached by organisations in New Zealand and the Philippines interested in how best to establish climate change adaptation knowledge generation and sharing facilities.

1.2 The need for adaptation action now

The market can be efficient at delivering solutions to immediate and visible problems. It can be argued that delaying a decision on action to address a future threat as long as possible is financially efficient. The Productivity Commission in its Issues Paper argues that the 'real options' approach, which considers the timing of decisions in relation to increasing availability of knowledge, is a valuable tool for adaptation. The implicit assumption is that we will have more knowledge about future climate change in part as the performance of climate models improves and in part because it may be possible to delay the decision until the climate change occurs.

Both these assumptions are flawed. With respect to climate models, it is highly likely (and widely recognised) that uncertainties are likely to increase as climate models improve and develop the capacity to simulate more Earth-atmosphere processes at even higher temporal and spatial resolutions. With respect to the onset of climate change, this is likely to be manifest through an increase in the severity and frequency of extreme events, in a manner so insidious that we struggle to recognise the change for what it is, until it is well advanced. Formal attribution studies (for example, by Min et al., 2011, Gillett and Stott, 2009, Zhang et al., 2010[2]) demonstrate clearly the complexity and difficulty involved in establishing that extreme events are due to climate change, and in the final analysis only permit a probabilistic statement of likelihood.

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[2] Gillett, N. P. and P. A. Stott (2009). "Attribution of anthropogenic influence on seasonal sea level pressure." Geophysical Research Letters **36**.

Min, S.-K., X. Zhang et al., (2011), "Human contribution to more-intense precipitation extremes", Nature, **470**, 378-381.

Zhang, X., F.W. Zwiers, et al., (2010), "Detection of human influence on twentieth-century precipitation trends." Nature, **448**, 461-465.

It is widely recognised that we need to adapt now to future impacts of climate change. We can outline four reasons why this is the case.

The first reason is related to timescales. Especially for large infrastructure and structures such as sea defences and (especially, nuclear) power stations, the adaptation time scales are long, both in terms of the duration the structure is expected to be in place, and the timescales from project inception to completion. A good example is the North Sea defences built by the UK and Netherlands following the great storm of 1953 which led to the loss of some 2,500 lives. Governments in both countries took the immediate decision that such a catastrophe could never be allowed to happen again, and moved to put in place sea defences which would realize this decision. In both countries, the final sea defences were not completed until the mid 1980s, i.e., it took 30 years from decision to completion. Thus, to delay decisions around adaptation is likely to have negative consequences where the timescales to realize projects are long – to delay is likely to mean that the infrastructure isn't in place in time to address the impact. In the case of the North Sea defences, the Dutch defences were engineered to last for more than 200 years - it is clear that engineered structures with such long lifespans must take into account climate change (in this case changes in storminess and flooding) and sea-level rise.

The second reason is that there are no guarantees that climate change will follow a linear pathway. Events such as the reorganisation of ocean currents due to freshening from meltwater have the capacity to trigger abrupt and/or rapid climate change. The palaeoclimatic record tells us that such events are possible – witness the Dansgaard-Oeschger and Heinrich events in the last glacial period, and Bond events during the Holocene. These are events which see abrupt climate transitions taking place over just a few decades. Bond events have been linked to the collapse of civilizations, for example the third event has been linked to the collapse of the Akkadian Empire and the end of the Egyptian Old Kingdom. Even in the absence of non-linear transitions in climate such as these, we may expect the rate of change of climate, and the associated sea-level rise, to accelerate over time – all climate models suggest that the pathway that greenhouse gas concentrations are currently tracking is exponential over time.

The third reason is that, even if climate change does take a linear pathway, it does not necessarily follow that impacts will follow suit. The concept of such thresholds is very easy to understand in agriculture and horticulture, and indeed the GRDC has recently completed a project 'Critical thresholds (tipping points) and climate change impacts/adaptation in horticulture'. It is likely that such thresholds are widespread in ecosystems and biodiversity, ecosystem services, and primary industries such as fisheries. Their implications for food security and, in turn, global trade and security, are likely to be considerable.

The final reason is that there are a wide range of practical strategies that can be undertaken today to increase robustness and that also increase resilience to future climate change, even under uncertainty. Hallegatte (2009)[3] defines five such strategies: no-regret, reversible, safety margin (that reduce vulnerability at null or low cost), soft (institutional or financial tools) and, finally, strategies that reduce decision-making time horizons. The Productivity Commission recommends 'no regrets' strategies in its Issues Paper. However, care must be taken in evaluating such 'no regrets' options. Solutions which deliver to present-day climate variability may well differ depending on whether they are made on the assumption of a stable or changing climate. Examples include decisions to rebuild or relocate following a bushfire, and investment decisions in agriculture.

We have argued in this section for the need to undertake action to adapt to future climate change now. Such action must be underpinned by the best possible information. NCCARF has the capacity and processes in place to be a critical knowledge provider.

[3] Hallegatte, S., (2009), "Strategies to adapt to an uncertain climate change", Global Env. Change, **19**, 240–247.

1.3 Sector by sector overview of adaptation knowledge needs in Australia

Below, we explore for a number of sectors some key adaptation challenges that cannot be met through market mechanisms. Some are examples of adaptation challenges that have occurred in the past, some are future challenges. All would have benefited, or would benefit, from NCCARF outputs and processes of knowledge communication.

1.3.1 Managing the impacts of climate extremes

1. *Removal of insurance cover in Roma and Emerald*. A large insurance company recently announced that it would no longer offer flood cover on new policies in these Central Queensland towns. This looks to be an example of an Insurance company moving to correct what is perceived as a market failure, i.e., inadequate provision of flood defences. If levels of protection are not improved, the company will no longer bear what is seen as unacceptable levels of risk. It is interesting that the company is not removing cover in towns where there are defences even where these are insufficient/inadequate, and are known to be such, e.g., Charleville.

2. *The Grantham relocation in the Lockyer Valley*. Following a flash flood in the Lockyer Valley, SE Queensland, during the 2011 floods, the local council took the initiative to buy land and distribute it as building plots to community residents who were affected by the flood. This is just one in a history of community relocation in Australia, and it represents a market failure caused primarily by lack of knowledge of the long-term climatology of the affected site, i.e., an adaptation deficit.

1.3.2 Water management and supply

3. *Water resources for Perth* have been in decline for a considerable period, related to persistent drought. Today, the water storages for Perth are at only 22% of capacity. The atmospheric processes underlying this trend can be related to anthropogenic climate change. Further, the climate models are largely in agreement that anthropogenic climate change will lead in future to drying conditions. This consensus between observed drying, underlying atmospheric processes and climate model projections leads to the conclusion that the SW Australian drying trend is unlikely to reverse. Given the size of the likely investment required to secure Perth's water supplies under climate change, the likely timescales of return on investment, and the penalties for failing to secure supply, it is likely that the strategic planning and investment would be most cost-effectively carried out by government.
4. *Managing the Murray-Darling Basin (MDB) under a changing climate*. The MDB supplies 40% of Australia's agricultural production by value. It is already a challenge to meet the water requirements of the various users in the MDB: irrigation, the public supply and the environment. This challenge is only likely to worsen under climate change. The market may resolve some parts of the challenge, but will not ensure that environmental flows are maintained unless the government takes a role. There is a need for research to fully understand how to manage river flow for the benefit of the complex riparian ecosystems of the MDB, and to meet Australia's responsibilities under the RAMSAR conventions.

1.3.3 Primary industries: agriculture, fisheries and mining

5. In the short term, *agriculture* will adapt to climate change, taking decisions on crop choice and management on a season by season basis. The knowledge required to underpin such adaptive management is held by RDCs. However, on the longer term

agriculture will require transformational changes to ensure resilience to climate change. An example might be relocation in response to declining water availability e.g., to the Ord River basin. The implications of such a fundamental redesign of the Australian agricultural economy with respect to the interactions with other sectors (including ecosystems) need to be well understood in advance.

6. The *marine environment* is already seeing the impacts of climate change. Fisheries will be required to be flexible and responsive to signals such as declining fish stocks.

7. The *mining industry* is a mainstay of the Australian economy, contributing around 10% of GDP. Mines are vulnerable to flooding and can remain closed for many months. Draining the floodwater is not straightforward due to the risks of contamination of ground and surface water, and the domestic supply. Ensuring business continuity under climate change and increased occurrence of extremes is essential not only for the industry itself, but for the Australian economy.

Research is required to fully understand these interactions, and needs to begin now to ensure an orderly transition and avoid maladaptation.

1.3.4 Settlements and infrastructure

8. The Productivity Commission refers to the need for *legislative and regulatory frameworks* to support planning decisions in the coastal zone which take into account risks from sea-level rise, and NCCARF would support this. However, local governments have knowledge needs which go beyond these frameworks to support decision making which properly take into account risk without unnecessarily limiting development in the coastal zone. At present, local governments lack ready access to appropriate, tailored information. NCCARF accesses local governments primarily through its local government portal but plans to work harder to address the critical and pressing needs of this sector in its next phase.

9. It is clear that successfully adapting Australia to climate change will require large amounts of *energy*, which should be delivered sustainably, i.e., without adding to the burden of atmospheric greenhouse gases. This electricity will be required to cool indoor spaces and power public transport systems. How is an adequate and secure supply to be achieved? Research is required to address this challenge, to understand what the possible future mix of energy might be, including the potential role of nuclear power, to plan the grid requirements to deliver electricity to the consumer, and to explore financing options and the balance of the public and private sectors in addressing these challenges.

10. Existing *public transport systems* will require retrofitting to ensure they can operate safely and reliably under extremes of heat, and that they are protected from extremes such as flooding and wind storm. New low-carbon public transport networks will be required to address mitigation targets and should also address adaptation, for example, being designed for comfort under extremes of heat.

1.3.5 Ecosystems

11. Market forces alone will not ensure the health of *ecosystems* under climate change, nor preserve biodiversity. Government at all levels has a role in protecting ecosystems. NCCARF has made some progress in developing the knowledge base to permit evidence-based decision making for ecosystems under climate change, but more remains to be done.

1.3.6 Human health

Research is required to understand and plan for the effects of climate change on:

12. The epidemiology of *vector-borne disease* and
13. *Water, air and food quality*, and the implications for public health.

1.4 Transdisciplinary knowledge needs

1.4.1 Australia in the international context

Traditionally, climate change impacts and the adaptive response are analysed on a sector-by-sector basis, and in situ. This approach is methodologically straightforward, and hence attractive. However, increasingly we understand that it is in the interactions between sectors, and between Australia and the rest of the world, that the greatest challenges and opportunities of climate change may lie. And yet our understanding of the nature of these challenges and opportunities is elementary. Failure of understanding may lead Australia to fall behind in relation to its trading partners and economic competitors.

1.4.2 Indicators of adaptation

Australia currently has no measure of its performance in reducing vulnerability to climate change and enhancing resilience. This applies not only to measures that are specifically designed to address climate change, such as building flood defences, but also actions which may act to reduce resilience, such as building in the floodplain. There is a need to develop a suite of adaptation indicators, and to measure performance against these on a regular (say, biennial) basis to understand the effectiveness of adaptation in Australia.

1.5 Conclusions

We have argued in this section that:

- Market forces are insufficient drivers to ensure effective adaptation in Australia.
- Planned adaptation undertaken by governments will be required in addition.
- An organization such as NCCARF is required to generate and deliver the knowledge needed by decision makers in governments and the private sector to undertake successful adaptation.
- Adaptation is required now to address the challenge of present and future climate change and to realize national and international opportunities.

In the next section, we explore NCCARF's contribution to the adaptation challenge.

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Part II: Activities of the National Climate Change Adaptation Research Facility

PART II: NCCARF ACTIVITIES

2.1 Introduction

Six months have passed since information about NCCARF and its activities was provided to the Commission. Over this time significant progress has been made. All research funds have been allocated and substantial effort has been made to engage with a wide variety of stakeholders. NCCARF projects are beginning to be delivered, and the NCCARF Board has developed a Prospectus to seek commitment from potential Partners in a Next Phase of NCCARF.

In light of these developments, NCCARF is providing an update to the Commission. NCCARF requests that this information is taken into account in the final report.

This update is important because the Commission's report is clear about the importance of information provision to support climate change adaptation (Chapter 6, pg. 93). NCCARF plays a significant role in establishing research direction, accessing and delivering research, and ensuring end user access to research outputs. Thus, NCCARF is already fulfilling the role of information provision identified by the Productivity Commission, and is currently undertaking an evaluation of the success of methods employed to engage with the full spectrum of end-users. Into the future, NCCARF intends to focus on increasing engagement with business, Industry and other end-users in Commonwealth, State and Local Government, and to adopt a more flexible and responsive approach to project identification and delivery.

2.2 NCCARF's contribution to foundational research

NCCARF has developed considerable foundational knowledge for the climate change adaptation agenda in Australia.

NCCARF's climate change adaptation research is applied research aimed at generating the knowledge needed by decision-makers in government and in vulnerable sectors and communities to manage the risks of climate change impacts. Sound climate change adaptation policies, decisions and initiatives need to be based on high quality information. The relatively new field of climate change adaptation can draw on existing information, but a substantial amount of new, targeted knowledge needs to be developed. All research funded through NCCARF can therefore be considered to be foundational in nature. As discussed below, most research is ongoing and outcomes will be delivered in the next nine months.

Despite most research projects being ongoing, NCCARF has already produced foundational knowledge, also discussed below. This includes:

- production of nine Climate Change Adaptation Research Plans to identify, sector-by-sector, knowledge gaps for adaptation in Australia. This world first approach establishes the adaptation research agenda in Australia.
- completed research reports available on the NCCARF website.

2.2.1 Establishing national research direction and priorities

NCCARF has worked with leading researchers and end-users in nine thematic areas (Emergency Management, Human Health, Settlements and Infrastructure, Marine Biodiversity and Resources, Terrestrial Biodiversity, Freshwater Biodiversity, Primary Industries, Social Economic and Institutional Dimensions, and Adaptation in Indigenous Communities), to consider available knowledge and knowledge needs and produce research plans for each theme. These plans, known as National Climate Change Adaptation Research Plans, are unique to Australia and position the nation's researchers to target their research effort at areas of priority to end-users. This provides the foundation of the climate

change research agenda and has application beyond the research that NCCARF delivers, influencing the directions and priorities of other research funding agencies and programs around Australia.

2.2.2 Broad overview of NCCARF research

To date, together with co-investors in the Marine Theme and the Human Health Theme, NCCARF has commissioned, and manages, a research portfolio of more than 140 projects with a total value of almost $40 million. Project teams comprise researchers from 33 universities, 61 Commonwealth, state and local government bodies and 25 private institutions.

The research is:

- Contributing to governments' understanding of the impacts of extreme events in Australia, how these might change as our climate changes, and what adaptation options are available to address the threat;
- Identifying vulnerable ecosystems, regions and communities and working to understand the causes of this vulnerability, the potential to increase resilience and the legislative and regulatory frameworks needed to support adaptation;
- Developing and evaluating tools for the planning, management and cost-benefit analysis of adaptation actions;
- Synthesising existing and emerging national and international research on impacts and adaptation and developing targeted communications products for stakeholders.

Much of this research is generating considerable foundational knowledge in adaptation. A research portfolio identifying all projects funded by NCCARF is provided in Appendix A.

It is important to note that most research projects are ongoing with the vast majority of final reports falling due towards the end of 2012 and in early 2013.

NCCARF carries out its research under two programs: the Adaptation Research Grants Program and the Synthesis and Integrative Research Program. As at June 2012, all of the research funds have been committed. This includes 96 ARGP projects and 44 SIR projects (see Table 1). This represents a substantial body of research and a significant investment in building capacity to address the challenge of climate change.

2.2.3 Adaptation Research Grants Program (ARGP)

The ARGP is a $34 million program focused on delivering research in 9 theme areas (see Table 1), and NARPs have been completed for each of these themes. $27 million of Australian Government funding has been augmented by $7 million leveraged through investment by the Fisheries Research and Development Corporation (into the Marine Biodiversity theme), the National Health and Medical Research Council (into the Human Health theme) and the National Water Commission (into the Freshwater Biodiversity theme).

Table 1: Break-down of the 96 ARGP projects funded in each of nine theme areas

Theme area	Number of projects
Freshwater Biodiversity	9
Emergency Management	11
Human Health	7
Marine Biodiversity and Resources	17
Settlements and Infrastructure	15
Social, Economic and Institutional Dimensions	17
Terrestrial Biodiversity	9
Primary Industry	3
Adaptation in Indigenous Communities.	8

2.2.4 Synthesis and Integrative Research Grants Program

The $4.5 million Synthesis and Integrative Research (SIR) program draws together existing information relevant to key topics in climate change adaptation to address issues or research needs identified by end-users. The focus is on bringing together existing knowledge from a variety of sources and disciplines to support decision-making. This knowledge is generally theme specific, whereas the requirements of policy development are for inter- and transdisciplinary information, frequently synthesized at the regional level. In many cases, SIR research produces the first comprehensive stand-alone body of research on policy-relevant topics. This is foundational knowledge, because it forms a basis for climate change adaptation action and research into the future. Please refer to the attachment for a list of SIR projects.

The areas of focus of the Synthesis and Integrative Research program are.

Adaptive Capacity
Historical Case Studies
Forest Vulnerability
Coastal Ecosystems Response to Climate Change
Learning from Regional Climate Analogues
Limits to Adaptation
Flooding in Australia
Impacts of Climate Change
Overcoming Barriers to Adaptation
Uncertainty in climate change science – the implications for adaptation
Food Security
Communication
Systems Thinking to Support Decision Making
Web-based Tools for Adaptation
Adaptation in Industry and Business
Economics of Adaptation
Adaptation and Mitigation: Avoiding Unintended Consequences

2.2.5 Multidisciplinary research activities

Each ARGP project is required to submit an End User Engagement Plan at the start of the project, and end-users should be involved at all points along the progress of the project, from development of the detailed work plan through to delivery of the results. Synthesis and Integrative Research Projects are required to involve end-users from an even earlier point, during proposal development.

A typical project will bring together a number of collaborating institutions. This has led to a rule that all projects which allocate more than $50,000 to a partner institution other than the lead institution must set up a sub-contract. As a measure of multi-institutional involvement in projects, 17 of the NCCARF projects have needed such sub-contracts.

NCCARF has carried out two 'tiered' projects under the Synthesis and Integrative Research program, which have brought together a number of institutions to address a research topic. In this way, NCCARF has brokered research consortia in order to address an issue which requires multidisciplinary involvement.

The first was the 'Historical Case Studies' project, which looked at the lessons to be learned about adaptation from studying extreme events which had taken place in the past. The events were:

- Pasha Bulker storm: example of an East Coast Low - Newcastle University
- Cyclone Tracy - Macquarie University
- Southern Cities Heatwave January-February 2009 - Queensland University of Technology
- Floods in Gladstone and Charleville, 2008 and 2009 - University of Southern Queensland
- King Tides in South-East Queensland and northern NSW - Griffith University
- Water Supply in Small Inland Towns: Kalgoorlie and Broken Hill - Murdoch University
- Drought in Small Inland Towns: Donald and Mildura - Newcastle University

In addition, an overarching synthesis and 'Lessons Learned' document was produced.

The second was the 'Limits to Adaptation' project, which looked at barriers and limits to adaptation in six regions of Australia, as follows:

- Alpine Regions - Griffith University
- Great Barrier Reef - James Cook University
- Coorong Wetlands - Australian National University
- Macquarie Marshes – University of New South Wales
- Torres Strait Islands - James Cook University
- Drought in Small Inland Towns - Newcastle University

These looked not only at the ecosystem barriers, but at the social and economic barriers in the societies whose livelihoods depend on these ecosystems. In addition, an overarching synthesis has been produced by University of Melbourne.

NCCARF has recently completed a research call to produce a portfolio of state-based studies of vulnerability, impacts and adaptation. These studies will be managed to ensure that together they address in a consistent manner the issues faced by individual states and territories around adaptation to climate change. Again, an overarching synthesis document is planned, to be prepared in early 2013.

2.3 NCCARF's end user engagement

Engagement with end-users has always been an essential aspect of all NCCARF's activities. This engagement has increased in recent years due to improved capacity within NCCARF and increased momentum of research funding, action and results. NCCARF engages end-users in a number of activities and mechanisms.

2.3.1 Direct stakeholder engagement

Local Government Associations – NCCARF engages directly with the Australian Local Government Association (ALGA) and relative State and Territory associations. The majority of Local Government association engagement occurs with ALGA. NCCARF also attended

the 2011 National General Assembly for local government in June 2011. The conference provided a platform for NCCARF to raise the awareness of the NCCARF Local Government Portal, network with local governments and local government agencies, continue to foster the relationship with the Australian Local Government Association and obtain insight about local government needs for climate change adaptation research (through networking conversations and attending the breakout session on climate change adaptation).

ACELG – NCCARF has maintained close ties with the Australian Centre of Excellence for Local Government (ACELG). On 4th May 2011 NCCARF had two staff attend the local government roundtable event hosted by ACELG. Donovan Burton from NCCARF wrote a paper for the roundtable discussion. NCCARF is currently exploring the possibility of co-organising a breakfast event with ACELG at the next ALGA National General Assembly.

NCCARF Local Government Portal (see www.localgov.nccarf.gov.au) Given the political framework of Australia (556 local government bodies within six states and two main territories) local governments also work in a multitude of policy frameworks for resource distribution, climate change risk identification and climate change adaptation policies. Although it liaises with the Australian Local Government Association and relevant state associations, NCCARF has recognised the need for a process which allows direct interaction with local governments. Given the above challenges NCCARF has realised that the most effective pathway to interact with a user group with such a broad geographic and jurisdictional diversity is through an online mechanism. This has led NCCARF to establish the Local Government Portal.

A reference panel of local government representatives was created to ensure that the Portal suited the needs of the end-user. The reference panel included representatives from each state/territory and contained a diverse collection of relevant local government types. The panel also included representatives from each of the local government associations as well as the Australian Local Government Association. The Panel members were engaged in person at a NCCARF hosted workshop as well as via telephone and online communication.

The Local Government Portal has over 230 registered members from local governments throughout Australia. At present the Portal is growing, without promotion, by 2-3 people per day.

Private sector engagement

NCCARF has increased its private sector reach considerably in the past 12 months. In particular the “Climate Change in the Boardroom” Project (headed by Gareth Johnston at Future Ready and including DLA Piper and Climate Planning) has given NCCARF a platform for direct engagement with business end-users. The nature of the direct involvement includes three boardroom lunches (Brisbane - 30th March; Sydney - 30th April; and Melbourne – 25th June).

An NCCARF representative has attended / will attend these events to engage with the participants, who represent a broad range of sectors. Although the project is in the early stages it has already received positive media attention in the BRW and the Australian Financial Review.

List of companies targeted through this research:

Teys/Cargill	Swiss Re	AMP
Pidcocks	Fujitsu	Macquarie
TVS Partnership	DLA Piper	GE capital
Qantas	Mirvac	NAB
Leightons	Stockland	IHG
Cundall	Lend Lease	CCA
AGL	Australian Ethical	Sara Lee

Origin	L J Hooker	Cerebos
GE	Corporate Express	Inghams
Siemens	BlueScope	IAG
Spark Infrastructure	Fuji Xerox	CGU
Westpac	Telstra	
Teachers Bank	Transurban	

NCCARF has also themed the second day of its 2012 *Adaptation in Action* conference to align with business engagement. During this day NCCARF has secured sponsorship from AECOM to host a business breakfast and has a plenary session of business risks and responses.

State government engagement

The Forum for NCCARF's Interaction with Australian States and Territories: Australian States and Territories are essential stakeholders for the core business of NCCARF. NCCARF needs to liaise with these important stakeholders to understand their research needs, to disseminate results from research, and to involve them in the many and diverse activities of the Facility.

Despite this need, the very broad diversity of Departments across the States and Territories makes working with each one individually a difficult if not impossible task for a nexus organisation like NCCARF.

To address the need for engagement, in 2008 NCCARF established FORNSAT - the Forum for NCCARF States and Territories - as a mechanism for all Australian state and territory governments to interact with the Facility, and also with each other, to progress climate change adaptation research and activity in Australia.

FORNSAT has proved to be a highly valuable forum for the exchange of ideas across a broad range of NCCARF stakeholders, as well as with NCCARF itself.

Each State and Territory was invited to nominate a representative to sit on the Forum and be responsible for liaising between NCCARF and the research and policy communities in their jurisdiction.

Meetings are held on a four to six monthly basis. They present a number of opportunities. At each meeting, State and Territory representatives are asked to describe the various research projects being funded or undertaken in their area. It quickly became obvious that this could enable the sharing of ideas, combining of synergistic projects and identification of leveraging opportunities. The meetings are also aimed at sharing new NCCARF research. To enable this, NCCARF is able to bring in its own Adaptation Research Network representatives and researchers to share their approaches and ideas. In turn, FORNSAT provides a valuable opportunity to access critical end user expertise in developing and assessing new research projects.

As well as exchanging ideas and information, FORNSAT attendees are able to build on ideas, policy development and policy approaches, and evaluate their work through peer interaction and comparisons.

Since its inception, the FORNSAT relationship has grown and members wish to regularly share ideas.

FORNSAT has been heavily involved in the review process for the two research programs managed by NCCARF: the thematic Adaptation Research Grants Program and the Synthesis and Integrative Research program, with representatives acting as members of the Scientific Review Panels which evaluate proposals. Not only is this invaluable to the process of assessing research proposals, but it emphasises the importance of stakeholder engagement in developing adaptation research.

NCCARF relies on FORNSAT members to publicise research calls through their networks.

FORNSAT members have been involved in organising and facilitating NCCARF seminars, workshops and events. In addition they have facilitated access to key stakeholders in their jurisdictions to assist NCCARF in articulating research needs and ensuring end-user relevance in its activities. FORNSAT members contribute strongly to the planning of large NCCARF events such as the annual conference.

FORNSAT provides a valuable resource for a broad group of adaptation stakeholders. An annual combined meeting of FORNSAT and the Adaptation Research Network conveners facilitates productive collaborative engagement between these two groups. The meetings are arranged around joint presentations by a Network and FORNSAT Member focussing on a topic of interest, thus allowing the views of researchers and end-users to be presented and discussed side-by-side.

Recently, with the establishment of an NCCARF Board, FORNSAT has provided an opportunity for the State representative on the Board to liaise face-to-face with other State and Territory representatives.

FORNSAT has helped its members to build important networks of experts and policy specialists. This has led to better and more effective reviews of policy and science, and resulted in higher quality adaptation plans and policies being developed and implemented. FORNSAT has been an important and positive initiative for States, Territories and NCCARF, and has improved coordination, cooperation and knowledge sharing between important stakeholders in climate change adaptation for Australia.

> "NCCARF's Forum for State and Territories (FORNSAT) meetings have been very valuable for a number of reasons. At these meetings the State and Territories get briefings on the range of NCCARF's activities, the activities of the Adaptation Research Networks and the climate change adaptation research projects it has funded. FORNSAT provides a forum for providing important end user perspectives for NCCARF's future planning. Importantly, it has also provided a regular forum for the various State and Territory participants to talk with each other and get regular briefings on climate change adaptation initiatives occurring in respective jurisdictions. It has been a useful forum for discussing the challenges of adaptation and sharing of experiences and lessons learnt."
>
> James Duggie, Western Australia's FORNSAT representative

2.3.2 Public good activities

In addition to core business, the expertise of NCCARF staff is often requested for a number of committees and forums. Examples include:

- Queensland Government Inland Flood Report: membership of science and steering committees
- Member, High Level Co-ordination Group on Climate Change Science (Federal Government)
- Member, South Australia Premier's Council on Climate Change
- Reviewer, First UK Climate Change Risk Assessment, 2012
- Review Editor, Intergovernmental Panel on Climate Change Working Group II Fifth Assessment:
- Convenors for session on climate change adaptation, Conference Planet Under Pressure – Knowledge towards Solutions, March 2012
- Member, Steering Committee for Conference on Climate Adaptation Futures, June 2012, Tucson, Arizona.
- Member, Fisheries Research and Development Corporation Advisory Committee.

- Member, Scientific Steering Committee, International Geosphere-Biosphere Program (IGBP)
- Reviewer, CSIRO Climate Adaptation Flagship, 2011.
- Observer, National Committee on Earth-System Science
- Board member, Institute of Marine and Atmospheric Science (IMAS), University of Tasmania
- Board member, Victorian Centre for Climate Change Adaptation Research (VCCCAR)

2.3.3 National and international recognition

NCCARF Staff are frequently invited to attend and take part in a number of activities which contribute to the national agenda. NCCARF staff were invited to give presentations at 20 external events.

2.3.4 NCCARF engagement activities, meetings and events

NCCARF runs a number of events and activities to involved stakeholders and end-users in research development and inform them of research outcomes. From 2009 onwards, NCCARF has run over 150 workshops, meetings, roadshows, seminars and other events which have included end-users as presenters and participants. Figure 1 is a geographical representation of the spread of NCCARF activities and events. Table 2 describes the various events held in each state.

Figure 1: Distribution of NCCARF activities and events involving end-users across Australia

Table 2: Types of activities and events conducted by NCCARF across Australia.

State	Event or Activity type	Number
Queensland	Conference	2
	Masterclass	1
	NARP Consulatations	1
	Partner Event	1
	Principal Investigators Meetings	1
	Research Call Workshop	6
	Roadshow	1
	Seminar	40
	Workshop other	1
New South Wales	NARP Consultation Workshop	1
	Partner Events	1
	Principal Investigators meetings	2
	Research Call Workshops	2
	Roadshow	1
	Seminar	7
	Workshop other	1
Victoria	FORNSAT Meeting	3
	NARP Consultation	1
	Research Call Workshop	4
	Roadshow	1
	Seminar	7
Tasmania	NARP Consultation	1
	Research call workshop	1
	Seminar	3
	Roadshow	1
	Workshop other	1
Western Australia	Partner event	2
	Principal Investigators Meeting	1
	Research call workshop	4
	Roadshow	1
	Seminar	2
	Workshop other	1
Northern Territory	NARP Consultation	1
	Research Call Workshop	2
	Roadshow	1
	Seminar	1
	Workshop other	1
Australian Capital Territory	Federal government engagement meetings	2
	NARP Consultation	5
	Principal Investigators meetings	4
	Research call workshops	1
	Roadshow	1
	Seminar	5

2.3.5 Conferences

NCCARF ran a highly successful international conference in 2010, with over 1000 attendees from 42 countries. More information: www.nccarf.edu.au/conference2010/

NCCARF hosts an annual domestic conference to share climate change adaptation research and knowledge. This is a relatively small event in odd years, when CSIRO runs its Greenhouse conferences which cover all aspects of climate change, and large in even years.

In June 2012 NCCARF will be co-hosting its annual conference with the CSIRO Climate Adaptation Flagship. Over three days NCCARF and CSIRO will bring together researchers, practitioners and decision makers to share knowledge and research approaches that inform policy and practice in planning for climate change in Australia.

The 2012 Climate Adaptation in Action Conference will showcase the contribution of adaptation science to planning and policy making across Australia. It will explore how robust adaptation decisions can be made in the face of uncertainty. Engagement in this conference has been very successful with 536 abstracts being accepted for oral or poster presentations at the conference. The conference is expected to attract over 700 delegates from the research and practitioner community around Australia. More information: www.nccarf.edu.au/conference2012/

2.3.6 National seminar series

NCCARF hosts a National Seminar Series designed to share expertise from around Australia and the world with a broad audience including end-users. More than 60 seminars have been held in every state and territory in Australia and are attended by a diverse audience. To demonstrate, since the beginning of 2011 the seminar series has collectively had 784 participants. The percentage of participants from each sector is shown in Figure 2.

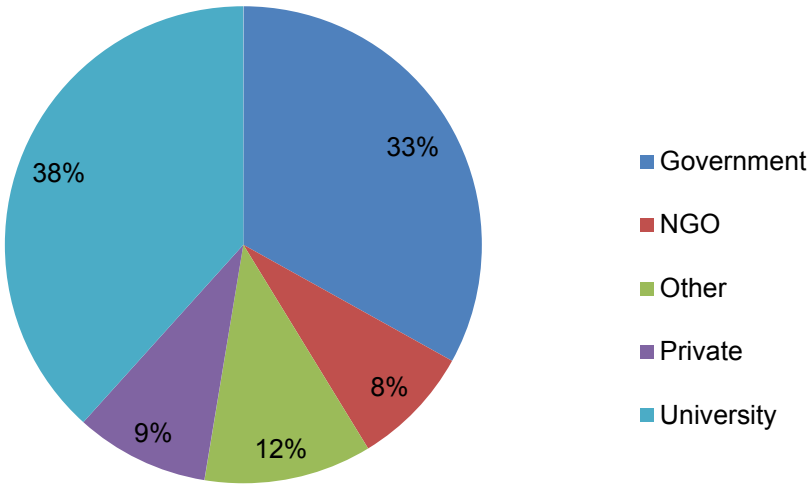

Figure 2: Distribution of attendees of NCCARF's National Seminar Series January 2011- April 2012 (n=783).

2.3.7 Roadshows

In 2010 and 2011, NCCARF organised forums in every state and territory to disseminate findings on the first phase of Synthesis and Integrative Research. These roadshows also included an update on NCCARF activities and in many places, invited speakers from state or local governments to give their perspective and contribute to an interactive panel session. The events were attended by a range of stakeholders including all levels of government, NGOs, consultants and local business representatives (particular those from development, energy and water).

2.3.8 Partner events

In 2011 and 2012, NCCARF has been showcasing research being conducted in its partner institutions and inviting local end-users to benefit from this research. Three events have been run, in Newcastle, Townsville and Perth.

University of Newcastle, November 2011

This event on 23rd November 2011, was held in collaboration with the University of Newcastle. It showcased projects supported by the Adaptation Research Grants Program and the Synthesis and Integrative Research Program and included a presentation from NCCARF's visiting fellow, Dr Wade Hadwen. It was attended by representatives from: University of Newcastle; Hunter Water; The Bureau of Meteorology; NSW State Emergency Service; Gosford City Council; Lake Macquarie City Council; NSW Office of Environment and Heritage; NSW Department of Innovation and Research; and local consultancies.

James Cook University, February 2012

This event on 23rd February 2012 was held in collaboration with James Cook University in Townsville. It showcased projects supported by the Adaptation Research Grants program and the Synthesis and Integrative Research Program. It was attended by representatives from James Cook University; QLD Department of Employment, Economic Development an Innovation; the Great Barrier Reef Marine Park Authority; CSIRO; Townsville City Council and NQ Dry Tropics NRM.

Murdoch University, March 2012

This event, on 15th March 2012, was held in collaboration with Murdoch University in Perth. It showcased projects supported by the Adaptation Research Grants program and the Synthesis and Integrative Research Program. It was attended by representatives from Murdoch University, World Wildlife Fund; Joondalup Shire Council; Kwinana City Council; Serpentine Jarrahdale Shire; Coastal Zone Management Pty Ltd; WA Main Roads; WA Water; Earthwatch; WA Department of Mines and Petroleum; WA Water, Curtin University; Wanneroo Shire Council; Mandurah City Council; and Fisheries WA.

2.3.9 Principal investigator meetings

NCCARF organises Principal Investigators' meetings for each of its research themes. The purpose of these meetings is to:

- Develop collaboration and synergistic interaction between projects
- Explore opportunities for developing papers and research proposals.
- Discuss opportunities for end-user communication and engagement
- Jointly address any problems that may be emerging.

Generally, it is an opportunity to network, and understand better how each research project fits into the overall NCCARF portfolio of projects. In addition, key stakeholders are invited to these meetings in order to have input to the research while it is ongoing and to develop an understanding of how they might be able to the use the information when it becomes

available. For example, stakeholders invited to the Settlements and Infrastructure meeting included representatives from Local Government Associations, Sydney Water, the Australian Green Infrastructure Council, Geoscience Australia, the Australian Council of Social Service, and various state government representatives.

Meetings have been held for the Emergency Management, Human Health, Primary Industries and Settlements and Infrastructure themes. Meetings are planned for Freshwater Biodiversity, Terrestrial Biodiversity, Social, Economic and Institutional Dimensions and Indigenous Communities in the coming months.

2.3.10 Synthesis and Integrative Research Strategy

The $4.5 million Synthesis and Integrative Research (SIR) program draws together existing information relevant to key topics in climate change adaptation to address issues or research needs identified by end-users. The focus is on bringing together existing knowledge from a variety of sources and disciplines to support decision-making.

In 2010-2011 NCCARF undertook an extensive stakeholder engagement program in order to develop the strategy for funding the SIR program. Workshops were held with broad groups of agency stakeholders from Australian, State and Territory Governments. Many of these workshops were followed up by meetings with individual stakeholder groups from different agencies to flesh out ideas.

The workshops included a background to NCCARF and the SIR Program and a discussion about potential research areas and needs from SIR Participants were encouraged to hold further discussions with their groups and other departments and provide feedback identifying any additional ideas. Over 100 people from State and Commonwealth Agencies attended the workshops and contributed to discussions.

A FORNSAT meeting was held in December 2010 where outcomes from workshops and meetings with the States and Territories were reviewed. Subsequently, further discussions were held with state and territory representatives to build on key ideas identified through the consultation process.

In addition, there has been on-going discussion with the Department of Climate Change and Energy Efficiency, the key Commonwealth Government stakeholder in the SIR Program, to define the broad framework for this program.

2.3.11 Science Review Panels

All research proposals submitted to both the Adaptation Research Grants Program and the SIR Program are assessed by an expert committee. This committee includes the project manager, NCCARF representatives, Australian Government representatives (DCCEE), independent experts and end-users from government or industry.

2.4 Adaptation Research Networks

The National Climate Change Adaptation Research Facility's Adaptation Research Networks, hosted by universities across Australia, are a community of researchers and practitioners working together to progress climate change adaptation knowledge. Established in 2008, there are eight Networks representing various themes.

2.4.1 Membership

Network membership is free and open to everyone. Since the launch of the Networks, Network membership has grown to over 5000 across the themes (doubling since 2010, Figure 3), and although originally designed to connect the research community in Australia, now include more policy makers, practitioners and community members than researchers.

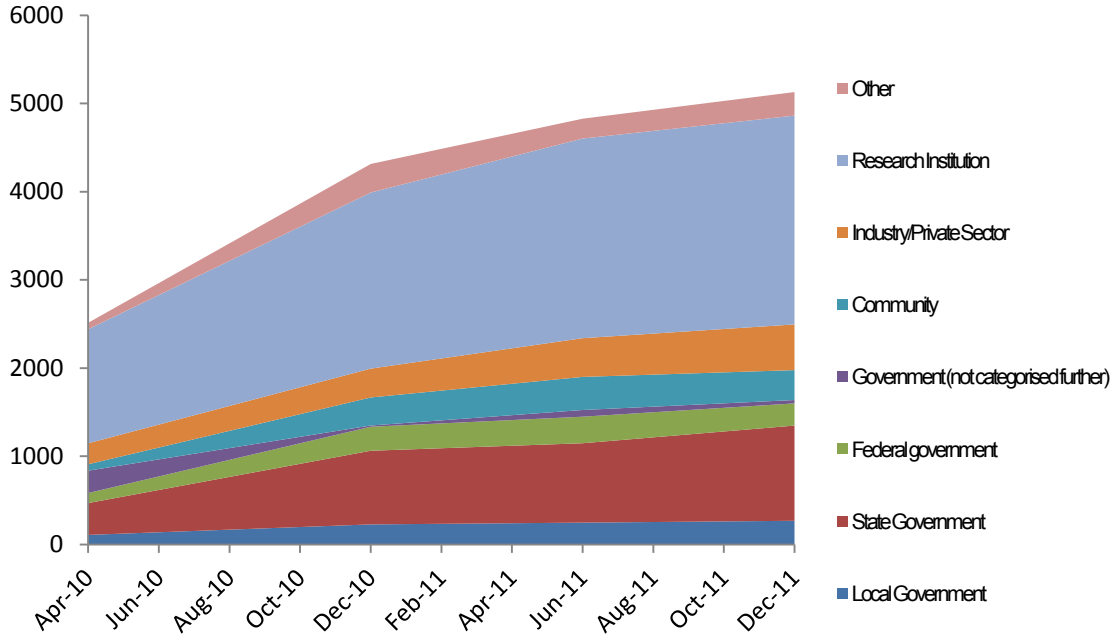

Figure 3: Adaptation Research Network membership composition from April 2010 to December 2011

2.4.2 Activities and events

Although the Networks have a common purpose, and seek to fulfil a set of agreed roles, they differ substantially in their focus, approach, funding, structure and management and governance arrangements. Networks have had the flexibility to develop their own set of activities and individual work programs, which has encouraged innovation and has allowed them to develop tailored activities best suited to their particular sector. Despite this, many of the Networks have engaged in similar activities over their four-year life span.

Table 3 summarises activities across the Networks. All actively promote and facilitate open exchange of information and sharing of resources using websites, membership databases, email lists, newsletters, bulletins and fact sheets. Network leaders actively meet with stakeholders individually and together as participants and leaders (organisers, facilitators or keynote presenters) at workshops, seminars, road shows and conferences across their various areas of expertise, research activity and Network responsibilities. Figure 4 indicates the spread of events run by the Networks across Australia which have engaged end-users.

Table 3: Activities and products developed by the Adaptation Research Networks 2008-2011

Activity	HH	EM	MBR	SI	TB	SEI	PI	Water
1. Promoting and facilitating open exchange of information and sharing of resources								
Network website	✓	✓	✓	✓	✓	✓	✓	✓
Membership database	✓	✓	✓	✓	✓	✓	✓	✓
Network nodes and node leaders			✓	✓			✓	✓
Email lists and forums	✓	✓	✓	✓	✓	✓	✓	✓
Network Workshops/events	✓	✓	✓	✓	✓	✓	✓	✓
Network roadshow			✓		✓			
Network newsletters, e-bulletins, brochures	✓	✓	✓	✓	✓	✓	✓	✓
Searchable database			✓	✓	✓	✓	✓	
Science/policy connections	✓	✓	✓	✓	✓	✓	✓	✓
Fact sheets, case studies, information sheets	✓	✓	✓	✓	✓	✓	✓	✓
2. Contributing to the synthesis of existing and emerging research								
Synthesis publications, Discussion papers	✓	✓	✓	✓	✓	✓	✓	✓
Conference papers	✓		✓	✓	✓		✓	✓
Research workshops	✓	✓	✓	✓	✓	✓	✓	✓
Literature review	✓	✓	✓	✓		✓		
Benchmarking survey				✓	✓		✓	✓
3. Contributing to the development and implementation of the NARPs								
NARP development	✓	✓	✓	✓	✓	✓	✓	✓
NARP implementation	✓	✓	✓	✓	✓	✓	✓	✓
NARP Review	✓	✓		✓				
4. Building research capacity								
Scholarships		✓		✓	✓		✓	✓
Travel support	✓	✓	✓	✓	✓	✓	✓	
International visitors	✓	✓		✓	✓			✓
Early career researcher workshops/Summer school/Mentoring/ Adaptation College	✓		✓	✓		✓	✓	✓

Figure 4: Distribution of Adaptation Research Network activities and events involving end-users across Australia

2.4.3 Adaptation Research Network highlights

A selected activity which is specifically targeted at end-users from each Network is discussed in more detail below:

National science synthesis and translating science to policy workshops: The **Water Resources and Freshwater Biodiversity Network** has run six interdisciplinary workshops to date addressing key issues in adaptation of water resources management and freshwater biodiversity conservation with topics including: water information needs, refugia, riparian zones, water governance, long-term ecological research/monitoring and environmental flows for Ramsar wetland sites. Further workshops are planned to be held this year on estuary management and recovery from drought. These workshops have served to synthesise the current state of knowledge and provide policy recommendations in the form of briefing papers available online and given directly to end-users, e.g. the Ramsar Convention Secretariat.

Focused strategy meetings with high level marine stakeholders: Following a targeted survey of high level marine stakeholders and based on a series of focused strategy meetings held in each of the state capital cities and Darwin/NT, **the Marine Biodiversity and Resources Adaptation Research Networ**k have identified the priority issues for government/peak body - industry/NGOs across five marine sectors. These are commercial fishing, recreational fishing, marine aquaculture, conservation management and tourism. A report from this project has been produced summarising these findings and is available online: http://arnmbr.org/content/images/uploads/Australian_Marine_Stakeholder_Needs_in_a_Changing_Climate.pdf

Network roadshows: The **Terrestrial Biodiversity Network** has held "roadshows" in each state and territory, bringing together researchers and stakeholders to systematically identify regional issues of climate change impacts and adaptation. There have been 370 participants, 62% of whom are stakeholders. The roadshows have significantly increased

stakeholder knowledge about the potential of adaptation to reduce negative impacts from climate change on terrestrial biodiversity.

Professional Masterclass: The **Primary Industries Adaptation Research Network** has recently held a Masterclass on climate change. This exciting and unique initiative has been developed to build capacity amongst early and mid-career researchers, research managers and policy analysts in the climate change adaptation space. The Masterclass program is structured as a series of three-day modules held in different locations across rural and regional Australia. Participants meet producers at the coalface of adaptation and find out how research, policies and new knowledge could help primary industries manage climate change risks and opportunities.

Local Government Initiative: The **Australian Climate Change Adaptation Research Network for Settlements and Infrastructure** is conducting an Australia-wide initiative to assist local councils to adapt to climate change. This program involves: gathering case studies and synopses on how local governments have used climate change adaptation tools and their application; a nation-wide survey of local councils to determine how climate change adaptation tools were used and perceived; a Decision Support Guide developed and then presented to councils in a series of presentations in capital cities and regional centres around Australian in May 2012.

Seminars and workshops: The **Emergency Management Network** builds knowledge and capacity for adaptation in the emergency management context through exposure to new practice and research through our research and policy seminar and workshop series, held in eastern, western and northern Australia. The Network has hosted over 10 international speakers including agency and research leaders. These events are aimed at policy makers and agency personnel as well as researchers. Recently the Network hosted a public event to disseminate the outcomes of the IPCC Special Report: “Managing the Risks of Extreme Events Disasters to Advance Climate Change Adaptation”.

The **Social Economic and Institutional Dimensions Network** has just opened a new scheme, the SEI-network *Adaptation Leadership Award*, which has been designed to support the development of future leaders in the social, economic and institutional dimensions of climate change adaptation. These Awards are worth up to $2,000. The Awards are intended to support fieldwork, collaboration activities or conference attendance. They will broaden the skills, perspectives and experiences of the successful applicants. Applications are invited from people who are either: researchers studying for honours, MSc or PhD at an Australian University; or employees of Australian Local Governments whose work concerns climate change adaptation.

The **Human Health** Adaptation Research Network has facilitated the production of two *special editions of journals*. These are: Asia Pacific Journal of Public Health – Special edition on climate change and health (Asia Pacific Journal of Public Health, 2011); and a special edition of Health Promotion Journal of Australia dedicated to health promotion and climate change. These journals are open source and have been promoted to the Network and health practitioners around Australia.

2.5 Other NCCARF communication and engagement activities

2.5.1 End user communication and engagement plans

NCCARF-funded research projects need to demonstrate that they have listened to end-users’ concerns regarding their information needs and understood their preferred communication formats preferred by members of respective industries and sectors. To this end, all research projects funded through the Adaptation Research Grants Program are required to complete an End-user Communication and Engagement Plan which identifies: the users of the information the project will generate including around policy, planning and

management; how information users will be involved in the project and its communication activities; how users will access the knowledge generated by the project during the its lifetime; and, how users will access the knowledge generated after the project is complete.

2.5.2 Research Impact Model

NCCARF supports research that strives for scientific excellence and maximises benefit for Australia, and works to procure and manage research projects efficiently and transparently. All research proposals submitted to NCCARF are required to meet the needs of specified end-users. To this end, NCCARF has developed its own Research Impact Model based on the model underlying the Impact Tool for Cooperative Research Centres (CRCs). The NCCARF model links all elements of the research value chain to identify the impacts and level of benefit generated by NCCARF research. The model applies to both the thematic research and synthesis and integrative research programs. All project proposals need to address the elements of the Impact Model, and successful projects will need to evaluate their research against their Impact Model on an on-going basis. NCCARF uses a Research Impact Model to ensure the benefits of its research to end-users maximised.

2.5.3 Website

The NCCARF website is NCCARF's primary tool for communication. Has recently undergone a complete remaking and the final result is a very useful repository of information for end-users. It includes an innovative search function which allows the user to search for and access all of NCCARF's research projects, Networks, products and publications. It will include an interactive event calendar for all upcoming NCCARF and Network events. This new website was launched in April 2012.

2.5.4 Social media

NCCARF uses social media as an important communication tool. NCCARF's Facebook page (http://www.facebook.com/NCCARF) has 431 members and its Twitter feed (http://twitter.com/#!/nccarf) has 461 followers. NCCARF also has a Youtube channel (http://www.youtube.com/user/nccarf) and a Vimeo page for longer videos (http://vimeo.com/nccarf).

NCCARF has expanded the use of social media with the launch of the new NCCARF website.

2.5.5 Products and publications

NCCARF produces and publishes a number of printed and online products and presentations designed for a wide range of audiences.

Research reports are detailed reports of the outcomes of the ARGP and SIR Program. They are useful for researchers and policy makers interested in the detailed methods and results of research.

Fact sheets are produced to provide a snapshot of key findings of each of the ARGP and SIR projects. NCCARF produces these in hardcopy and provides them online

NCCARF's quarterly newsletter is delivered via email to a mailing list of over 4000 researchers, policy makers, community groups and individuals worldwide. It provides an update on NCCARF activities, a column from the NCCARF Director; and an update from the Adaptation Research Networks.

Presentations including video (when available) and audio of all the NCCARF Seminars are made available on the website.

Presentations from all NCCARF events (including video, audio and powerpoint presentations) are made available on the website after the event.

NCCARF's products and publications are all directed towards capacity building in the research community and enhancing the ability of end-users to use research outputs.

2.6 Capacity building

2.6.1 Capacity building through participation in NCCARF research projects

To date, and together with the Fisheries Research and Development Corporation, which is a co-investor in the Marine Biodiversity theme, and the National Health and Medical Research Council, which is a co-investor in the Human Health theme, NCCARF has commissioned and is managing a research portfolio of more than 140 projects with a combined value of almost $40 million. Project teams comprise researchers from 33 universities, 61 Commonwealth, state and local government entities and 25 private institutions.

Clearly, the very act of undertaking these projects will build capacity. But almost of all of these projects employ early career researchers in some capacity. We surveyed five of the nine thematic areas in the Adaptation Research Grants Program and counted the number of early career researchers employed. The results are shown in Table 4. Although not all of these early career researchers are employed full-time, nevertheless their capacity to carry out research in climate change adaptation will be substantially enhanced.

Table 4: A snapshot of early career researchers involved in NCCARF Adaptation Research Grants Projects for five out of nine thematic areas

Thematic Area	Research Projects	Early Career Researchers	Average per Project
Emergency Management	11	23	2.1
Settlements and Infrastructure	15	38	2.5
Primary Industries	3	12	4
Freshwater Biodiversity	9	23*	2.8
Terrestrial Biodiversity	9	16*	2
TOTAL	47	112	2.5

*no data for one project

NCCARF has organised proposal-writing workshops in association with some of its Calls for Proposals. These are focussed mainly on the needs of 'non-standard' applicants coming from, for example, state and local government or the private sector. Generally, researchers in universities are well versed in how to write proposals, but this is not the case for NCCARF's important constituency of end users.

2.6.2 Capacity building through network activities

All Networks carry out substantial capacity building activities.

A flagship activity is the Adaptation College of the Social, Economic and Institutional Dimensions network. This is a group of 18 early career professionals from across Australia who work in research, government, and civil society, who were selected at the outset of the network by competitive process. They meet annually for one week to debate and discuss a single topic. In the past, they have considered such topics as barriers to adaptation, and

legal frameworks for adaptation. It is anticipated that this group will become key movers and shakers in adaptation action in Australia in the future. The learnings from this College, and the networks established, will sustain them throughout their career.

Other Networks have taken a more universal approach. Thus, the Settlements and Infrastructure Network's Early Career Researcher Workshops/Forums, held twice yearly with up to 30 participants, are open to all early career researchers on a first-come first-served basis. They provide opportunity to network, support and exchange ideas with fellow researchers in other Australian institutions and facilities. Abstracts and presentations are distributed.

Other activities include:

Marine Graduate School: The Marine Biodiversity and Resources Adaptation Research Network has run two intensive two-day graduate schools

Primary Industries Masterclass: The Primary Industries Network brings together early and mid-career researchers with producers at the coalface of adaptation to explore how research, policies and new knowledge could help the sector manage climate change risks and opportunities.

Freshwater Biodiversity Masterclass: This is a technical masterclass run by the Water Resources and Freshwater Biodiversity Network, covering topics such as climate projections and water scenarios; modeling climate change impacts on freshwater species; Bayesian networks for impacts modeling; science to policy; and science communication.

Writing Workshops: The Human Health Network has held two scientific writing workshops for post-graduate students and early career researchers.

Collectively the Networks have sponsored over 100 climate change adaptation scholarships, top up grants and travel bursaries representing over $1million of support for students, early career researchers and professionals, and synthesis research.

2.6.3 Capacity building at NCCARF conferences

NCCARF runs an annual conference. In odd years, this has been a relatively small event, because CSIRO runs a Greenhouse conference which addresses all areas relevant to anthropogenic climate change. However, in even years, we make it a major event, focussed exclusively on adaptation issues. It is designed to be a forum for practitioners and researchers to come together to understand the latest developments in adaptation, share learnings in policy and research, and network.

In 2010, the event was international, and we brought in over 25 speakers from overseas to address just over 1000 participants World leading adaptation experts such as Neil Adger, Suzanne Moser, Diana Liverman, Martin Parry and Stephen Schneider presented. Many overseas attendees paid for their own participation, and in the end there were representatives of 42 countries.

In 2012, we are running the annual conference as an Australia-focussed event, which speaks to the growth in Australian capacity to support such an event intellectually. We will have only two overseas speakers, one to update us in international policy developments in adaptation, and one who leads an institution similar to NCCARF in British Colombia. The conference will take place in Melbourne at the end of June. We received 530 abstracts from people seeking to make presentations, and to date have 450 registrations. Our target attendance is 800.

As part of these events, we seek to build capacity in early career practitioners and researchers by running an early career workshop on the day before the conference begins. We use this forum as an opportunity for participants to practise their presentations for the conference which follows, but also to share experiences and to network.

2.6.4 NCCARF Visiting Researcher program

NCCARF runs a Visiting Researcher program which brings two researchers each year into NCCARF for periods of between 3 and 10 weeks. With one exception, these have been overseas visitors. The benefit for the researcher is that it provides them with the space and time to pursue their research interests in a supportive environment. The benefit for NCCARF is that they are expected to participate in NCCARF activities, especially workshops and roadshows, and to contribute to the development of projects in the Synthesis and Integrative Research Program by contributing intellectual capital and expertise. Overall, it is an opportunity for NCCARF in particular and the Australian adaptation community in general to build capacity through interaction with different perspectives on adaptation.

Visiting Researchers to date have been:

- Declan Conway – University of East Anglia, UK
- Pauline Dube – University of Botswana
- Robert Glennon – University of Arizona, USA
- Wade Hadwen - Griffith University
- Saleemul Huq – International Institute for economic Development, UK
- Nova Mieskowska - Marine Biological Association UK
- Meg Parsons – University of Melbourne
- Jim Salinger – University of Auckland, New Zealand

2.6.5 Capacity building through leveraging on visiting researchers

NCCARF is proactive in ensuring that visiting researchers from overseas are exposed to the adaptation community in Australia, to their mutual benefit. Some examples follow.

Masterclass following the SREX Lead Author meeting

In May 2011, NCCARF was the local organiser for the Fourth Lead Author meeting of the IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX). This brought a number of international experts in adaptation and disaster management from overseas to the Gold Coast. NCCARF took the opportunity to organise a Masterclass in Brisbane which proved to be enormously popular. We had a capacity of 100, which was rapidly over-subscribed, with attendees from across Australia. This built capacity across the community of adaptation, from policy to research, and from professors to junior public servants. More information is available from http://www.nccarf.edu.au/masterclass

The NCCARF Emergency Management Network took advantage of the SREX Lead Author meeting to organise a workshop in Melbourne which brought together international experts in disaster management (who attended the SREX meeting) with state emergency services in Victoria.

Events organised around overseas visitors

NCCARF as a matter of course organises seminars around overseas visitors to Australia. In the early years, these were focussed on Brisbane, but increasingly as we become known nationally we organise events in other major cities of Australia. Recent seminars (2011 to date) are shown in Table 5.

Table 5: Seminars by overseas speakers 2011 - 12

Seminar details	Location(s)	Date
Sotiris Vardoularkis (UK Health Protection Authority) The first UK Climate Change Risk Assessment – findings and lessons learned for the health sector	Canberra and Brisbane	Apr-12
Robert Glennon (University of Arizona) Unquenchable: America's water crisis and what to do about it	Brisbane, Melbourne	Apr-12
Tom Wigley (NCAR, USA and University of Adelaide) Consistency between observed and model-predicted temperatures over the 20th century	Brisbane	Feb-12
Nick Klingaman (University of Reading) Will a warmer world change Queensland's rainfall	Brisbane	Feb-12
Lewis Ziska (US Department of Agriculture) Climate change and plant biology: Exploring the links to public health	Sydney	Dec-11
Diogo de Gusmao (Met Office Hadley Centre) The Science behind changing sea levels	Brisbane	Dec-11
Nick MacGregor (DEFRA) Conserving England's natural environment in a changing climate and Richard Fuller (University of Queensland) Climate adaptation for Australia's biodiversity	Brisbane	Nov-11
Nova Mieszkowska (Plymouth Marine Research Laboratory) The value of time-series data to track climate-driven changes to intertidal systems & provide policy-relevant evidence & advice'	Townsville	Oct-11
Roger Street (UK Climate Impacts Programme) Preparing for the Climate Challenge - a UK perspective	Canberra, Sydney, Brisbane, Melbourne	Aug-11
Rob Wilby (Loughborough University) Detecting and adapting to changing flood risk; policy and practice in the UK	Brisbane	Aug-11
Declan Conway (University of East Anglia) Adapting to Climate Change in China: Lessons for Research and Policy	Sydney, Melbourne, Adelaide, Brisbane, Hobart	Jun-11
Lisa Schipper (Stockholm Environment Institute) Adaptation 2.0 and the end of the honeymoon	Brisbane	May-11
Saleemul Huq (International Institute for Environment and Development, UK) The co-evolution of adaptation science and policy making	Canberra, Melbourne	Feb-11

NCCARF has worked with other organisations to ensure that maximum impact is achieved with overseas visitors. Thus, Rob Wilby gave seminars for NCCARF, but was actually a Visiting Fellow with VCCCAR, the Victorian Centre for Climate Change Adaptation Research. Similarly, Robert Glennon was a Visiting Researcher with NCCARF, but gave a seminar for VCCCAR in Melbourne. Where appropriate, visitors will be offered to end-user organisations as well as academic institutions. Thus, both Rob Wilby and Roger Street visited the Department of Climate Change and Energy Efficiency in Canberra, and Roger Street visited the State Government of New South Wales.

2.6.6 ARC funding for adaptation

One measure of developing capacity around adaptation would be the number of research grants funded in the area of adaptation by organisations other than NCCARF. We have looked at the portfolio of research projects funded by ARC which are relevant for adaptation. The numbers over the three years from 2009 to 2010 are:

2009 10 projects (of all types – Linkage and Discovery)

2010 9 projects

2011 41 projects

Clearly there has been a recent increase, which is encouraging but not conclusive: a sample of one year is insufficient, and there are many confounding variables.

2.7 Success of NCCARF in leveraging cash and in-kind support for research and engagement activities

A key NCCARF objective is to build and harness the capacity of the research and user community. To do this we have built on the Australian Government investment in NCCARF and leveraged additional funding, capacity and other resources. In addition we support the Networks' role in leveraging funds to support research and identifying the best research projects and teams,

Financial leveraging against the funds in the Adaptation Research Grants Program has been delivered both in cash and in-kind. Leveraging against the intellectual capital of NCCARF has largely been delivered through in-kind support and expertise. The Adaptation Research Networks have been instrumental in building research partnerships with other programs and institutions contributing in the area of adapting to climate change.

2.7.1 Australian Research Grants Program (ARGP)

Financial information on ARGP projects is provided in Table 6. Overall, of the $28 million in ARGP research funding awarded, NCCARF directly manages over $20 million which has attracted almost $32 million in cash and in-kind contributions. This direct and measurable amount represents additional investment of one and a half times government funds. This is a significant achievement from a national research community which had not previously focused on addressing adaptation to climate change.

Table 6: Breakdown of projects in the Adaptation Research Grants Program[1]

Research Theme	Qty	ARGP Cash ($)	Applicant Cash ($)	In-kind ($)	Project Total ($)
Emergency Management	11	1,770,322	240,038	1,855,137	3,865,497
Settlements and Infrastructure	15	5,203,207	1,522,032	5,796,827	12,522,066
Terrestrial Biodiversity	9	2,944,584	119,530	3,125,312	6,189,426
Primary Industries	3	704,190	300,000	937,377	1,941,567
Social, Economic and Institutional Dimensions	17	4,570,556	302,007	4,086,965	8,959,528
Freshwater Biodiversity	9	2,800,643	503,049	11,215,492	14,519,184
Indigenous Communities	8	2,586,853	111,000	1,833,133	4,530,986
NCCARF ARGP Totals	72	20,580,355	3,097,656	28,850,243	52,528,254
Human Health	7	2,817,884	N/A	N/A	2,817,884
Marine Biodiversity and Resources	17	4,878,549	N/A	N/A	4,857,549
ARGP Totals	96	28,276,788			

[1]Of the nine themes of research funded though the ARGP two are not administered by NCCARF. Information regarding leveraging in-kind and cash contributions through research in Human Health (NMHRC administered) and Marine Biodiversity and Resources (FRDC administered) is not included here.

2.7.2 Networks

The unique contribution of the Networks to both research and decision makers in Australia and internationally is more comprehensively covered elsewhere. Their impact and value is far greater than can be represented on a balance sheet and includes capacity building in researchers to recognise climate change as a factor that needs to be considered in most future research across many fields.

As shown in Table 7, networks leverage over 70% of their resources on average both in cash and in-kind contributions. Almost one quarter of the Networks' cash income is through direct contributions by hosting institutions and affiliations.

Table 7: Adaptation Research Networks: details of cash and in-kind funding, January 2009 to June 2013 ($)

Network	NCCARF cash funding	Host contribution		Other contributions		Total
		Cash	In-kind	Cash	In-kind	
Terrestrial biodiversity	1,454,544	130,000	1,160,000	0	1,120,000	3,864,544
Water resources & freshwater biodiversity	1,454,544	200,000	590,417	309,000	8,760,159	11,314,120
Marine biodiversity & resources	1,454,544	432,000	401,000	60,000	1,016,000	3,363,544
Settlements & infrastructure	1,625,456	640,000	3,336,000	100,000	282,800	5,984,256
Emergency management	745,456	200,000	695,180	200,000	0	1,840,636
Social, economic & institutional dimensions	1,367,272	313,200	1,314,856	0	326,928	3,322,256
Primary industries	1,220,000	400,000	530,000	0	1,020,000	3,170,000
Human Health	872,727	11,758	488,000	150,000	400,000	1,922,485
Total	10,194,543	2,326,958	8,515,453	819,000	12,925,887	34,781,841

2.7.3 NCCARF Partners

The Partners who have supported NCCARF from its inception have contributed in both cash and in-kind (see Table 8) Their early recognition of the need to understand and prepare for changes in the climate system has provided critical resources to develop broad and coordinated research programs. Their contributions have enabled them to establish leadership in this emerging field.

Table 8: Contributions from NCCARF partners

Partner Contribution: Cumulative	Cash ($)	In-Kind ($)
Qld Government	2,000,000	1,075,000
Griffith University	1,000,000	4,000,000
Macquarie University	1,000,000	3,000,000
Newcastle University	500,000	3,200,000
Murdoch University	250,000	750,000
University of Southern Qld	250,000	250,000
James Cook University	500,000	1,000,000
QUT	500,000	1,700,000
University of the Sunshine Coast	237,500	712,500
TOTAL	6,237,500	15,687,500

2.7.4 Leveraging of other in-kind contributions through NCCARF activities

The NCCARF Secretariat records leveraging gained through our activities in Synthesis and Integrative Research and Knowledge Communication activities as well as through managing activities such as the ARGP.

We have initiated and supported events that involve priority stakeholders from research, government and business interests. This has fostered greater connections between research producers and those who depend on access to the best knowledge available for their decisions. Our research and knowledge communication has involved high calibre input from national and international experts on adapting to climate change. NCCARF not only builds on the best knowledge available but contributes from the Australian perspective to international research and governmental forums.

NCCARF has gathered significant assistance during research calls, gaining technical assessments of research proposals by independent referees. The calibre of our Science Review Panel is an important resource in such a sparsely populated area as climate adaptation research and reflects our reputation for credible and independent science.

Table 9 excludes NCCARF Partner contributions (covered above). It shows a continued increase in leveraged contributions such that the first half of 2011 more than matches the amount leveraged in 2008-2009. More importantly it demonstrates practical and effective involvement in Australian climate adaptation research and its communication nationally and internationally.

Table 9: In-kind leveraging through various NCCARF activities (estimated)

Significant NCCARF Leveraging, 2008 to mid-2011 (SIR= Synthesis and Integrative Research Program)	$
Start of NCCARF (May 2008) to end 2009	
Emergency Management NARP	34,500
SIR Forest Vulnerability Assessment	46,375
Social, Economic and Institutional Dimensions Workshop	43,500
SIR Workshop	25,000
Settlements and Infrastructure NARP	17,500
Terrestrial Biodiversity NARP	13,175
Marine Biodiversity and Resources NARP	12,500
Workshop	12,500
SIR Workshop	11,000
Human Health NARP	10,000
Marine Report Card	3,500
TOTAL	229,550
January – December 2010	
Coastal Ecosystems Stakeholders Workshop	6,500
2010 Conference	180,000
Glenelg adaptation planning workshop	33,500
Natural Disasters and Adapting to Climate Change-Book	17,000
Seminars	15,750
Phase 2 Synthesis and Integrative Research Program	12,750
Freshwater NARP	12,500
Settlements and Infrastructure NARP	10,250

FORNSAT	7,000
TOTAL	295,250
January – June 2011	
2011 Conference, Cairns	50,000
Great Barrier Reef (GBRMPA) Workshop, Cairns	71,000
ACELG Local Government Round-table	50,000
Natural Disasters and Adapting to Climate Change-Book	25,460
Indigenous Communities NARP	25,000
SIR Coastal Ecosystems Stakeholders Workshop	16,750
SIR Regional Analogues Stakeholder interviews and workshops	10,625
2011 FORNSAT	9,000
ARGP Principal Investigator Meeting - Health	5,500
Local Government Web Portal Reference Panel	5,250
TOTAL	314,905

2.8 The Next Phase of NCCARF

NCCARF is well situated and structured to fulfil the knowledge needs of practitioners. It harnesses the best capabilities throughout Australia's research institutions. It provides a bridge between decision-makers (in businesses, governments and elsewhere) and leading climate adaptation researchers. In the First Phase of the Facility, we have built the institutional base and are delivering a major portfolio of research outputs and applications to equip decision-makers with the knowledge and tools they need.

By clustering the capacity of institutions across the nation, NCCARF supports knowledge generation and adoption more effectively than if these activities were carried out in isolation. NCCARF's focus on engaging end-users throughout the life cycle of projects and on the delivery of useful information ensures that the benefits of research are maximised.

The First Phase of NCCARF ends on June 30 2013 and the NCCARF Board is seeking additional and new funding to extend the lifespan of the Facility for a further 7 years. This will enable results from the First Phase to be delivered to end-users, together with support in using the research outputs. Most products from the First Phase of the Facility will be delivered in early 2013. This provides little time for communication activities related to research products and little time to ensure uptake by relevant bodies. Without such activities it is likely that many research outputs will not reach their target audiences and the significant investment in generating research will be wasted.

Of course, the First Phase of NCCARF has developed the very basic and essential research outputs for adaptation. Much remains to be done, and an ambitious program of research is planned for the Next Phase.

The Board intends to alter the funding model for NCCARF research to ensure that research effort can be specifically targeted at the needs of end-users and delivered within required timeframes. The Board is seeking a substantial funding contribution from a wider range of partners including Commonwealth, States and Territories, Universities, Business and Industry. This will change the balance of funding to be different from the First Phase and will be reflected in the governance and the operational activities of a future Facility.

NCCARF
National
Climate Change Adaptation
Research Facility

Appendix A

APPENDIX A: NCCARF PROJECTS RELEVANT TO DRAFT REPORT

NCCARF Project	Relevant report chapters
IClimate Project – a searchable database on climate change impacts and adaptation in Australia - Elvira Poloczanska, CSIRO	6
Adaptation of the built environment to climate change induced increased intensity of natural hazards David King James Cook University	7
A spatial vulnerability analysis of urban populations to extreme heat events in Australian capital cities Margaret Loughnan Monash University	7
Developing an Excel spread sheet tool for local governments to compare and prioritise investment in climate adaptation - Stefan Trueck, Macquarie University	7, 10
Displaced twice? Investigating the impact of Queensland floods on the wellbeing and settlement of a cohort of men from refugee backgrounds living in Brisbane and Toowoomba - Ignacio Correa-Velez, La Trobe University	7
Living Change: Adaptive housing responses to climate change in the town camps of Alice Springs - Ralph Horne, RMIT University	7, 8
Development of tools that allow local governments to translate climate change impacts on assets into strategic and operational financial and asset management plans - Jacqueline Balston, University of South Australia	7
Australia's country towns 2050: what will a climate adapted settlement pattern look like? - Andrew Beer, Flinders University	7
Reforming Planning Processes Trial: Rockhampton 2050 Penelope Fry, Rockhampton Regional Council	7, 8
What would a climate-adapted Australian settlement look like? David Griggs, Monash University	7
Strata Title in a world of climate change: Managing greater uncertainty in forecasting and funding common property capital expenditure - Chris Guilding, Griffith University	7, 8
Limp, leap or learn?: Developing a legal framework for adaptation planning in Australia - Jan McDonald, University of Tasmania	7, 8
Past, present and future landscapes: understanding alternative futures for climate change adaptation of coastal settlements and communities - Phil Morley, University of New England	7, 8
Coastal urban climate futures in SE Australia: from Wollongong to Lakes Entrance. - Barbara Norman, University of Canberra	7
A Framework for Adaptation of Australian Households to Heat Waves - Wasim Saman, University of South Australia	7
A model framework for assessing risk and adaptation to climate change on Australian coasts - Colin Woodroffe, University of Wollongong	7, 8

NCCARF Project	Relevant report chapters
The legal, institutional and cultural barriers to adaptation to sea-level rise in Australia - Jon Barnett, University of Melbourne	7, 9
Developing adaptively: The role and capacities of private sector development institutions in urban climate change adaptation, - Jago Dodson, Griffith University	7, 9
An assessment of Australia's existing statutory frameworks, associated institutions, and policy processes: do they support or impede national adaptation planning and practice? - Karen Hussey, Australian National University	7, 9
Costs and coasts: an empirical assessment of physical and institutional climate adaptation pathways - Ryan McAlister, CSIRO	7, 9
Climate change impacts on workplace heat extremes: health risk estimates and adaptive options - Elizabeth Hanna, Australian National University	8, 11
Pathways to climate adapted and healthy low income housing - Guy Barnett CSIRO Climate Adaptation Flagship	8
Every state for themselves? Learning from cross-border regulatory instruments to support and promote climate change adaptation in Australia - Wendy Steele, Griffith University	9
Supporting evidence-based adaptation decision making in Australia's states and territories - Investigators to be announced June 2012	9
Learning from the past, adapting in the future: identifying pathways to successful adaptation in Indigenous communities - Meg Parsons, University of Melbourne	10
Recovery from disaster experience: its effect on perceptions of climate change risk and on adaptive behaviours to prevent, prepare, and respond to future climate contingencies - Helen Boon, James Cook University	10
Harnessing private sector logistics for emergency food and water supplies in flood prone areas - Leo Dobes, Australian National University	10
The right tool for the job: Achieving climate change adaptation outcomes through improved disaster management policies, planning and risk management strategies - Michael Howes, Griffith University	10
Exploring the adaptive capacity of emergency management using agent-based modelling - Lin Padgham, RMIT University	10
Public understandings, risk perceptions, and responses to climate change and associated natural disasters - Joseph Reser, Griffith University	10
Learning from experience: Historical case studies and climate change adaptation (synthesis report) - Anthony Kiem, University of Newcastle	10
Historical Case Studies: Adaptation lessons from Cyclone Tracy - *John McAneney* Macquarie University	10
Historical Case Studies: The 2008 floods in Queensland: A case study of vulnerability, resilience and adaptive capacity - Armando Apan, University of Southern Queensland	10

NCCARF Project	Relevant report chapters
Historical Case Studies: Adaptation lessons from Cyclone Tracy Part II – the institutional response and Indigenous experience of Cyclone Tracy - Katharine Haynes, Macquarie University	10
Storm Tides, coastal erosion and inundation - Rodger Tomlinson, Griffith University	7,10
Historical Case Studies: Impacts and adaptation response of infrastructure and communities to heat waves - the southern Australian experience of 2009 - Jim Reeves, Queensland University of Technology	10
Historical Case Studies: East Coast Lows and the Newcastle-Central Coast Pasha Bulker Storm - Garry Willgoose, University of Newcastle	7,10
Historical Case Studies: Drought and the future of small inland towns - Anthony Kiem University of Newcastle	7,10
Historical Case Studies: Resilience and water security in two outback cities – Glenn Albrecht, Murdoch University	10
Flooding in Australia: Damage to buildings during the 2010-2011 Eastern Australia flooding events - Matthew Mason, Macquarie University	10
Living with floods: key lessons from Australia and abroad - Karen Hussey Australian National University	10
Extractive resource development in a changing climate: learning the lessons from recent weather events in Queensland, Australia - Vigya Sharma, University of Queensland	10
Investigating factors that inhibit and enable adaptation strategies following the 2010/11 floods, David King - James Cook University	10
Beach and surf tourism and recreation in Australia: vulnerability and adaptation - Mike Raybould, Bond University	11
Climate change adaptation - building community and industry knowledge - Jenny Shaw WA Marine Science Institution	11
Estuarine and nearshore ecosystems – assessing alternative adaptive management strategies for the management of estuarine and coastal ecosystems - Marcus Sheaves, James Cook University	11
Determining future invasive plant threats under climate change: an interactive decision tool for managers - Leslie Hughes, Macquarie University	11
Adapted future landscapes – from aspiration to implementation - Wayne Meyer, University of Adelaide	11
The role of refugia in ecosystem resilience and maintenance of terrestrial biodiversity in the face of global climate change - Stephen Williams, James Cook University	11

NCCARF Project	Relevant report chapters
Joining the dots: integrating climate and hydrological projections with freshwater ecosystem values to develop adaptation options for conserving freshwater biodiversity - Leon Barmuta and Peter Davies, University of Tasmania	11
Adapting to climate change: a risk assessment and decision framework for managing groundwater-dependent ecosystems with declining water levels - Jane Chambers, Murdoch University	11
Displaced twice? Investigating the impact of Queensland floods on the wellbeing and settlement of a cohort of men from refugee backgrounds living in Brisbane and Toowoomba - Ignacio Correa-Velez, La Trobe University	11
Changing heat: direct impacts of temperature on health and productivity – current risks and climate change projections - Keith Dear, Australian National University	11
Health impacts of climate change on Indigenous Australians: identifying climate thresholds to enable the development of informed adaptation strategies - Donna Green University of New South Wales	11
Dengue transmission under climate change in Northern Australia: linking ecological and population based models to develop adaptive strategies - David Harley Australian National University	11
Climate change and rural communities: Integrated study of physical and social impacts, health risks and adaptive options - Anthony McMichael, Australian National University	11
Projection of the impact of climate change on the transmission of Ross River virus disease - Shilu Tong, Queensland University of Technology	11
Assessing the potential for, and limits to, insurance and market-based mechanisms for encouraging climate change adaptation - John McAneney, Macquarie University	11
Enhancing the adaptive capacity of small-to-medium enterprises to climate change and variability - Natasha Kuruppu, University of Technology Sydney	11
Economics: Economics of government as insurer of last resort for climate change adaptation - Leo Dobes, Australian National University	11
Systems thinking: Overcoming challenges for decision making about climate change adaptation - Kambiz Maani, University of Queensland	11
Communication: Climate change adaptation in the boardroom - Gareth Johnston, Future Ready Pty Ltd	11
Adaptation in industry and business: Climate change adaptation – a framework for best practice in financial risk assessment, governance and disclosure - Jason West, Griffith University	11