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Research Facility

Synthesis and Integrative Research
Final report

Leading adaptation practices and support strategies for Australia: An international and Australian review of products and tools

Robert Webb and Jie-lian Beh

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Australian National University

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The role of NCCARF is to lead the research community in a national interdisciplinary effort to generate the information needed by decision makers in government, business and in vulnerable sectors and communities to manage the risk of climate change impacts.

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Disclaimer

The views expressed herein are not necessarily the views of the Commonwealth or NCCARF, and neither the Commonwealth nor NCCARF accept responsibility for information or advice contained herein.

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Glossary

For the overall climate change adaptation context the report follows the high level definitions used in the 2007 Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (Parry et.al. 2007, p.6):

Adaptation is the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity.

Vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, the sensitivity and adaptive capacity of that system.

For some other frequently used terms in the report the following provide brief definitions:

Adaptation decision entry points: the stages in a sector's or organisation's business processes at which there is likely to be a strategy, plan or decision impacted by climate change.

Adaptation products: any resource (currently available or planned) designed to support end users' adaptation planning and decision making processes (e.g. adaptation process guidelines and standards, supporting methods and analytical tools, knowledge and data sources, policy guidance and directions); as well as supporting services (e.g. training, skilling, advice, networks and communities of practice). Its physical manifestation may typically be a web-based portal, document, process or tool, or an interpersonal/'face to face' supporting service.

Adaptation product functions: a product can have one function or multiple functions that meet end user needs. Some products (e.g. adaptation process guide; analytical tools) typically have one main function; other products (e.g. portals) have multiple functions.

Adaptation tools: sometimes used interchangeably with the term 'adaptation products'. However in this report it is used to denote a subset of adaptation products that tend to be more mechanistic or automated in their application as in methodological, modelling or analytical tools where input information is translated by a well-defined and standard process into outputs.

Adaptation portal: a web-based product whose overall function is to provide and guide the user via a single initial access point to a range of adaptation related functions and information (e.g. adaptation process guidance, data, tools, knowledge sharing functions).

Climate impacted systems: socio-economic-environmental systems vulnerable to the impacts of climate change including natural systems (e.g. water, natural environment) and human systems (e.g. built environment, industries, human health and wellbeing).

Climate impacted sectors: the sectors with organisational units that make adaptation decisions (e.g. governments at all levels, private industry sectors, community and non-government sectors). Typically an organisation in any of these sectors will need to take decisions that may be impacted by a number of climate impacted systems sometimes with complex interdependencies.

Communities of practice: networks of adaptation practitioners who interact and engage in a process of collective learning on adaptation practices

Sector/organisational business processes: the way a sector, or organisation within a sector, thinks about and describes the processes it carries out to achieve its objectives, including the interdependencies between the processes.

List of abbreviations

ACE CRC – Antarctic Climate and Ecosystems Cooperative Research Centre

ACOSS – Australian Council of Social Service

AGIC – Australian Green Infrastructure Council

AGO – Australian Greenhouse Office

AGD – Attorney General's Department (Australian Government)

ALGA – Australian Local Government Association

ANCAS – Australian National Climate Adaptation Service

ANDS – Australian National Data Service

ANU – Australian National University

AR5 – Fifth Assessment Report of the Intergovernmental Panel on Climate Change

ASBEC – Australian Sustainable Built Environment Council

AURIN – Australian Urban Research Infrastructure Network

BOM – Bureau of Meteorology

BRRT – Building resilience rating tool (Insurance Council of Australia funded)

CADP – Coastal Adaptation Decision Pathways Program

CBA – Cost Benefit Analysis

CCRSPI – Climate Change Research Strategy for Primary Industries

ClimDDIR – Climate Model Downscaling Data for Impacts Research Project

CMA – Catchment Management Authority

COAG – Council of Australian Governments

CSIRO – Commonwealth Scientific and Industrial Research Organisation

DAFF – Department of Agriculture, Forestry and Fisheries (Australian Government)

DCCEE – Department of Climate Change and Energy Efficiency (Australian Government)

DEFRA – Department of Environment, Food and Rural Affairs (UK Government)

DSEWPaC – Department of Sustainability, Environment, Water, Population and Communities (Australian Government)

EC – European Commission

EU – European Union

GA – Geoscience Australia

GBCA – Green Building Council of Australia

GRDC – Grains Research and Development Corporation

HCCREMS – Hunter and Central Coast Regional Environmental Management Strategy

ICA – Insurance Council of Australia

ICLEI – International Council for Local Environmental Initiatives

IGCC – Investor Group on Climate Change

IPCC – Intergovernmental Panel on Climate Change

LAPP – Local Adaptation Pathways Program

LAPS – Leading Adaptation Practices and Support Project

LGAQ – Local Government Association of Queensland

MCA – Multi-criteria Analysis

NARCLiM – NSW/ACT Regional Climate Modelling Project

NATSEM – National Centre for Social and Economic Modelling

NCCARF – National Climate Change Adaptation Research Facility

NGO – Non-government Organisation

NIEIR – National Institute of Economic and Industry Research

NIWA – National Institute of Water and Atmospheric Research (NZ)

NRM – Natural Resource Management

NSWOEH – New South Wales Office of Environment and Heritage

NZMfE – New Zealand Ministry for Environment

OECD – Organisation for Economic Co-operation and Development

PROVIA – Programme of Research on Climate Change Vulnerability, Impacts and Adaptation (United Nations Environment Program)

RDA – Regional Development Authority

RIRDC - Rural Industry Research and Development Corporation

RMIT – Royal Melbourne Institute of Technology

ROC – Regional Organisation of Councils

SECCCA – South East Councils Climate Change Alliance

UKCIP – United Kingdom Climate Impacts Programme

UNDP – United Nations Development Program

UNEP – United Nations Environment Program

UNFCCC – United Nations Framework Convention on Climate Change

Uni SA – University of South Australia

UNSW – University of New South Wales

VCCCAR – Victorian Centre for Climate Change Adaptation Research

WALGA – Western Australian Local Government Association

ABSTRACT

Australia's adaptation effort is at a watershed. On the one hand, recent growth in experience and research is supporting progress by early adopters, especially those who have benefited from government seed funding; and there is a gradual increase in private as well as public sector interest across several sectors. On the other, this has not yet brought about systemic change, there has been limited movement from assessment to action, and many of the initial government support programs have reached or are reaching their end point. This places a premium on learning from experience to date, and developing and promulgating good products and services to support organisations and decision makers in their adaptation practice. Otherwise progress will be limited and the gains to date could easily be lost. This report addresses the need for a more intentional approach to providing practical support.

It introduces a structured framework and methodology to analyse end user needs and currently available support products and services. This is based on three interrelated lines of project research:

1. the distillation of good adaptation principles based on adaptation research and practice;
2. the clarification of end user needs based primarily on stakeholder consultation across many sectors, supplemented by the literature, which in this area is fairly sparse; and,
3. a review of current international and Australian adaptation support products.

Drawing on extensive stakeholder engagement through both consultation and workshops, it concludes that there is a significant gap between user-needs and what is currently available. This is partly related to the nature and content of the products themselves, but also to lack of guidance on product availability, selection, and appropriate use, and limited user confidence in current process and data products. This is compounded by the fragmentation of effort in developing and supporting adaptation support products and services.

The report proposes a number of future adaptation support strategies to address these issues. The product strategies especially address three identified components of user need, each of which requires specific but complementary products:

1. entry level guidance,
2. more complex decision making guidance, and
3. adaptation process assurance, benchmarking, and review.

They also reflect the need for a number of common or 'core' products to be developed and maintained nationally, and the opportunity to make progress in this direction by building on some current initiatives; whilst at the same time stressing that it is crucial to encourage development and delivery of other products that can draw on these common resources, but are customised to the differentiated needs of various sectors, regions and jurisdictions.

A number of enabling strategies are identified to enhance user capabilities and confidence, and the sources of advice in selection and use of products and good

practices. Finally, the report addresses the need for a national entity to coordinate and support delivery of the 'core' products and services and to facilitate the decentralised development and delivery of customised products and services by other providers.

The extensive stakeholder engagement and high level of consensus provides confidence in the diagnosis and the need for significant intervention in this area. The proposed strategies and next steps provide a manageable pathway to a coherent and cost-effective response.

EXECUTIVE SUMMARY

Adaptation practice – addressing a significant gap

The need to address climate change adaptation is growing internationally and in Australia. There has been a significant investment in adaptation research, risk assessment and planning in Australia, especially since 2007, with substantial support from government funding. This has led to a strong growth of adaptation knowledge and practical experience, which has confirmed that adaptation planning and decision making introduce new and complex challenges. These arise from the need to address not only traditional climate variability but also increasing current climate risks, and even greater future risks. Additional complexities arise from the pervasiveness of climate impacts and responses across natural and human systems, sectors and scales, the need to consider a range of time horizons, and the levels of uncertainty often involved.

However the development of products to support adaptation practice and decision making is currently highly fragmented in Australia, leading to some confusion amongst end users and insufficient critical mass and continuity of resourcing to provide sustained product support and improvement. For public, private and community sector organisations grappling with adaptation decisions there is a significant support gap, and an urgent need for products that will provide better guidance and more confidence. There is currently no national strategy to achieve this. This project has carried out both research and strategy development to address this need.

The timing for a more coordinated strategic approach is right. There is potential to distil the learning from the investment of recent years. There are also individual product initiatives under way or planned which, if positioned and enhanced within a more intentional overall strategy, could collectively make a significant difference.

The timing is also critical. Australia's adaptation effort is at a watershed. On the one hand the recent growth in experience and research is supporting progress by early adopters and especially those who have benefited from government seed funding. On the other, this has not yet brought about systemic change. In a future with more constrained government funding and most organisations still at first base, the foundation built to date could easily be lost. There is an urgent need to develop and promulgate good practices and products to better support organisations and decision makers.

Research findings

The product strategies proposed in the report have been developed from three interrelated lines of research:

1. *Good adaptation principles* have been identified, based on the growing body of adaptation research and practical experience, including the stakeholder consultation carried out for this project. An effective practice support strategy should reflect these principles.

2. *End user needs have been clarified, based primarily on stakeholder consultation and workshops supported where available by the rather sparse literature in this area.* Informed by this, and an analysis framework and methodology developed by the project, the following components of end user needs were identified; each of which requires a distinctive response:
    - S*ocietal and political readiness* to address adaptation issues and associated social change processes. Whilst not the primary focus of the project, it is of great importance in setting the context for the other three components
    - *Entry-level guidance* for organisations just embarking on the adaptation journey;
    - *More complex decision making guidance* leading to investment and action
    - *Adaptation process assurance, benchmarking and review*.

    The last three of these in particular are amenable to the provision of process support, data, and knowledge sharing products. The consultations, workshops and literature revealed significant current support issues and gaps from an end user perspective, including the need for:
    - better guidance on adaptation process and data product availability, and on appropriate selection and use of products to meet specific needs;
    - more confidence in whether process products reflect good practices; and in the reliability of, and ability to properly interpret key data sources;
    - available and sustained support in product selection and use, including access to independent advice and assurance
    - knowledge on who else has addressed similar adaptation issues, in order to exchange experience, insights and advice

    It also emerged that in meeting these needs some elements of products are likely to be common or 'core' across sectors and regions, whilst others are highly differentiated.

3. *Adaptation support products currently available or planned were identified, categorised and reviewed*. More than 300 international and Australian products have been recorded in a database, under the overall categories of adaptation 'process support' products, 'data' products, and integrating 'knowledge portal' products. Review of the products helped identify the range of user support functions that can potentially be provided. However it also confirmed that, at least in Australia, there has been a great deal of isolated product development, and the fragmentation of effort means that products often have limited lives, and lack sustained user support and continuous improvement.

From the above analysis it became clear that there is a significant need across sectors for common or 'core' products that could be developed, supported and maintained nationally. If done well, such an approach would provide greater assurance to end users – the critical mass to enable continuing support and improvement, and be more cost-effective, avoiding unnecessary duplication of effort.

However, it was equally clear that the intrinsic diversity of business objectives, business processes and institutional arrangements across sectors, regions and jurisdictions means that the common products will often require translation to these differentiated contexts. Consequently, strategies need to cater for both common or 'core' products, and ancillary products that draw on these, but which can also be tailored and enhanced for particular audiences.

Proposed strategies

Based on the detailed findings, strategies have been proposed to address the needs and current gaps identified. These strategies were progressively developed and reviewed through the stakeholder consultation and workshop processes. A review of current products and initiatives against the end user needs and criteria, also helped identify certain products that have the potential to be built on, in implementing the proposals. As summarised below (reference is to relevant strategy numbers in Chapters 3 through 6), the strategies are that:

- *Multi-function knowledge portals* with flexible entry points and easy navigation be central to adaptation support product strategies (Strategy 3.1).
- Portals customised to the *differentiated needs of specific end user groupings* (e.g. sectors, regions, jurisdictions) be encouraged as a critical element of product and service delivery, though in a way that progressively minimises duplication and shares knowledge by drawing on and contributing to a number of *nationally supported common or 'core' products and services*; and a *National Adaptation Portal* be developed to include such common or 'core' products for delivery to other providers as shared services, as well as direct to end users where appropriate (Strategies 3.2, 3.3, 3.4).
- *Nationally supported 'adaptation process' support products* be developed to meet *entry-level guidance*, *complex decision making guidance and assurance needs*, building on existing and already planned products wherever possible (specific proposals are included in the report), and also be used to inform sector-specific guidelines (Strategies 4.1, 4.2); and that these be delivered through the National Adaptation Portal along with other priority knowledge sharing functions (also identified in the report).
- Projects be initiated to *distil emerging best practices* for use in future adaptation initiatives and process products. Three priority topics are proposed (Strategy 4.3).
- There be more systematic identification and coverage of, provenance over, and access to, *key adaptation-related data sets and data bases,* especially those that are identified as high priority for national support. This includes the next wave of climate and socio-economic information and scenarios; hazard, exposure and impact data; and risk, vulnerability and adaptation options information (Strategies 4.4 to 4.7)
- Future *adaptation knowledge portal design and development* (including the National Adaptation Portal) be enhanced by collaboration across several current and planned portal initiatives identified in the report (Strategies 4.8, 4.9). The project has run a first workshop of leaders from relevant initiatives, where a number of collaboration opportunities were identified.

- A *mapping and register of current and planned adaptation products* be developed and maintained, building on the product database developed by the project, and drawing on the experience of the Australian National Data Service. This will facilitate product awareness, access and selection by end users, and re-use and collaboration between product and service providers (Strategies 4.10, 4.11). In conjunction with other strategies, this will also help confirm readily available sources for inclusion in the National Adaptation Portal (Strategy 4.12).
- A *national coordinating capability* be established, starting with a multi-stakeholder (public, private and community sector) National Adaptation Forum, and preferably evolving towards a more formalised and sustained Australian National Climate Adaptation Service (ANCAS) entity. This will deliver the national common or 'core' products and services; develop relationships and shared activities with other national/sectoral/jurisdictional organisations, and with international counterparts; and foster ongoing learning, good practices and sustained support over time (Strategies 5.1 to 5.4). Coordination options are discussed in the report and the project is facilitating a series of discussions with public and private sector organisations who have expressed interest in facilitating the first stages of such an approach in order to progress priority strategies.
- *Enabling initiatives* be developed to support knowledge broking activities at national and other levels (e.g. regional and sectoral), communities of practice, skilling, quality assurance and accreditation approaches; mainstreaming of adaptation products and processes into ongoing business activities and government agencies; and stronger linkages between adaptation practice, policy and research, supporting greater consistency of adaptation policy and approaches across government agencies and levels (Strategies 5.5 to 5.10).
- *Future research* be considered in a number of areas to support implementation of the proposed strategies (Strategy 6.1).

Whilst the proposed strategies are specific to Australia, the analytical framework and approaches developed by the project could also be of value in more detailed analysis of needs and products for specific end user segments, and potentially to other countries addressing adaptation support strategies.

Next steps to progress the proposed strategies are identified, including further promulgation of the findings. Subject to support and commitment, and confirmation of relevant roles and responsibilities, business cases and implementation planning could progress for priority initiatives within an overall program approach (Chapter 7). This would include a process of continuing engagement and co-design with stakeholders and end users, as commenced by the project.

The extensive stakeholder engagement and high level of consensus that emerged during the project provides confidence in the diagnosis and the need for significant intervention in this area. The proposed strategies recognise the need to meet highly differentiated end user needs, whilst at the same time gaining the benefits of shared development and support, and taking the opportunity to build on existing products and approaches wherever possible. They provide a manageable pathway and a coherent and cost-effective response to a significant gap in adaptation practice capability and support.

1. CONTEXT AND OBJECTIVES

1.1 Project background and objectives

This report covers the findings and recommendations of the 'Leading adaptation practices and support strategies (LAPS) project. It was led by the Australian National University (ANU) and funded from February to November 2012 by the National Climate Change Adaptation Research Facility (NCCARF) under the Synthesis and Integrative program (NCCARF 2012a).

Climate change adaptation is a significant issue for Australia (Palutikof 2010, Cleugh et al. 2011) with an increasing urgency to respond to the climate trends and extremes already becoming evident (Steffen 2011). There are significant vulnerabilities in water supply and quality, natural ecosystems, the built environment (human settlements and infrastructure), many industry sectors and human health and wellbeing.

Organisations increasingly need to take climate change into account in planning and decision making. Bringing the climate dimension in adds a number of characteristics that in combination make adaptation decision making distinctive, novel and challenging. These include:

- the pervasiveness of climate impacts on natural and human systems, leading to new and complex interdependencies across sectors;,
- the need to consider the range of time and spatial scales at which climate impacts, and responses are likely to play out;
- significant uncertainties, especially for medium and longer-term decisions; and,,
- current institutional arrangements, including resources, roles and responsibilities, which are often not well aligned to the new challenges.

Some sectors, such as water and agriculture have significant experience in handling climate variability. There is growing experience in handling current day risks that appear to be increasing due to the early signs of climate change (e.g. in hazard and emergency management). There is limited experience in managing the far more significant and widespread risks associated with medium to longer term climate change.

The new complexities require effective adaptation support products for organisations to use at all stages in the decision making process, from planning through to assessment, decision making, implementation and review. In this report, we use the term 'product' to mean any resource (currently available or planned) designed to support end users' adaptation planning and decision making processes (e.g. adaptation methodological and process guidelines and standards, supporting methods and analytical tools, data sources, knowledge sources, and in some cases policy guidance and directions); as well as supporting services (e.g. training, skilling, advice, networks and communities of practice). Its physical manifestation may typically be a web-based portal, document, process or tool, or an interpersonal/'face to face' supporting service.

Whilst there has been significant activity in developing such products in Australia in recent years, this effort has often been fragmented and there is a significant gap in

meeting needs from an end user perspective (e.g. Preston and Kay 2010, NCCARF and ANU 2012, Webb 2012).

It was in this context that the primary outcomes for the project were to recommend a strategy to provide enhanced climate adaptation support products and tools for use within Australia, in a way that reflects leading adaptation practices; and to identify complementary strategies to ensure effective uptake and use of products. The underlying objective is to develop enhanced capabilities to respond to climate change risks and opportunities.

To that end, the project actively engaged with a wide range of stakeholders including end users (decision makers, policy makers, practitioners and advisers), sector representative organisations, and product providers. This included all levels of government (national, state, territory, regional and local), private sector industry and professions, community and non-government organisations, consultants and researchers. Internationally, it especially included key adaptation support product and service delivery organisations.

1.2 The Australian context

There has been significant investment in adaptation research, risk assessment and planning in Australia especially since 2007 following the Commonwealth Government's Adaptation Framework (Commonwealth of Australia 2007) and related federally funded programs (DCCEE 2012a, b), as well as initiatives by state, territory and local governments, and parts of the private sector. This has included funding through the Department of Climate Change and Energy Efficiency (DCCEE) for the National Climate Change Adaptation Research Facility (NCCARF 2012b), the CSIRO Climate Adaptation Flagship (CSIRO 2012a) and directly to a number of project and program initiatives (e.g. the Local Adaptation Pathways Program, the Integrated Assessment of Human Settlements Program, and most recently the Coastal Adaptation Decision Pathways Program (DCCEE 2012c)). There has been additional support through other government agencies (e.g. Department of Agriculture, Forestry and Fisheries (DAFF) and the Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC)), and several sectoral research funding bodies (e.g. the National Health and Medical Research Council, Primary Industry Research and Development Corporations). In addition, some sectors (e.g. water, agriculture) have a long tradition of managing for climate variability which can provide a strong base for considering more substantial impacts of climate change (Dovers 2009).

The last five years has been a period of innovation and learning, reflected in a growing contribution to national and international knowledge and experience, as evidenced by the vitality and variety of Australian contribution to the major national and international adaptation conferences and publications in recent years. Work is starting to synthesise some of the findings from this investment (e.g. the NCCARF Synthesis and Integrative program (NCCARF 2012a) and the CSIRO Evaluating Adaptation Pathways project (Stafford Smith 2012)). However, as assessed by practitioners and other stakeholders in a recent submission to the Productivity Commission (Webb 2012), translation of the above investment into strategy development and proactive response has been patchy. Also the historical emphasis has been on managing climate as a key driver of natural

resource inputs and variability (hence the emphasis on water and agricultural sector impacts), and on current climate hazard risks, rather than the more complex, interdependent and uncertain future climate threats.

The initial emphasis for federal and state funding was to support local government planning, but activity has also increased in the private and most recently, community sectors. The range of sector submissions to a recent Productivity Commission inquiry into barriers to adaptation (Productivity Commission 2012a) is a measure of this widening interest in Australia. Meanwhile, responses have continued to be developed in areas of traditional climate sensitivity (e.g. water and agriculture); though these are often contested as the combination of climate and other pressures challenge traditional approaches, such as in recent water reform and planning for the Murray Darling Basin (Connell and Grafton 2011).

A number of adaptation support products have been developed and used in this period. This has been good for initial innovation and buy-in, but now runs the risk of being too fragmented and unsustainable. Several products have foundered for lack of critical mass and sustained resourcing. Evidence from a range of stakeholders is that the level of adaptation risk management, response and decision making confidence is generally low and patchy in both the public and private sectors and that adaptation practice capability is not yet effectively embedded in normal business processes (Webb 2012). A central challenge is how to consolidate effort where this is likely to be most effective, whilst still meeting the genuine differentiated needs of end users.

At the same time, government funding for adaptation is tightening, with most of the federal DCCEE funded adaptation program funding (DCCEE 2012 a, b) either finalised or drawing to a close. A Commonwealth Government adaptation policy review is currently under way, including the Productivity Commission inquiry. Several state and territory adaptation policies and strategies are also in flux with significant changes in elected governments in recent years. A Council of Australian Governments (COAG) Select Council on Climate Change was established in 2012 in order to, amongst other things, develop national adaptation priorities and work plans (Commonwealth of Australia 2012a); but it is too early to know how this may support significant adaptation initiatives.

Adaptation effort in Australia is therefore at a watershed. On the one hand the strong growth in experience and research is supporting progress by early adopters and especially those who have benefited from government seed funding. On the other, in a future with more constrained government funding and with most organisations still at best at initial stages in adaption planning, this foundation could easily be lost. This places a premium on developing and promulgating good practices and relevant products to better support organisations and decision makers. There is currently no national strategy to achieve this.

The project addresses this issue. It also has the potential to contribute to a broader agenda in which practice, research and policy are more closely linked, especially drawing on the growth of practical adaptation experience in Australia over the last 5 years. Thus one of its origins was a 2010 NCCARF/ANU sponsored workshop (NCCARF & ANU 2012) in which representatives of 20 significant regional and local

adaptation projects from around Australia and across many sectors, were brought together to distil significant challenges and emerging good practices based on experience to date. The participants were selected to bring practice, policy and research perspectives. The collective findings were validated in a follow-up process with all participants and also compared to evidence from the literature (Webb et al. 2013). Amongst other things this confirmed the importance of developing more effective adaptation practice capability.

This initial workshop led to a more recent (May 2012) NCCARF/DCCEE/ANU sponsored workshop, including a wide range of private, public and community sector representatives as well as consultants and researchers. The focus was on practical experience and research informing current adaptation policy development. One of the conclusions was that a key priority for governments (Commonwealth, state and territory) should be to enhance adaptation capability through more effective consolidation and sharing of knowledge and experience (Webb 2012).

Consistent with these other initiatives this project has engaged widely with those in practice, research and policy roles, both individually and through joint workshops, to not only advance the project but also further enhance the linkages between practice, policy and research (Figure 1.1).

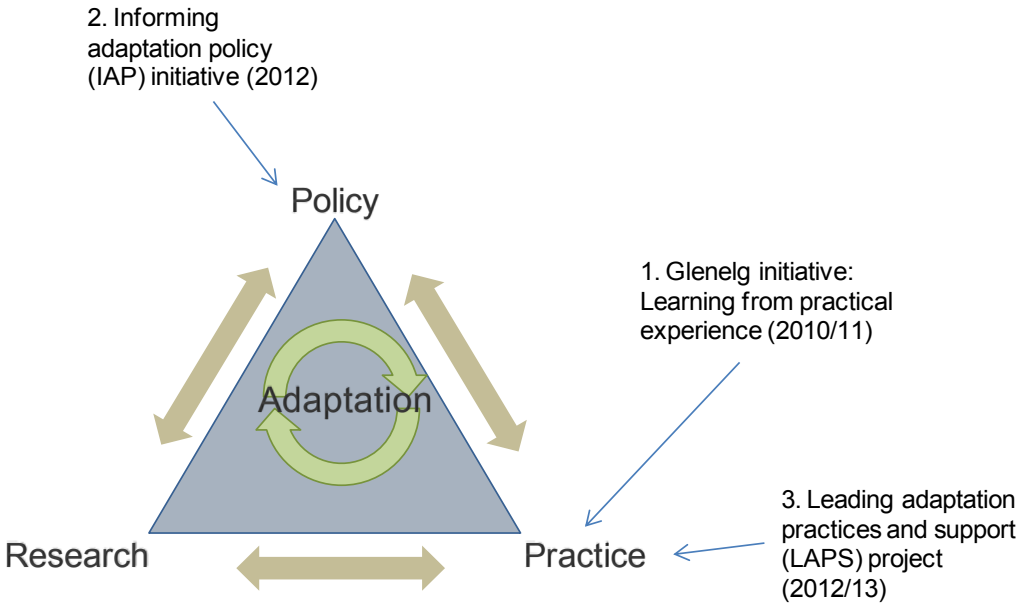

Figure 1.1 A broader agenda: linking practice, policy and research

Each project had its own primary focus but was carried out in a way that engaged, and drew out the links between practice, policy and research.

1.3 The international context

As in Australia there has been growing attention in other developed countries to adaptation issues, though the evolution of policy and support arrangements in each country has varied according to a range of political, economic and climate contexts (Ford and Berrang-Ford 2011).

The UK has taken a leadership role in adaptation at both domestic and international levels (Boyd et al. 2011) with a long history of consistent support at the national level especially through Department of Environment, Food and Rural Affairs programs. This includes the current development of a National Adaptation Programme (DEFRA 2012a) and support for product development and delivery activities by the UK Climate Impact Programme (UKCIP 2012a) formed in 1997. The latter has evolved through several phases of development (UKCIP 2011) and its products are widely used and referred to both inside and outside the UK with some other countries adopting these products (e.g. Klimatlose in Germany). National adaptation programs have been developed in several European countries from 2000 onwards. More recently the European Union has published a White Paper on adaptation in which developing the knowledge base is a priority (European Commission 2009), and is investing in support products such as the Climate-Adapt portal (European Commission 2012), which also incorporates some UK Climate Impact Programme approaches.

The International Council for Local Environmental Initiatives (ICLEI) has developed a number of adaptation products for use by local governments in each of its global regions, with particularly well developed adaptation products and services provided to municipalities in Canada (ICLEI Canada 2012a), the USA (ICLEI USA 2012), and similar initiatives in Europe, Oceania and more recently Asia.

In New Zealand, policy guidance across many sectors has been developed by the Ministry for Environment (NZMfE 2012) and more recently, a number of nationally supported adaptation support products have been developed, especially through the National Institute of Water and Atmospheric Research (NIWA 2012).

Adaptation support for developing countries, whilst sharing many of the characteristic issues and needs of developed countries, has generally had an emphasis on how adaptation should be positioned within the broader development agenda (OECD 2009; Parry 2009). The emphasis in recent times has ranged from actions under the key multilateral climate agreements (e.g UNFCCC 2012a) to many other levels of support, including community based adaptation initiatives (e.g. CARE 2010), typically part-funded by aid and development programs. Institutions providing adaptation support products have included the UNFCCC, UNDP, UNEP, World Bank, national aid agencies and non-government aid organisations.

There has also been increasing interest from the private sector both within countries (e.g. larger companies, industry associations and professional bodies) and internationally (e.g. the UNFCCC Adaptation Private Sector Initiative (UNFCCC 2012b) which includes a database of relevant initiatives; the Network for Business Sustainability review of relevant literature (Nitkin et al. 2009); and an OECD report on private sector engagement with adaptation (Agrawala et al. 2011)).

In reviewing the international experience, this project has looked at the above and many other sources (see especially Chapter 4), whilst acknowledging that in a fluid and fast moving field, it is not possible to identify all current initiatives. In reviewing individual products for potential relevance in the Australian context the emphasis has been on those available in the English language.

2. RESEARCH ACTIVITIES AND METHODS

2.1 Project framing and scoping

A project reference group (Appendix 1.1) was established at the outset to provide input, advice and guidance through regular meetings. The Group had representatives with relevant experience from each level of government, a non-government organisation, the private sector and research. It endorsed a framing and scoping statement at the outset of the project. Although only a nine month project, it was decided that a broad scoping was appropriate for initial development of a national strategy as anything less might prejudge priorities. Consistent with this, the following scope was adopted:

- include public, private and community sector needs
- include all product types that might enhance adaptation capabilities with needs and priorities to be revealed through stakeholder engagement. Include a fairly complete coverage of Australian products, complemented by some of the more frequently referenced international products
- include enabling (e.g. for delivery, support, uptake) as well as product strategies
- proposed strategies to be grounded in:
    - identified good adaptation principles and practices
    - what is necessary to support effective adaptation decision making by end users
    - active engagement with a range of stakeholders consistent with the above approach.

In this report, we use the term 'stakeholders' to include all who have an interest in adaptation and related support products, which may be from a practice, policy or research perspective. This includes product end users (decision makers, policy makers, practitioners) and we will use the term 'end users' if the comment is specifically for this subset.

A key project approach was to seek collaboration and information exchange with other relevant projects so as to minimise any unnecessary overlap and maximise the ability to draw on relevant findings from elsewhere.

2.2 Project analytical framework and methods

The project analytical framework is summarised in Figure 2.1. Overall product strategies are developed initially at a broad level. These are based on an analysis of various end user sector needs, emerging adaptation good principles and practices, and an analysis of the types of products currently available (Chapter 3).

Within these overarching product strategies, a more detailed review of individual products then leads to identification of product strategies for specific categories of end user need, with some particularly interesting 'benchmark' products also identified where possible (Chapter 4).

These proposals are complemented by a range of proposed governance and enabling strategies (Chapter 5) to provide a supportive context within which products are developed, delivered and used. Together they provide a set of proposed strategies to support Australian adaptation capability development. Each step of this process has been informed by extensive stakeholder engagement as well as relevant documented sources.

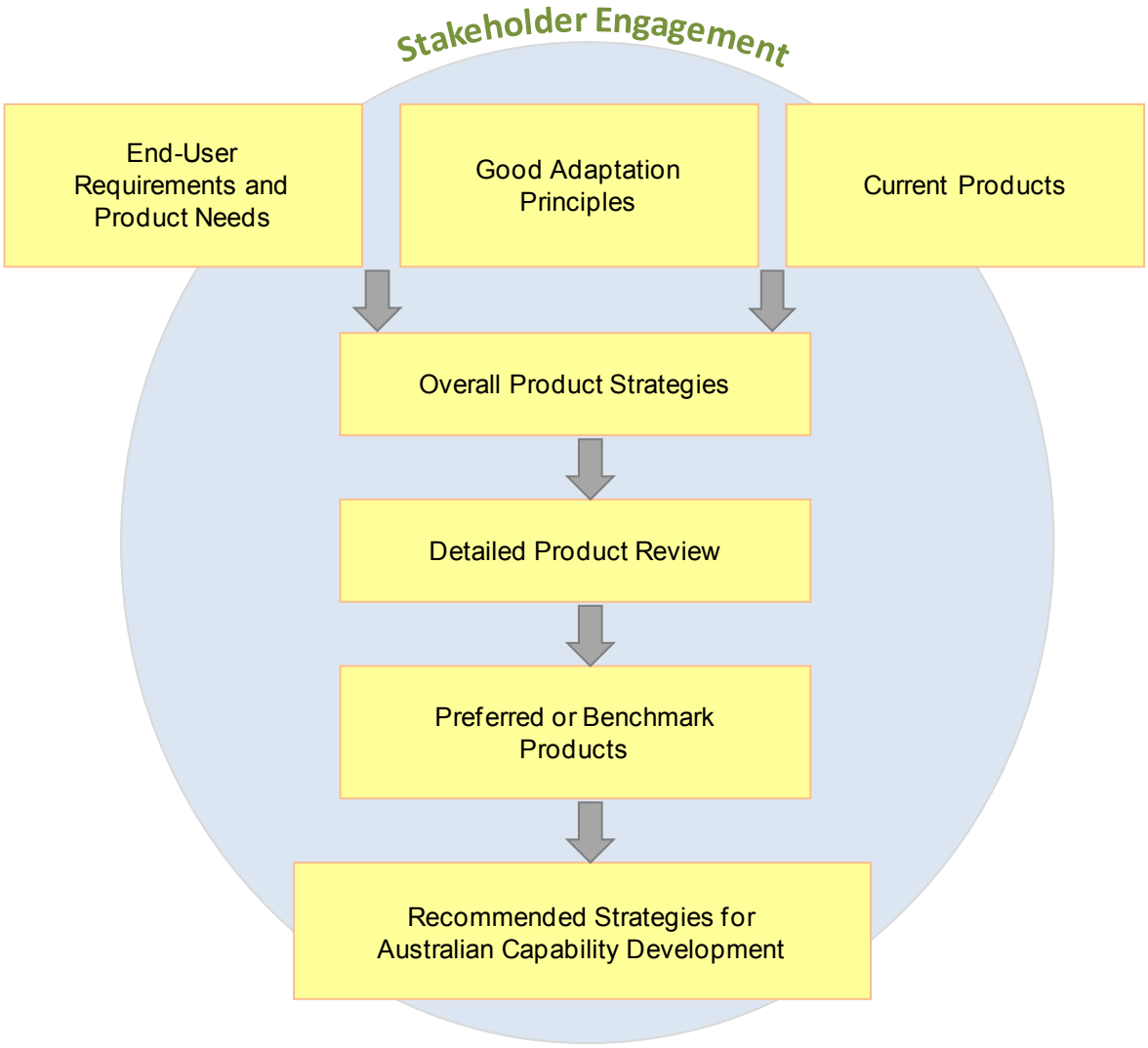

Figure 2.1 Overall project analytical framework

Methods employed during the life of the project included:

- literature review (of peer reviewed and 'grey' literature)
- drawing on the findings of existing surveys of relevant stakeholders in Australia
- internet searching of websites to discover the most relevant adaptation products, supplemented by referrals from discussions with stakeholders. The latter process was especially valuable for identifying products either under-development or planned.

- development of a database of identified products, and analysis of these, starting with categorisation into related types of products, and then review of individual products against a range of criteria. It should be stressed that the purpose of the review was to identify products that might be of particular interest in the context of developing a strategy for Australia, so it does not in any way reflect on how effective the products are in meeting their own objectives. It also does not assume that any current product will be directly applicable to future Australian needs. Such an assessment would require more detailed user-based assessment and piloting, which was beyond the timing and resources of this project. However it does assume that it is appropriate to consider building on existing or planned products before initiating any new product development, and identifies those of most interest
- semi-structured individual and small group discussions, and a number of workshops with a range of stakeholders and end users, to better understand issues, needs and priorities. These covered a wide range of public sector, private sector, and non-government organisations, as well as adaptation practitioners, researchers and product providers. Focusing questions were developed at an early stage to guide each form of stakeholder interaction, and these questions evolved in scope and detail throughout the project as the central issues became clearer. All key stakeholder interactions were documented. The workshops proved especially crucial as they enabled development and validation of collective, as well as individual views, at key stages. Workshops included:
    - a multi-stakeholder *Informing Adaptation Policy* workshop in May 2012 (including public, private, community, research sectors and policy-making participants) with a focus on how adaptation practice and research could better inform future adaptation policy in Australia. One output was a submission on behalf of the participants (Webb 2012) to the Productivity Commission Inquiry into Barriers to Effective Climate Change Adaptation commissioned by the Australian Government. Whilst this workshop was sponsored by ANU, NCCARF and DCCEE separately from the project itself, it was planned and managed by the project team, and being held at a formative stage of the project, informed both the findings and proposed strategies.
    - a key multi-stakeholder (public, private, community, non-government organisation, research sectors) workshop held in July 2012, and follow-up validation with participants, to review and help shape interim findings, conclusions and recommendations. A further output from this workshop was development of a Consultation Paper including draft recommendations, on which the participants and other stakeholders were invited to comment.
    - a workshop held in August 2012 with end users in the Hunter Region of New South Wales to further test emerging conclusions at the practical and grass-roots level
    - a workshop held in December 2012 with a range of current adaptation product developers at national, state, regional and sector levels, to establish the extent to which it should be possible to build on significant

current and planned product developments, including potential collaborative opportunities

- progressive reviews with the project reference group (approximately six weekly).

It was decided early in the project to rely more on individual and small group discussions supplemented by workshops, rather than survey techniques. This was partly because a number of recent surveys were identified early in the project covering broad context setting issues, and it was felt that further surveys at this level would not add significant value. At the next level of detail it was considered that surveys would be too blunt an instrument, especially given the relative newness of some of the detail under review, and the risk of accidental misinterpretation of new concepts being introduced.

2.3 Report structure

Chapters 3, 4 and 5 document the core research findings and proposed strategies based on these findings. Chapter 3 covers the three streams of research that underpin overall product strategies. The first of these streams is a synthesis of good adaptation principles and practices drawing primarily on previous studies and a literature review. These inform several aspects of the subsequent analysis and are also used as criteria in the review of individual products. The second stream is an analysis of end user needs across a number of sectors based on a combination of stakeholder engagement and (where available) documented sources. The third stream, based on research into products currently available and used internationally and in Australia, develops a categorisation of product types. A framework is developed for identifying end user needs and matching to products, and the chapter concludes with a set of overarching product strategies based on the preceding analysis.

Chapter 4 extends the analysis to another level of detail. Based on a product database developed by the project from a range of international and Australian sources, and a set of product review criteria, it identifies specific products of interest and related strategies for each category of end user need (adaptation process, adaptation data and information, and adaptation knowledge management and sharing). In Chapter 5 these proposals are complemented by a range of proposed national governance and enabling strategies to provide a supportive context within which products can be developed, delivered and used.

Whilst the above analysis is supported by a growing body of evidence and experience, and consistent input across a wide range of stakeholders, there are areas that would benefit from further research. Some of the knowledge gaps and potential areas of future research are summarised in Chapter 6.

Finally Chapter 7 draws together the previous threads, emphasises that a move towards the proposed strategies will be a change process in its own right, and indicates some of the required next steps.

3. RESULTS AND OUTPUTS: LEADING PRACTICES AND END USER NEEDS

This chapter identifies the extent to which leading adaptation principles and practices have been identified based on adaptation experience to date, and the support needs for a number of key sectors. It draws on these conclusions to develop overall product strategies, which in turn inform the more detailed product reviews and strategies covered in Chapter 4.

3.1 Leading adaptation principles and practices

Several studies have identified adaptation challenges (often referred to as barriers and enablers), and good adaptation principles and practices that respond to these challenges. These should be incorporated in future support products. Some of the source studies are identified below.

A project contracted by the European Environment Agency (Prutsch et al. 2010) developed 'guiding principles for adaptation' based on a review of the literature supported by case studies. The UK Climate Impact Programme has also developed 'guiding principles' that have evolved from practical use of their products such as AdOpt (UKCIP 2012b) and distilled 'main lessons' learned from 14 years' experience providing support products and services (UKCIP 2011). Other products reviewed in this project also include explicit or implied good principles, and some studies have reviewed key elements to be included in vulnerability and adaptation projects (e.g. Soares et al. 2012).

A comprehensive review of 'barriers to adaptation' was carried out by Moser and Ekstrom (2010) based primarily on a literature review, and currently being tested though a number of case studies in the San Francisco region of California. The identified barriers were mapped to a 'rational decision making' process which has similarities to the risk management cycle commonly used as a framework for adaptation planning, decision making and review. It also identified a number of 'cross-cutting' barriers that might be significant at all or several stages of the process. Effective responses to these barriers should be reflected in good principles, practices and products.

In a similar vein, a synthesis of the challenges and emerging good practices was carried out in the Australian context in 2010, based on the experience of 20 local and regional adaptation projects (NCCARF & ANU 2012) and a comparison of the findings with a review of the literature (Webb et al. 2013). This has a number of common features with the Moser and Ekstrom (2010) analysis, although it approached the exercise in the opposite sequence (i.e. started by synthesising the experience of a significant number of actual adaptation projects and then compared these with the literature) and used the risk management cycle as the basis for mapping conclusions. Many of the findings were consistent with those in Moser and Ekstrom (2010), though the Australian study identified more issues as cutting across many or all of the process stages.

Based on this growing body of knowledge and experience a synthesis of good adaptation principles has been developed for application in future adaptation planning, programs and projects (Webb 2013). These principles should therefore also be reflected in future products that provide guidance on the adaptation process, and they have accordingly been used as criteria in the review of products referred to later in this report. They can be summarised as follows:

1. S*ustained and effective leadership* (both formal and informal) is necessary to engender commitment, credibility and engagement over time.
2. *Effective stakeholder engagement* is required through all adaptation stages, in order to understand the range of stakeholder motivations, perspectives, values and beliefs; build progressive awareness and understanding of climate related issues; and gain participation and confidence in, and commitment to, adaptation framing, processes, actions and objectives.
3. *Maintaining a balance of social, economic, environmental and institutional objectives.* Thus social issues (e.g. values, norms, perceptions, preferences, equity) and institutional issues (e.g. relevant 'rules', roles, organisational responsibilities) need to be understood and analysed, as well as environmental (e.g. biophysical, natural resource) and economic issues. This ensures adaptation options meet broader stakeholder objectives. In respect of institutional issues this includes addressing the frequent lack of clear decision making roles and responsibilities that arise from the pervasive nature and different scales of climate impacts and responses. Changes may be needed internally within the decision making organisation and to broader and external institutional roles and approaches. Aligned institutional arrangements are necessary for initial progress and also to facilitate the ongoing and often unpredictable adaptation process.
4. *Learning from the experience and activities of other relevant adaptation initiatives,* so that confidence can be gained and progress accelerated, even though each organisation ultimately has to make its own decisions. This can assist in all stages from effective framing onwards.
5. *Following adaptive management* approaches, including monitoring, evaluation and learning (including social learning) that builds on growing experience and new knowledge and can also assist in progressive reframing. This is particularly relevant to climate change adaptation, being a continuing and evolving process rather than a single project, decision or initiative.
6. *Explicit and agreed framing and scoping* of the adaptation issues needs to be addressed up front, with preparedness to iterate these as subsequent stages and knowledge unfold. As summarised in Fuenfgeld et al. (2012) framing can be described as the process by which various stakeholders or actors interpret and give meaning to the adaptation intent and process, including developing a (preferably shared) understanding of the nature of the adaptation issue and especially *why* it needs to be addressed. The framing adopted has significant consequences for subsequent choices such as project scoping, resourcing and selection of objectives. There are quite legitimate alternative framings and response thresholds, for example including longer term transformational change responses as well as transitional and incremental changes; and broader resilience building as well as more direct impact and risk reduction approaches.

The appropriate framing will depend on many factors including the nature of the issue and an understanding of acceptable and non-acceptable thresholds.

7. *Addressing various spatial (local/regional/broader) and temporal (short/medium/longer term) scales* involving choice of the most appropriate scales for the issue at hand, and in some cases, the need for solutions that address multiple scales at the same time. In particular, it is worth considering the extra leverage that can be gained from regional level assessment and planning (e.g. more strategic approaches, cross institutional collaboration and shared resources) to complement local activities.
8. *Taking an integrated 'systems' approach* to understand and manage climate risks, including causal links and interdependencies with other climate and non-climate drivers, in order to support appropriate decisions and avoid maladaptation. This can also include integration across sectors, jurisdictions, and spatial and temporal scales.
9. *Focusing on evaluation of adaptation options most relevant to support decision making*. The type of evaluation appropriate will depend on the nature and scope of possible adaptation responses, which will in turn be partially determined by the response to many of the preceding principles. This can usefully be an iterative process to avoid over-analysis of unlikely options and focus on those more likely. It should include consideration of *inter alia* :
    - both the positive and negative direct and indirect effects of the adaptation options;
    - which stakeholders will experience each of the effects, and the social implications of these;
    - their implications for other policy objectives, including, but not only, climate change mitigation objectives;
    - their likely feasibility, robustness to uncertainty, and cost effectiveness.
10. *Articulating a clear statement of adaptation vision, intent, objectives and goals*, recognising that this will be influenced by many of the above factors and may very well need to be negotiated and iterated during the process.
11. *Carefully choosing methodologies and methods* most appropriate to the issue, tailored where necessary to local need. These should reflect the above principles and also emerging best practices, including that:

    - *climate risk assessment* be addressed (and preferably first) from the perspective of *current local* climate issues, knowledge and experience (bottom-up), as well as *externally projected* climate changes and impacts (top down).
    - *methods of analysis* and related data be identified and chosen according to *different decision types and practical resource and capacity constraints;* this is assisted by encouraging 'fast iteration' between steps where relatively quick and approximate analysis at earlier stages of the process can be sufficient to narrow down feasible options, that can then guide where more detailed analysis may be worthwhile. These iterative approaches can be used to save wasted effort and in particular reduce the risk of over-analysis at early stages.

- guidance for *decision making under uncertainty* is often essential, including the optimum sequence and timing of decisions. Options that do not foreclose or limit future adaptation actions can be especially useful.
- *cumulative data and knowledge management* processes and systems are crucial to support iterative and adaptive management processes, incorporating qualitative, quantitative, local, expert and cross-disciplinary inputs
- consideration be given as to when and how to *mainstream* (integrate) adaptation planning, decision making and implementation into current organisational roles/structures and business/decision making processes.
- approaches should reflect *multiple possible entry points* to adaptation initiatives, and that the process is often non-linear and the *sequence context specific*.

The studies underlying these distilled principles have been drawn from a variety of sources (different literature reviews, case study locations, sectors and jurisdictional/institutional contexts). Therefore, it seems these adaptation principles are quite generic and robust – though the relevant weighting is likely to be specific to each adaptation context. As such, these principles have been used in this project to assist in developing appropriate support product strategies and to review individual products.

They also provide a useful 'stepping off' point for the identification of next level down best practices consistent with these principles, recognising that these will sometimes be dependent on context including framing choices, decision types and individual sectors. These can then be progressively built into the next generation of support products and tools.

3.2 Understanding end user needs – a framework

The overall adaptation principles may be quite generic to different adaptation contexts, but the translation to the support needs of individual sectors and organisations is still necessary. This is a critical step in identifying appropriate product and enabling strategies.

3.2.1 Segmenting areas of climate impact

Climate change impacts are diverse and pervasive. Segmenting the areas of potential climate impact will help the analysis of user needs and the categorisation of available products. Three views are considered below – 'impacted natural and human systems', 'impacted regional and spatial systems' (which can include geographical and jurisdictional distinctions) and 'end user sectors' (which is where decisions are usually made and implemented). An end user sector is usually affected by a number of systems impacts and in ways that may differ from sector to sector. Certain socio-economic-environmental systems are inherently more vulnerable to the impacts of climate change than others. For example, the COAG Select Council on Climate Change has recently agreed 'to recommend seven national priorities for collaborative adaptation action to COAG: water resources, coasts, infrastructure, natural ecosystems, agriculture, emergency management and vulnerable communities' (Commonwealth of Australia 2012b).

For the purposes of this report the following *key impacted systems* have been adopted for categorisation of support needs and products:

- water (quantity and quality)
- natural environment (including ecosystems, biodiversity)
- natural resource based industries (e.g. agriculture, forestry and fisheries/marine) where the impacts can be quite direct)
- other industries (including manufacturing and service industries), where the impacts are often indirect
- built environment (including settlements and infrastructure)
- human health, wellbeing and security (an integrating theme impacted by all others).

Understanding interdependencies across these systems is important when taking the more integrated view necessary from the other two perspectives.

The second categorisation is at *impacted regional or spatial scale*, where an integrated view of impacts and responses may be required across the above impacted systems:

- coastal
- urban
- rural
- remote
- public land (reserves and parks)
- mountain/alpine
- small islands
- regional (which may combine several of the above).

This spatial view may be complemented by jurisdictional distinctions and by the significantly different climatic contexts of northern and southern Australia.

Thirdly (but most importantly for this section), the project has categorised potential end users (which includes decision makers) according to *decision making sectors*. Given the pervasive nature of climate impacts, a wide range of government and non-government agencies, private sector and community sector organisations will be involved in adaptation decision making at the national, state, regional and local levels. It is through the organisations within these sectors that institutional rules and roles are delivered and decisions taken. They may be impacted by several of the above 'impacted systems', in quite complex ways, and will often need to address different regional or spatial scales. Indeed it is this interaction across systems, spatial scales and sectors that often leads to a lack of clarity of organisational decision roles and responsibilities for adaptation issues.

The key impacted (and decision making) sectors include:

- Commonwealth Government
- state and territory governments
- local governments (councils and shires)
- regional bodies (e.g. NRM agencies/CMAs; RDAs; ROCs)

- emergency management
- health
- community services.
- private industry sectors and related value chains
    - primary industries (agriculture, forestry and fisheries)
    - property development, construction and operations
    - infrastructure development, construction and operations
    - utilities (e.g. water, transport, energy, communications) as suppliers to the built environment
    - mining, oil and gas
    - manufacturing (e.g. food, wood, metal products, petroleum/coal products)
    - tourism
    - logistics and supply
    - financial services/investment/banking
    - insurance.

The project has engaged with stakeholders across many of these sectors, supplemented by documented sources where available, in order to identify adaptation support issues and needs. This has included public, private and community sectors. To date most adaptation experience is evident in the public sector, but there has also been a noticeable growth in interest and activity in certain areas of the private sector, and (more recently) the community services sector. Examples in the private sector include those industries dependent on natural resources (e.g. primary industry and related processing), the insurance industry (which naturally has a long-standing interest in climate related hazards), the built environment sector and the investment funds sector. Especially in the private sector, it is difficult to gauge relative priorities at this stage as many organisations may not yet be aware of the climate implications for their business, and some activities may be commercial-in-confidence – so there may be more issues and need for support than appears on the surface. It is also very early days in assessing needs for the community services sector.

3.2.2 End users business processes, decision entry points and mainstreaming

The conceptual framework for identifying end user support needs is shown in Figure 3.1. Mapping of the end users' business processes leads to identification of the adaptation 'decision entry points' (i.e. the stages at which decisions are made which need to take climate implications into account), which leads in turn to the need for support products.

Organisational business processes in pursuit of business outcomes tend to be very specific to each sector. However, many component processes (e.g. making an infrastructure or asset decision) can be quite generic. Within an overall business process, decision 'entry points' are identified where climate change responses may be necessary.

Individual decisions can have distinctive characteristics such as different asset lives and decision timelines (Stafford Smith et al. 2011) and the extent to which a decision is conditioned by statutory requirements (PROVIA 2012). The nature of the decision,

including the extent of uncertainty, will also determine the most appropriate range of adaptation options (Hallegatte 2009) and the support products, methods and tools most likely to be useful (Dessai and van de Sluijs 2007; Ranger et al. 2010; PROVIA 2012).

The decision entry point is also the natural time to consider the extent and timing for the mainstreaming of adaptation plans, decisions and implementation into other organisational roles, processes and issues.

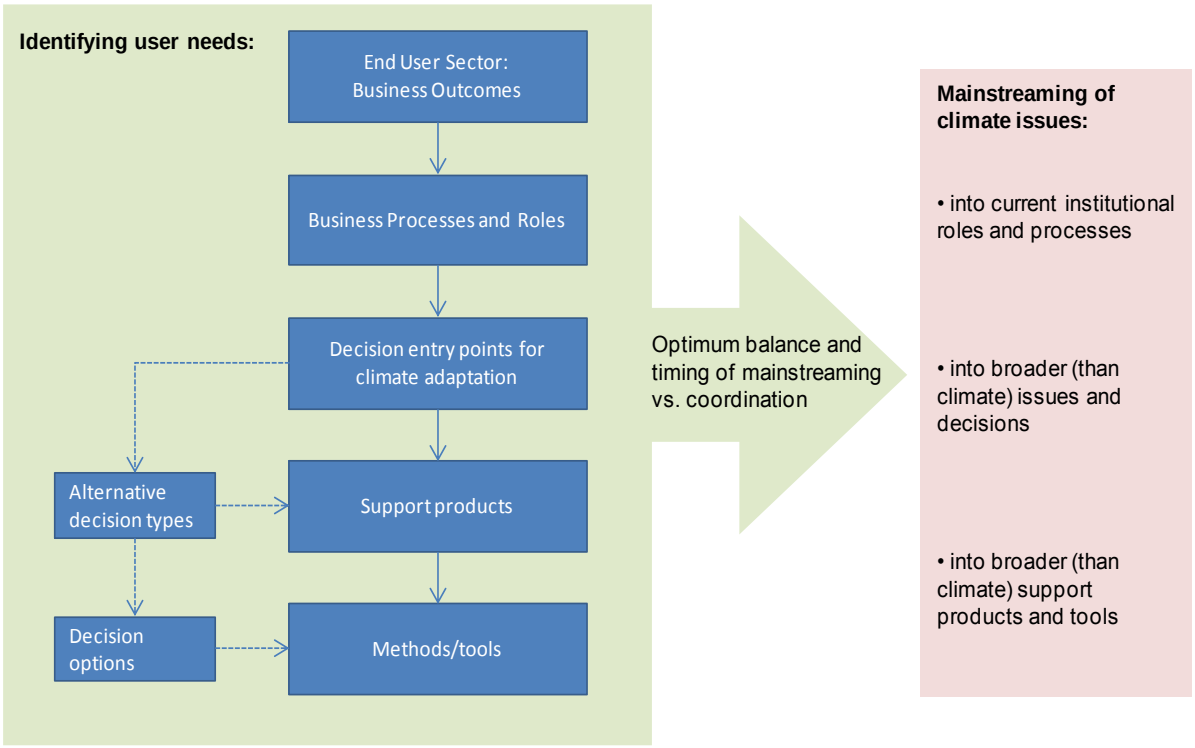

Figure 3.1 A framework for analysing end user needs

As shown in Figure 3.1 mainstreaming can apply at several levels:

- Business processes and associated organisational roles – can the climate adaptation issues be effectively handled within existing organisational roles and responsibilities and the current business and decision making processes?
- Decision analysis – do the adaptation issues need to be combined and integrated with other (including non-climate) issues for an effective decision?
- Support products – should the adaptation support products be integrated with other broader decision analysis and support products? Most of the products identified in this project are specific to climate adaptation. However they could also be integrated with other products from an end user perspective.

Mainstreaming is generally considered most likely to achieve sustained outcomes, but there are situations where the response to climate change risk requires a distinct adaptation focus outside the realm of 'normal' organisational decision making. Typically this is where the extent of climate impact and the nature of interdependencies across impacted areas are particularly significant.

This could require, for example:

- development of an integrated Climate Change Adaptation Plan or equivalent. Several state/territory and local governments have developed, or are in the process of developing such integrating plans (e.g. NSWOEH 2012a, Victorian Government 2012a, GoSA 2012, STCA 2013). This may also be necessary for certain private sector organisations with significant and complex climate impacts
- the need to frame issues and decisions more broadly than 'business as usual' processes and decision making; for example if the adaptation response is likely to trigger transformational as opposed to incremental change, or reflects complex interdependencies which cut across traditional boundaries, challenging existing institutional roles and processes.

Another practical reason for not immediately or fully mainstreaming can be the need to build organisational adaptation capabilities where the initiative requires insights, skills or expertise not initially or widely held within an organisation. However there is general consensus in the adaptation literature that to be effective over time, adaptation needs to be integrated (or mainstreamed) into existing decision processes and structures at all levels (Smit and Wandel 2006; Adger et al. 2007; Dovers and Hezri 2010). This means that strategies should be established in a way that facilitates mainstreaming as a desirable end state, whilst recognising the value of maintaining a distinctive adaptation perspective in certain situations such as those mentioned above.

3.3 End user needs – application to key sectors

The project has engaged with a number of stakeholders across many sectors through a combination of workshops, semi-structured interviews and discussions, supplemented by documented sources where available, in order to identify support issues and needs. (See also Section 2.2 on project methods, and Appendix 3.1 on the range of stakeholder organisations engaged by the project). Some of the themes covered in this process are shown at Figure 3.2. The framework described in Section 3.2 was used to help structure the analysis and findings.

It was not been possible to cover all sectors equally in the available time and resources but the conceptual framework outlined in Figure 3.1 has shaped the analysis and been developed explicitly for some sectors, where we have mapped relevant business processes and related decision entry points as a basis for identifying actual or potentially useful products. Whilst this is mostly the sector's own business processes, in some cases it includes support by one sector (e.g. insurance, fund investors) for products that supports decision making in other sectors (e.g. households, developers, companies).

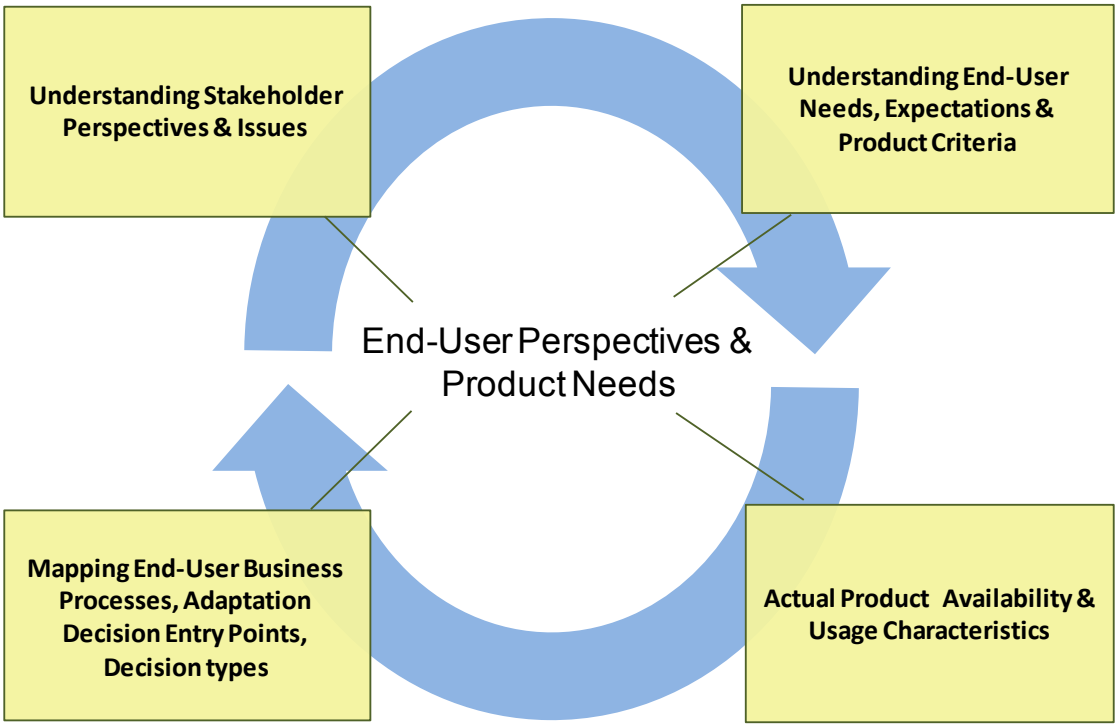

Figure 3.2. Analysing stakeholder and end user needs: themes covered

3.3.1 Local (and other levels of) government

Based on a number of surveys in recent years the local government sector (councils and shires) has been amongst the most active in responding to adaptation, though more so for coastal than for rural and remote councils (e.g. Gardner et al. 2010; Booth and Cox 2012). Indeed local government is a natural starting point for the analysis as it brings together the full range of impacted systems and decision types covering the natural environment, built environment (settlement and infrastructure), social and economic issues, all at the local level.

A summary of some of the readily identifiable local government adaptation activities in Australia in recent years is at Appendix 3.2. Of the 560 councils in Australia, approximately 150 have been involved in various DCCEE funded initiatives, and some of these and additional councils have been involved in state and territory government initiatives, state–based mutual insurance sponsored assessments, and state-based local government association initiatives.

The overall picture is that at least a third and probably more local governments have engaged in some form of adaptation risk assessment or planning, though to date this has mostly been first pass assessments and awareness-raising with far fewer examples of movement to significant adaptation response and action. On the latter, numerous challenges have been identified. Generally speaking coastal councils have progressed further than inland, rural and remote councils, but still with a long way to go. As a general rule those councils who have progressed as part of regional groupings and who have won funding grants, appear to have gained most traction.

A recent NCCARF-funded project has focussed on cross-scale barriers from a local government perspective and identified four main groupings of barriers to adaptation (Mukheibir et al. et al. 2013, p3):

- a poor understanding of the risks, limited access to and the uncertainty of climate change impact related information
- an inconsistent governance structure, coordination, communication and leadership between both the vertical tiers and horizontal levels of government
- an inconsistent problem definition and appropriate climate change adaptation framework to use for planning, and
- competing priorities due to limited operational resourcing, such as staffing and funding, to plan and implement responses'.

The project also identified enabling strategies which included improving cross-government coordination and consistency, use of regional initiatives, more standardised guidance for adaptation risk management and business cases, a central mechanism for adaptation-related data management and sharing, and improved resourcing.

These findings are very consistent with those identified from the current project in the context of supporting adaptation practice. Firstly, they confirm that lack of clear adaptation process, knowledge and guidance are current barriers for local governments. Secondly, they show that many local governments, whilst progressing their own planning, are looking for more leadership, consistency and coordination from other levels of government.

The current project has benefited from discussions with the Australian Local Government Association, state Local Government Associations, individual councils, and a workshop with a number of councils and other authorities in the Hunter region of New South Wales. Based on these consultations, the main local government business processes that are likely to be impacted by climate, and the potential adaptation decision entry-points, are mapped in Figure 3.3. Whilst the terminology and applicable state legislation, regulations and guidance may vary from state to state, the core processes and decision types are generic across councils. Also shown is a sample of currently available or planned products that are potentially applicable to these decisions. Recent studies have confirmed that there is a need for more guidance for councils as to which tools to use in what circumstances (Booth and Cox 2012) and that councils need support products that recognise very different starting points and sequences of discovery and activity (Fuenfgeld and Webb 2012).

The main conclusions from the above analysis are that:

- The needs are quite generic across local governments at the level of overall business processes, decision types and support products, recognising however that they will need to reflect certain jurisdictional differences.
- There are already a large number of available products potentially of value to councils, but considerable confusion as to which tools are of most use in what context.

- The understanding and capacity to select and use appropriate products and tools (including availability and appropriate use of climate and other key data sets) is highly variable, with many councils not yet embarked on serious adaptation assessment and response, and those who have, often relying heavily on external funding and assistance (consultants and/or researchers). There is therefore a need for both entry level and more sophisticated decision support products; and the facility to enter the process at various points and navigate to the information or sources that best support where they are at in the process.
- For many councils the need is for entry-level support, including self-assessment against good or standard governance expectations for managing climate change risks, and initial approaches to climate risk management and planning.
- For other councils who are past the entry stage there is a need for more detailed guidance to assist in complex climate impacted decision making.
- The extent of regional or landscape-scale climate change planning is highly variable, and even where progressed there is a need to better link the strategic planning insights with statutory approval processes, as too many issues are being addressed at the local individual development application level.
- There is a lack of clarity on decision making roles and responsibilities with multiple organisations involved and a need for more explicit and consistent policy and guidance from other levels of government.
- There is inconsistency between councils in the approach to collection and use of adaptation relevant data (e.g. hazard mapping).
- In a few cases, strong regional and collaborative approaches are emerging with the potential to address some of the above issues. In particular, such approaches are starting to generate greater consistency and transparency of approach which has potential to generate community and business confidence and reduce the potential for legal challenges to council decisions.
- Some councils or grouping of councils (typically those who have won funding support from other levels of government) have made significant progress in planning in recent years..

These conclusions have significant implications for product support strategies, which are developed in later sections of this report.

Whilst the level of decisions may be different, state, territory and Commonwealth governments face similar issues and needs in managing their own assets and operations. Therefore, support product solutions for local government are also likely to be useful for other levels of government.

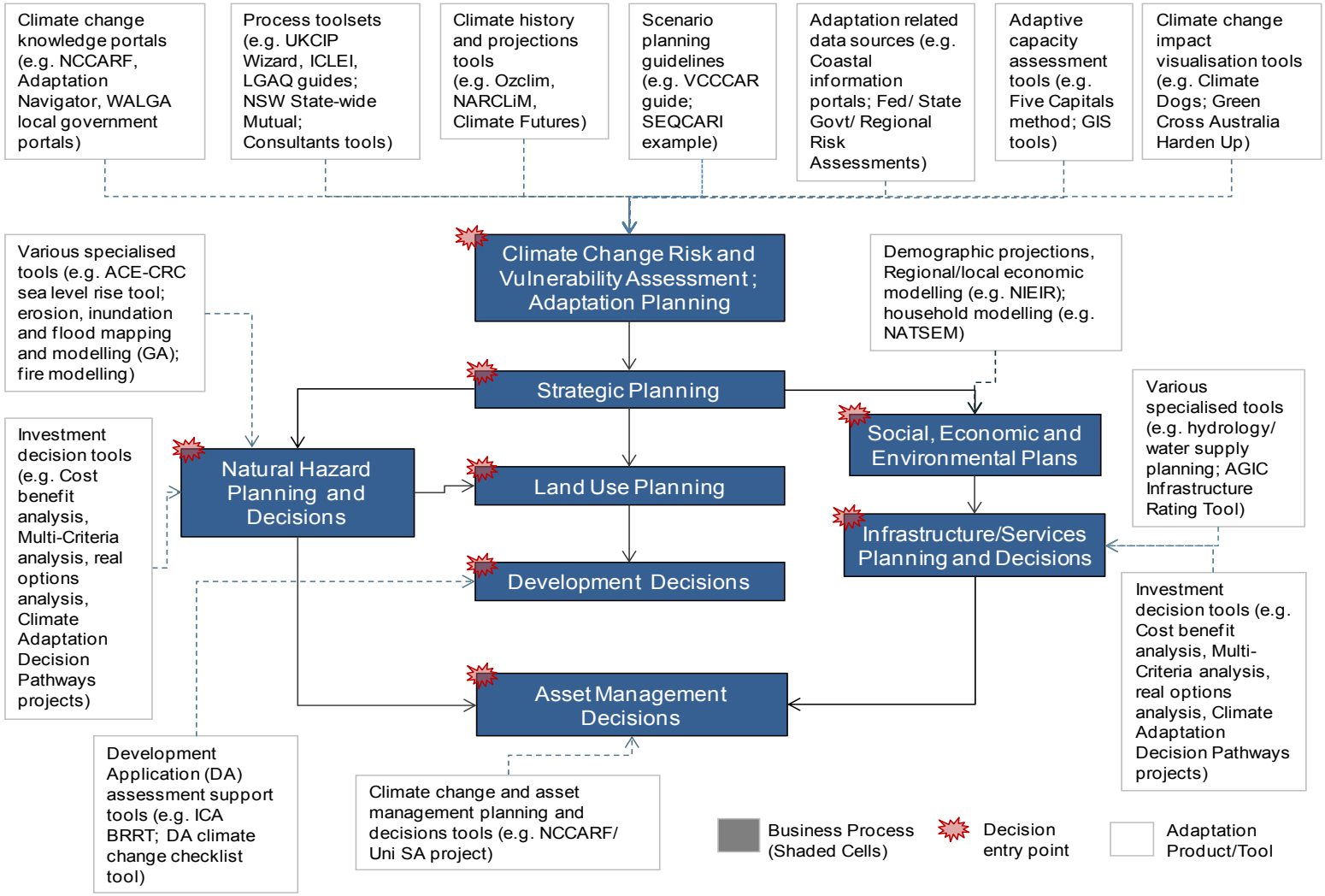

Figure 3.3 Business processes and adaptation decision entry points: a local government example

3.3.2 Private sector: built environment

The Australian Sustainable Built Environment Council (ASBEC 2012) has developed a strategic framework to address adaptation issues. Discussions with representatives of the private sector contributing to the built environment reveal in many respects the same processes and issues around settlement and infrastructure identified for local government. The business processes, decision entry points and some relevant products are shown at Appendix 3.3.1.

Whilst the organisational objectives will sometimes differ there is a common need for many products and tools. In addition, for the private sector the inconsistency of approach across states, and across individual councils within a state, is a barrier to confident investment and adds to costs; and there is limited confidence in current data sets available for adaptation planning.

Within the sector there has also been a growing interest in building and infrastructure 'sustainability' rating systems that include specific climate adaptation criteria (e.g. AGIC 2012; GBCA 2012).

3.3.3 Private sector: insurance and finance

The insurance and financial investment sectors are also keenly interested in built environment issues and decisions. Again, whilst the business processes and objectives are different, there is a common need for some of the more generic products and tools, and they share the concerns of other sectors in the lack of coverage, accessibility, provenance (supporting credibility), consistency and interpretation of key data sets (e.g. hazard and impact mapping).

In both sectors, there is also growing interest in products and tools that can support better-informed decisions and provide assurance in other sectors. For the insurance industry this includes the Insurance Council of Australia funding of the Building Resilience Rating Tool (ICA 2012) for intended use not only by the insurance industry but also by other decision makers (e.g. developers, designers/architects, builders, households and councils). For funds investing in significant assets, as represented for example by the Investor Group on Climate Change, it includes an interest in explicit assurance that companies or developers are addressing climate risks and using best practice planning and decision making approaches, and in there being a range of products and tools that support that objective (IGCC 2012).

Business processes, decision entry points and some relevant products are shown in Appendix 3.3.2 and 3.3.3 for insurance and financial investors respectively.

3.3.4 Natural resource based sectors

This includes natural resource management (including water supply and quality and other impacts on ecosystem health and biodiversity) and primary industries. With a history of responding to climate variability these sectors are in some respects better prepared to deal with climate change challenges, at least to certain limits. Again at the most generic level, the needs are quite common with other sectors (i.e. the need for risk management processes and decision making on various spatial and time scales under significant uncertainty), although standard risk and uncertainty management

approaches may be less in demand in this sector (GRDC 2012) than in many of the larger commercial organisations in the built environment sector.

The smaller scale of many organisations in this sector suggests that entry level products may be especially useful, although there are also many instances of individual organisations and enterprises well progressed in researching and developing climate responses (e.g. EPNRM (2010) for a regional natural resource management body, and ABC (2011) for an example of a private sector strategic shift – in this case acquiring wine industry assets in Tasmania's cooler climate). It should be recognised that whilst the above comments may be true across much of this sector, there is very significant diversity of size, investment time-scale and other characteristics that need to be reflected in how needs are met for individual sub-sectors and enterprises.

For trade exposed primary industry sectors there is the additional adaptation challenge of anticipating how climate change impacts nationally and internationally may affect competitiveness and market/price volatility for heavily traded products, requiring more sophisticated economic risk and opportunity planning (Stokes and Howden 2010).

There are also a number of more specific climate analytical tools relevant to each sector (e.g. hydrological modelling for water; ecosystems and species modelling for natural resource management; and agriculture, forest and fisheries and marine based models for primary industries). Primary industry sectors are relatively well served by capabilities and products that bring together the climate related products for their sectors (e.g. through the various CSIRO Sustainable Yields projects for water CSIRO 2012b); the Climate Change Research Strategy for Primary Industries (CCRSPI 2012); the Grains Research and Development Cooperation (GRDC 2012) websites for some primary industries) and there are additional initiatives planned. For example the Climate Change Research Strategy for Primary Industries website indicates that it is planning for:

- a database of all relevant climate change research development and extension activities, for use by Climate Change Research Strategy for primary industries partners
- a national communication portal for climate change research and policy in primary industries.

However the climate knowledge for natural resource management is currently both more challenging and fragmented. It is especially challenging in that there is limited knowledge on how individual species may respond to climate change, and even greater uncertainty as to how complex ecosystems will be impacted. This has significant implications for appropriate adaptation responses. There have also been suggestions for some time to consolidate the knowledge management capabilities across the 56 natural resource management regions in Australia (Campbell 2006). Whilst it is still early days, this agenda should now receive a major boost through the Commonwealth Government funded programs being developed as part of the Clean Energy Future package, which will include development of climate adaptation planning for each region and associated capability and product development (DSEWPaC 2012; DCCEE 2012d).

3.3.5 Private sector: value-added manufacturing sectors

For many value added manufacturing sectors the major impacts can be on other parts of the value chain (e.g. on input resources and materials, supply and market distribution; and changing national and international competitiveness driven by climate change) Thus, the impacts typically have a larger indirect component. Overall approaches to risk management and decision making under uncertainty are even more relevant but the complexity and interdependency of factors throughout the value chain means that climate assessment tools are less available for these sectors. Some overseas studies are starting to address these issues (e.g. Foresight 2011). Some NCCARF-funded projects are also relevant such as those for the food industry, which has links from agriculture through processing to retail, and international as well as national suppliers and markets. Based on 36 case studies of Australian entities distributed along the food-supply chain, Michael and Crossley (2012) find there is significant scope for improved risk management approaches, which tend to be more formalised in larger entities and, where used, less formal in the smaller entities such as those typically found in agricultural production; and for more useful climate-related information and advice to support such processes. They also refer to techniques that may help explore the many risk interdependencies, including those connected to climate, along the food-supply chain.

3.3.6 Community services and health sectors

Climate adaptation has only recently started to be factored into community services sector planning. Relevant research projects have commenced (e.g. an NCCARF-funded Australian Council of Social Services project) or are planned (e.g. a Victorian Centre for Climate Change Adaptation Research-funded community sector project).

The health sector has been a focus of adaptation planning for some time with a range of direct and indirect impacts and risks recognised (McMichael et al. 2009). The complexity and diversity of implications again means that the generic risk management products are relevant, supported by more sector-specific analytical tools for health risks. There is also potential for climate related health planning tools targeted to specific audiences such as local government (Bell 2012).

3.4 Summary of end user needs – four components

From the above analysis, and related discussions with stakeholders, it is clear that there are some common needs across sectors for products that assist with the climate risk management process and more specific decision making within that process, and for certain key data sets. However, it is equally clear that the diversity of business objectives, business processes and institutional arrangements means that these common needs often require translation to specific sectors and contexts. In addition, there are many examples of analytical and other support tools that are specific to individual sectors. Consequently, any overall product strategies will need to cater for both common or ‘core’ needs, and products tailored to particular audiences. Some of these relate to guidance in the adaptation process and some to the data and information needed within that process.

At the highest level, four components of adaptation process and related support needs have been identified (Figure 3.4). The broadest component is that of *societal and political readiness* to address adaptation issues, and associated change processes. This includes processes that shape the gradual evolution of social priorities (including values and preferences) and institutions (including roles and rules) supported by growing knowledge. Whilst these processes can in some cases be supported by products, they are generally the focus of much broader facilitating processes such as policy-related national debate, community engagement, and deliberative democracy or equivalent processes, supported by social learning from experience. The approaches and issues at this level often extend far beyond climate adaptation. For these reasons, this component has not been the main focus of the project.

However, this component can support leadership and effective framing as key enablers of more specific planning and decision making processes, and can also help address the major challenge of transformational change. A repeated theme in the stakeholder and end user discussions was that a lack of appropriate leadership and framing are often the biggest barriers to effective progress. Encouraging national, regional and local understanding of climate related issues is a key enabler for the other components, especially where transformational responses may be necessary. Research is also emerging on how climate driven transformational change can be linked to more traditional decision making processes and methods (Park et al. 2011; Stafford Smith et al. 2011).

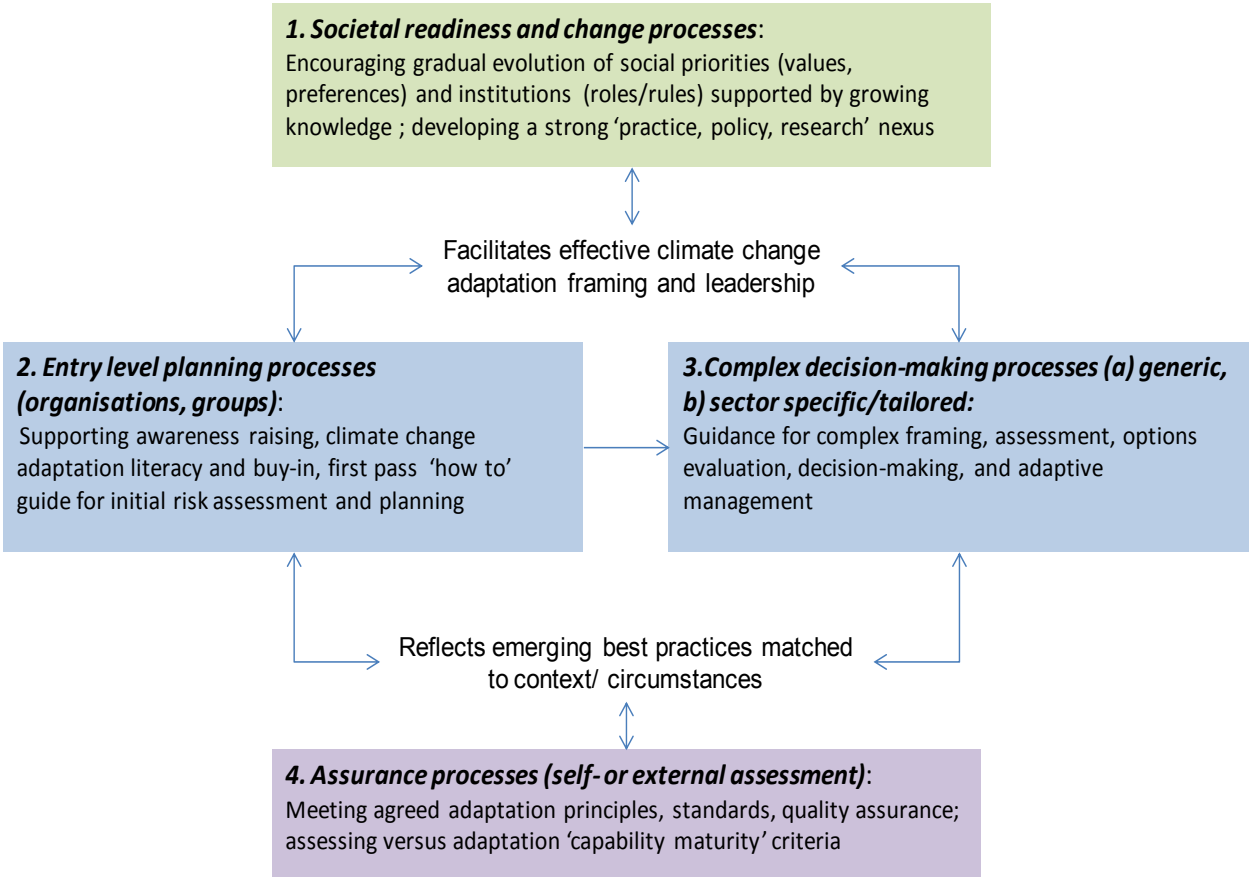

Figure 3.4 Components of adaptation needs and supporting processes and products

The other three components and the distinction between them are central to the identification of appropriate support products. The second component is the need for *entry level guidance* for organisations just embarking on the adaptation journey. Here the main objectives are awareness raising, preliminary understanding of risks and potential responses, broad level planning, and gaining of a level of stakeholder commitment to progress to more detailed stages. The process guidance products for this component can potentially be quite generic or at least have a major generic element.

The third component is the need for more specific and often *more complex decision making guidance* leading to investment and action. It is likely that there are still common or 'core' needs and related guidance products that can be useful across sectors, but also that more tailored sector-specific products will have increasing value, complemented by a wide range of (generally) sector-specific analytical tools that support the broader processes (e.g. hydrological, ecosystem, built environment assessment and modelling tools).

In respect of data products typically used in more complex adaptation decision processes, there were numerous instances where different sectors called for improved coverage, access, provenance and interpretation of data, and often for datasets likely to have a significant element of common interest across some or many sectors (e.g. climate, socio-economic, hazard, impact, vulnerability, risks and options data).

Both the second and third components in Figure 3.4 may need web-based portal, process and data products, but the level of detail for the second and third domains is quite different.

The fourth component is that of *assurance*. Here the need is not so much for detailed support in *how to* go about the adaptation process, but rather an assessment of *how well* an organisation is addressing the adaptation challenge. This may be an organisational self-assessment, useful at either entry level or later stages to assess progress in developing adaptation capability, and as an assurance over certain decision making processes; or it may be an external assessment and assurance process. Examples of the former included suggestions from some councils that sets of standard 'good climate governance' questions would be useful for self–assessment (including for the elected Council), and for internal purposes such as assurance of council Development Approval decision processes. Examples of the latter include public accountability (e.g. the UK National Indicator NI188 local government adaptation reporting index required of local governments until recently in the UK (DEFRA 2010); required or encouraged conformance with standards such as the proposed Standards Australia Climate Adaptation Settlements and Infrastructure Standard (Standards Australia 2011); or private sector assurance (e.g. based on stakeholder discussions, a growing requirement from funds investors for evidence that companies and major infrastructure projects are tackling climate risks and adaptation effectively; and incorporation of climate adaptation criteria in building and infrastructure rating schemes such as those run by the Green Business Council of Australia (GBCA 2012) and Australian Green Infrastructure Council (AGIC 2012)).

Such assurance products may also have strong links to adaptation benchmarking and review products and processes.

An effective overall product strategy will need to address all four components in Figure 3.4 but in respect of the first, it is mostly concerned about the nexus between this and the other three, especially with how effective leadership and framing are established.

As a reflection of the current gap between product needs and actual products available, there were few if any stakeholders or end users expressing confidence that they had access to the set of products they needed, or indeed confidence in how to make valid or most effective use of what is currently available.

3.5 Product categories and stakeholder concerns

In addition to the distillation of good adaptation principles and the evidence of end user needs, the range of products currently available have been reviewed to assist in developing overall product strategies.

For the purposes of analysis, adaptation support products have been grouped into three overall categories (and several sub-categories) – process support products, data and information products and knowledge portal products. The latter can include examples of the first two categories as well as other knowledge management and sharing functions. These are summarised in Figure 3.5 and the brief descriptions below. The three overall categories are also consistent with those adopted in an OECD study which summarised various tools in a developing country context (Hammill and Tanner 2011).

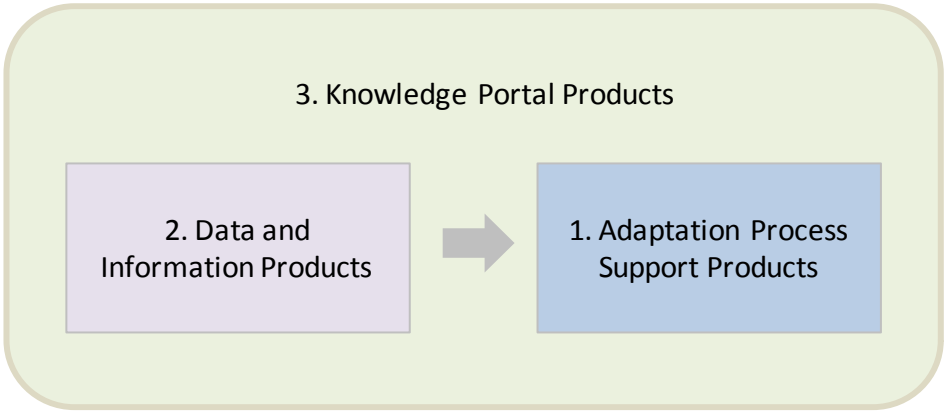

Figure 3.5 Adaptation support product categories

Category 1: Adaptation process support products

Description: These products typically guide the user through a series of steps to help with adaptation planning, decision making and review, often as a component of a longer term adaptation program or agenda, and hence with iterative cycles of learning and progression. Many are based explicitly or implicitly on the risk management process and cycle (moving from context setting, though risk analysis/vulnerability

assessment, adaptation response options assessment, to decision making, implementation, monitoring, evaluation and review).

Some products only cover some of these steps. Some are oriented directly to end users, others to professionals/practitioners. They also vary in the level of detail including the extent to which they provide specific procedures and/or templates to assist the user, and refer to more specific methods and tools for use within individual steps.

Category 2: Data and information products

Description: These products provide adaptation data and information (e.g. on climate, hazards, exposure, impacts, risks, vulnerabilities, adaptation options) and/or underlying natural or human system data, which end users and decision makers need to incorporate at various stages in the adaptation assessment and decision making process. They can include individual databases, more extensive data portals that bring together multiple sources, and related tools and models that generate value-added data from 'raw' data.

Some of the data are derived from technical and scientific processes (e.g. historical and projected climate information and scenarios; related biophysical and hazard impacts; some socio-economic analyses). Other information may be based on more qualitative assessments (e.g. summaries of typical climate related risks and available adaptation options distilled from case studies, which may be useful for organisations taking their first steps in adaptation planning). Desirably the information is accompanied by assessments of confidence and uncertainty.

Category 3: Knowledge portal products

Description: These web-based products help the user navigate to relevant adaptation guides and information, with the benefit that they bring together in one place access to the various sources a user may need. They help manage knowledge by bringing it together within a meaningful structure, share the knowledge by providing flexible and guided access to users, and in their most useful form assist the user translate the knowledge into a useful purpose (e.g. supporting decision making). The report refers to these as 'knowledge portals' or just 'portal' products for convenience, and to the various types of knowledge included in a portal as 'user functions' or just 'functions'. Many (but not all) adaptation websites are set up as portals (i.e. they are specifically designed to help users navigate to the most relevant elements of the adaptation process and content). The portal can provide several functions to users, including those covered in Categories 1 and 2 above, but also a range of other types of knowledge (e.g. project data bases and case studies, contacts, research, relevant legislation). The information needed may be located on the portal or accessed through a link from the portal.

Most relevant knowledge portals only cover some of the possible functions, and indeed some focus on only one. They generate their own knowledge and otherwise provide links to other sources. Some are oriented directly to end users, others more to professionals, practitioners and researchers. Some focus on adaptation needs across

the board, others are system, region or sector specific. They also vary in the level of detail and comprehensiveness.

Chapter 4 covers the range of available products identified in each category in more detail. At this stage it is sufficient to note that there is already a large number of products in existence, in Australia and internationally, reflecting a demand for each type of product. However, overall stakeholder and end user feedback during the project indicates that, at least in Australia, there are significant issues around the usefulness of current products, which can often be traced back to the current fragmentation of product development and support.

All three product categories are relevant to most end users, who need to combine an overall adaptation process with data and knowledge-sharing across multiple functions. To be useful, such products need ongoing development and user support, realistic and sustained resourcing, user engagement and feedback, and continuing learning and innovation. To be credible and legitimate, they need assurance that they are reflecting good practices, reliable data, and backing from key stakeholders and experienced end users.

However the current fragmentation of support products, data and tools means many end users are confused as how to select, interpret and make effective use of relevant products; most products are lacking in transparent quality assurance; and products lack the resource and critical mass to provide continuing development, support and improvement. This does not support confident and effective decision making; and is unlikely to be cost-effective or sustainable.

3.6 Overall end user needs and product strategy

This section brings together the good adaptation principles, end user needs analysis and high level product categorisation and stakeholder concerns, in order to develop overall product strategies.

Whilst the experience in practical adaptation projects has grown, there remains a significant capability, information and support product gap for end users across all sectors.

The diverse business processes, decision entry-points, decision-types and organisational contexts suggest a need for specific products customised to sector need. The different starting context for individual end users (even those in the same sector) points to the need for products that are flexible as to where they enter the product and process, and how they navigate to various functions. This can be, for example, very different for an organisation with staff new to adaptation as opposed to one with far more experienced staff.

This suggests that a central component of a future adaptation product strategy should be flexible, knowledge- and web-based portal products which can be architected to meet such requirements. Inclusion of a range of potential functions and sources that support planning and decision making will allow the user to integrate useful guidance on good practice adaptation processes with relevant data, and useful sources of experience and expertise. Figure 3.6 shows the range of functions which could be

included in a typical adaptation portal based on the stakeholder consultations and the review of current portal products (see Chapter 4).

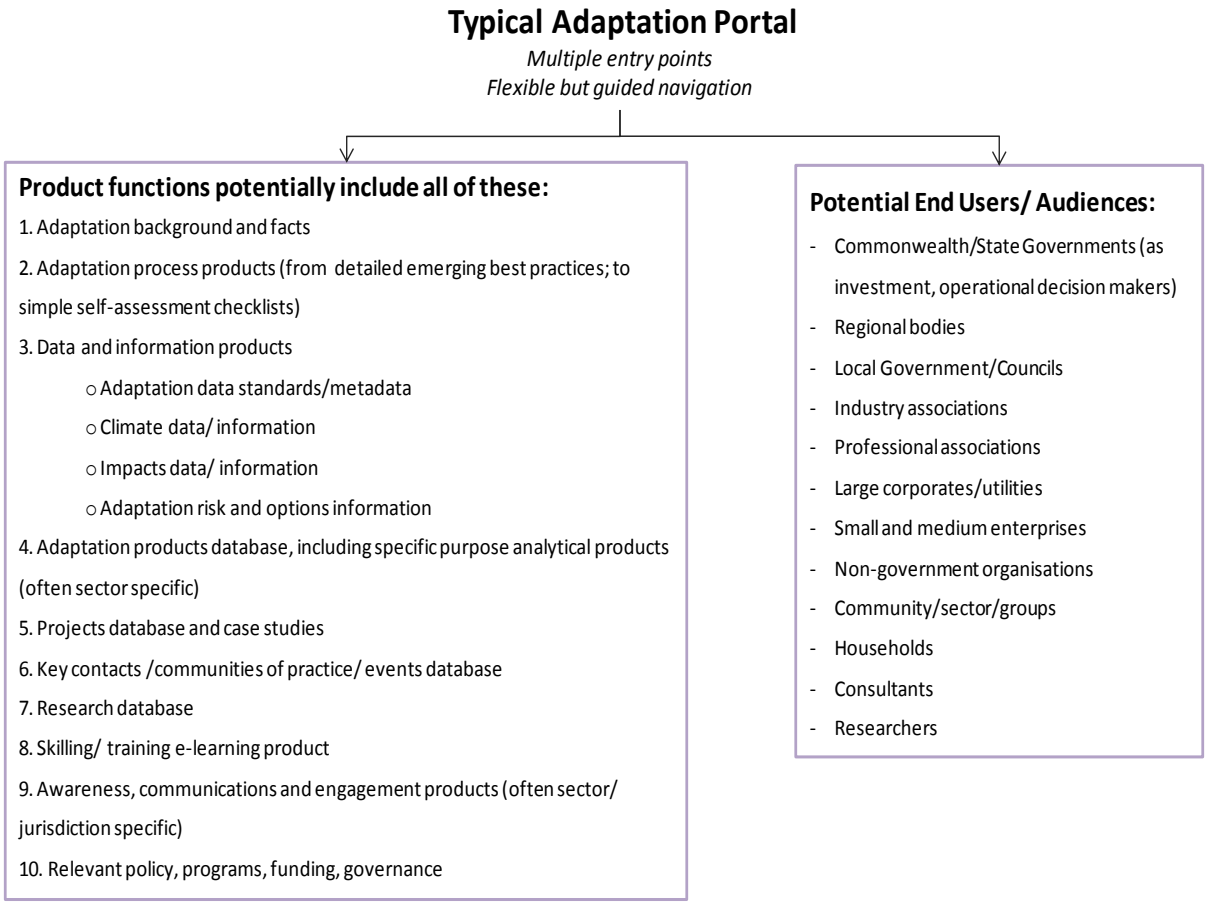

Figure 3.6 Potential functions and end users of a typical adaptation portal

***Strategy 3.1**: Multi-function knowledge portal products with flexible entry points and easy navigation between topics and functions to be the centrepiece of an overall adaptation product strategy to support end users*

The diversity of business processes and decision types across different sectors means that there is likely to be a continuing demand for end user sector-specific products and similarly, given regional and jurisdictional variation, for region and location-specific products. This suggests that no one portal could possibly meet all needs.

Whilst the adaptation and decision making context is sector- and user-specific there are some common needs across sectors and users for process, data and knowledge sharing. This suggests the value of some relatively standardised common or 'core' support products and shared services for reasons of efficiency and effectiveness i.e. to

avoid wasted effort and confusion, and provide critical mass for continuous improvement and support.

From a national strategy perspective, portal products would therefore desirably be layered (reflecting different levels of need) and nested (with consistent and shared content between levels where possible). Common needs could be distilled in nationally developed and supported core products, and ancillary needs developed and added according to jurisdictional, sector or other more specific requirements. In some cases this is likely to include mainstreaming relevant adaptation components into products and processes with scope broader than adaptation, especially for more specific (e.g. sector and regional/local) products.

Figure 3.7 shows a potential national architecture of such products that could evolve progressively from the range of products and initiatives already in existence and planned. The development of customised products for specific sectors or regions would be decentralised and essentially 'demand/market driven', though made more cost-effective by the shared national initiatives outlined in this report, including a National Adaptation Portal.

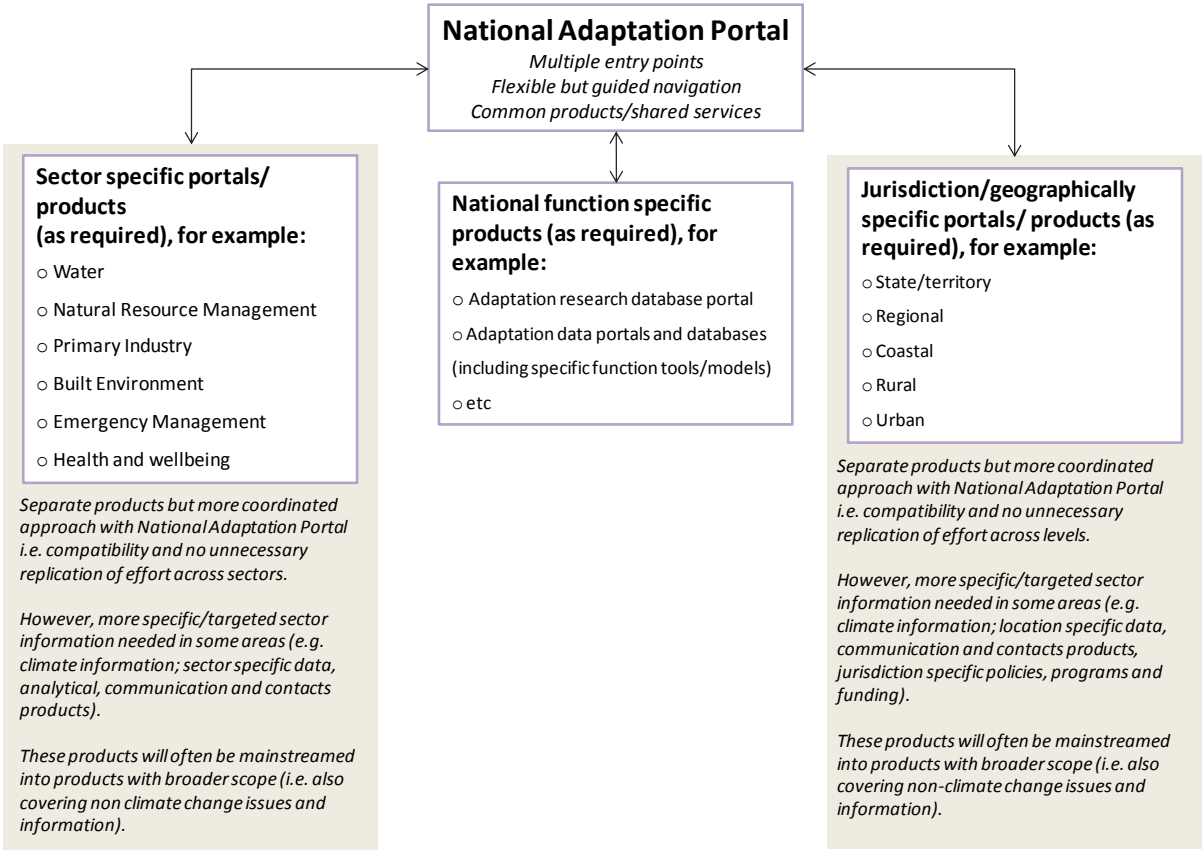

Figure 3.7 Overall adaptation portal architecture – a distributed model

Strategy 3.2: *Development of portals customised to meet unique needs of specific end user groupings be encouraged (e.g. for specific sectors, jurisdictions/geographic regions, functions, professional disciplines etc.), though in a way that minimises unnecessary duplication, and maximises sharing of knowledge.*

The inputs provided by stakeholders through consultations and workshops indicate that, whilst it would need to be confirmed by next level design and implementation planning, many functions typically included in an adaptation portal could use common or 'core' products that might be developed once only across a whole sector, or across regions, or indeed in some cases nationally. These core products would be made available to more specialised portals as 'core' or shared services, with the advantage of avoiding unnecessary duplication of effort and also providing a critical mass of usage that justifies ongoing development and support. Some consultants noted that even where they may have their own similar proprietary products, they would find it helpful to have comparable nationally endorsed core products in order to provide confidence to clients.

Strategy 3.3: *A number of adaptation functions likely to be included in portals to have common or 'core' products developed and delivered nationally as shared services, in order to minimize unnecessary duplication, and provide a critical mass of ongoing development and support for these products over time. This would include at least each of the overall user-need components identified (i.e. entry level, complex decision making and assurance).*

Strategy 3.4*: The nationally developed core components to be included in an Australian National Adaptation Portal with sufficient operational resource to:*

- *provide a level of support to other adaptation product service providers*
- *continuously improve the products over time based on practical user experience and relevant research*
- *validate that the appropriate or accredited use of core components provides a degree of assurance that best practices are being applied.*

This national portal would provide open access to other service providers who wish to incorporate or link the core components into their own products. It would also be directly useful to some end users, particularly when building up initial understanding and awareness. In this context, it could be oriented to any of the end user segments shown in Figure 3.6).

The above strategies provide overall direction. The next section reviews individual products to establish which might be useful to put this into practice in the Australian context, and Chapter 5 covers supporting governance and enabling strategies.

4. RESULTS AND OUTPUTS: PRODUCT ANALYSIS AND STRATEGIES

This chapter reviews a range of current (or in some cases under-development or planned) products in Australia and internationally to establish to what extent they could play a significant role in putting the overall product strategies into practice.

It describes the Adaptation Product Database developed by the project, and the product review criteria that have then been used to assess which products might be of particular interest in the above context.

4.1 The Adaptation Product Database

An Adaptation Product Database has been developed including Australian and international products, populated primarily by internet search complemented by input from a few other projects which have carried out partial product searches or summaries (Hammill and Tanner 2011; Aldum 2012; IGCC 2012) and by referral from stakeholder discussions. The latter has been especially helpful for identifying planned and under-development products.

Each product has been classified into one of the three overall product categories and related sub-categories (Figure 4.1). A number of standard fields have been used to further describe and classify each product in the database (see example of a product entry and extract of a database report at Appendix 4.1). It is maintained as an Access database for convenient update, access and reporting and could potentially be developed into a useful product in its own right.

The current data base includes approximately 300 individual products (approximately 90 in Category 1, 80 in Category 2 and 130 (of which around 30 are general portals) in Category 3). The database cannot claim to be comprehensive, as we have concentrated on those sources most likely to have products relevant to the project objectives. In particular, there are many more relevant data and analytical products available, often sector or system specific, and also additional products in individual countries overseas - we have not attempted to be exhaustive in these areas. However we have identified some of the more common or general sources in these areas as a starting point.

LAPS Database Structure		1.0 PROCESS STAGES				
		1.1 Framing/ Scoping 1.2 Decision Making Criteria	1.3 Impacts, Risk, Vulnerability Assessment	1.4 Options Identification 1.5 Options Assessment	1.6 Decision Making 1.7 Implement-ation	1.8 Monitoring, Evaluation & Review
2.0 DATA & INFORMATION	2.1 Climate Data	✓				
	2.2 Impact Data	✓	✓			
	2.3 Risk/ Vulnerability Information	✓	✓			
	2.4 Adaptation Options Information	✓		✓		
3.0 KNOWLEDGE PORTALS	3.1 Policy/ Regulations/ Governance/ Programs	✓		✓		
	3.2 Case Studies/ Contacts Database	✓	✓	✓	✓	✓
	3.3 Analytical Tools		✓	✓	✓	
	3.4 Research		✓	✓	✓	✓
	3.5 Engagement and Communication	✓	✓	✓	✓	✓
	3.6 Skilling and Education	✓	✓	✓	✓	✓

✓	End users at particular process stage very likely to use these data/information and knowledge products, often as an iterative process.

Figure 4.1 Product Database structure (categories and sub-categories).

High level numbering refers to the three categories identified in Figure 3.5.

Overall conclusions are that:

- a large number of products already exist with little general guidance as to which are most relevant to particular purposes
- in some areas (and especially process products) there is significant overlap in the content of individual products, though different product structures and language can make this difficult to discern, and this adds to confusion amongst end users; however in many cases the proliferation of products reflects the intrinsic diversity of purpose (e.g. different types of data and information) and target audience (e.g. tailored portals)
- several instances were discovered where a quite interesting product had been withdrawn or is not effectively supported or maintained because it relied on temporary funding or a knowledgeable and enthusiastic individual.

The proposed future strategies address these issues.

4.2 Product review criteria and process

To help assess the products for relevance in the context of a proposed Australian product strategy, review criteria (or features) have been developed for each of the three overall product categories. These are summarised in Figure 4.2 with the more detailed criteria shown at Appendix 4.2. Product review criteria include:

- Functional features: which review the functional coverage against the range of product categories and sub-categories identified
- User oriented features: a range of features that are likely to make the product more acceptable to end users (e.g. relevance, currency,; accessibility, flexibility, ease of use and interpretation, availability of support credibility, legitimacy)
- Good adaptation principles: Does it reflect leading adaptation principles? (as summarised in Chapter 3)

1. Functional features: meets user needs

Product Category 1:

Adaptation Process Guidance

(E.g. risk management cycle; multiple entry points and iteration)

Product Category 2:

Adaptation Data/Information

(E.g. on climate, impacts, risks, adaptation options)

Product Category 3: Adaptation Knowledge Portals

(E.g. knowledge systems, skilling, engagement and communication)

2. Delivers user oriented features

(applies to all 3 Categories)

3. Reflects good adaptation principles

(applies primarily to Category 1)

Figure 4.2 Product review criteria

A preliminary scan helped identify a subset of products for more detailed review against the above features as described later in this chapter. This review was carried out as a desk exercise by the project team as the project was not resourced to carry out direct end user piloting or testing of such a range of individual products. However, the overall conclusions reported below were also reviewed through several of the workshop processes where there was familiarity with some of the products. The conclusions should be viewed as an initial screening sufficient to shortlist products that appear to be of significant interest in delivery of the related strategies, but should be clarified and validated with potential users in the suggested follow up steps, including implementation planning of the recommended strategies. The review framework and methodology outlined above provides a robust basis for such a 'next step' review of these or indeed other products, as well as design criteria for new or improved products.

4.3 Adaptation process products

Most adaptation process products guide the user through a sequence of steps, emphasising that in practice they are rarely followed sequentially, with frequent iteration taking place between steps. The steps identified differ in name and number

between products and not all products cover all steps or to the same degree. In many cases they can be (and often are) mapped to the standard risk management process (Figure 4.3) which is also compatible with the overall international and national risk management standard AS/NZS ISO31000:2009 (Standards Australia 2009) and the DCCEE risk management guide (AGO 2006). Indeed the products often encourage incorporation of the outcomes of the adaptation process into the broader organisational risk management process.

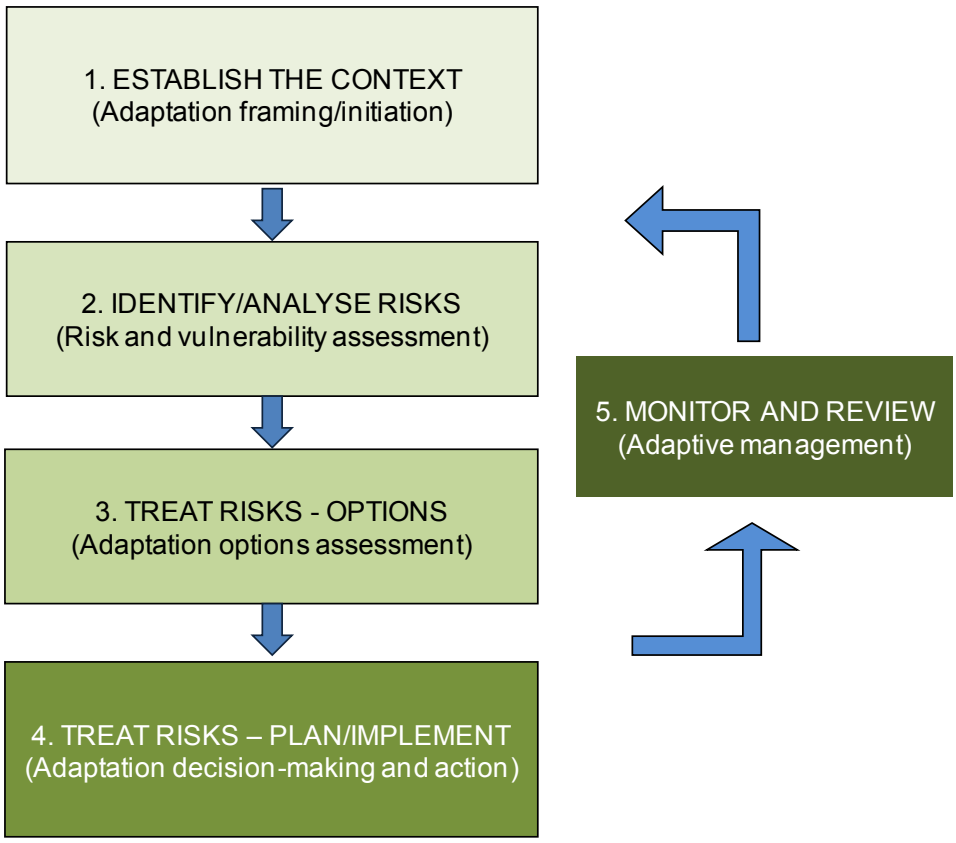

Figure 4.3 The standard risk management process and adaptation process stages

There has been support for using the risk management process as a useful overarching framework for adaptation (e.g. Willows and Connell 2003; Jones and Preston 2011). It has also traditionally been adopted as the guiding methodology in a number of adaptation areas (e.g. emergency and hazard management) at both the organisational and community level. Given the widespread use of risk management processes in both public and private sector organisations, it can also support mainstreaming of adaptation. Other end-to-end and cyclical process frameworks (e.g. the rational decision making framework adopted by Moser and Ekstrom 2010) can also be readily mapped to the risk management framework. It does have some limitations especially in handling the early stages of more transformational change, and where

there are significantly contested values which can require broader overarching social engagement and framing approaches as a prerequisite to the use of risk management processes. In some conceptual discussions on adaptation, so called 'risk-based' approaches have sometimes been contrasted with 'vulnerability-based' approaches, the former taken to be future-outcome and biophysical-impact oriented, and the latter present-state and social capacity or resilience-oriented, with the possibility also raised of combining these in 'integrated' assessment (Wolf 2012; Wolf et al. 2012). However these distinctions are not determined by use of an overarching framework such as the above risk management process, which can encompass any of these approaches, but rather by the decision of the practitioner as to how they are operationalised (Wolf et al. 2012).

The risk management process is therefore a quite robust framework for analysing most adaptation activities. Within this framework we have adopted a number of 'standard steps' to help map and categorise products in terms of their functional coverage (see steps identified earlier at Figure 4.1). We based this set primarily on those in the UKCIP Risk Framework (Willows and Connell 2003) with some additional detail from products developed recently through DCCEE's Climate Adaptation Decision Pathways Program (HCCREMS 2012, SECCCA 2012). These were chosen because of their relatively complete coverage of the process though (as mentioned above) it was found that nearly all products are in effect based on a quite consistent set of steps, albeit often described and grouped somewhat differently.

The following analysis reviews process products against the review criteria and identifies a number of products that could form the basis of nationally supported 'core' products in each of the component user needs (i.e. entry level, complex decision making, and assurance). It then identifies a number of areas where 'best practice' projects could provide the basis for ongoing enhancement of these products.

4.3.1 Process product review and strategies

The summary review of the subset of adaptation process products is at Appendix 4.3 and the main conclusions are summarised below.

Entry level products

Notable examples of entry level products include the current DCCEE Guide (AGO 2006) and the Local Government of Queensland Guide (LGAQ 2007) in Australia, and the UKCIP Wizard (UKCIP 2012c) and EU Climate-Adapt Support Tool (European Commission 2012) internationally (the latter itself in part drawing on UKCIP products). Several more are included in the detailed review, and the conclusion is that the UKCIP Wizard could be a good basis on which to develop a core product for Australian use, being up to date, user-friendly, reflecting good principles, and widely used and recognized both in the UK and internationally.

Complex decision making support products

A number of process support products for more complex decision making have been identified. Examples include the UKCIP Risk Framework (Willows and Connell 2003), the ICLEI Canada guidance product (ICLEI Canada 2012b) and more recently the

UNEP sponsored PROVIA Guide (PROVIA 2012) though the latter is still under development, along with a possible EU funded user-oriented product through the Mediation Project (Mediation 2012). Within Australia there is nothing of this type in the public arena though several consultants have their own proprietary tools. However under the DCCEE funded Climate Adaptation Decisions Pathways program (DCCEE 2012c) several projects have developed procedural guidance to support decision making and in particular two projects have focused on a comprehensive guidance document (HCCREMS 2012; SECCA 2012) as a primary deliverable. Whilst developed and tested on local government coastal issues, this product could, with some slight modifications and enhancements, provide the basis for a more generally useful product in Australia. Its' approaches are quite consistent with the main international products identified, it is up to date with latest thinking, and has been tested (albeit with a limited audience to date) in the Australian context.

Assurance products

The third component of adaptation process needs and products has features that are distinct from the entry level and decision making process products. This must be taken into account when interpreting the comparative product review which uses criteria that are more relevant to the previous two components. Assurance process products assess *how well* adaptation activities are being handled organisationally, rather than on providing guidance on *how to* carry out each stage. In this case it may be necessary to develop a product or products specifically for this purpose, but guidance might come from other products, such as the Standards Australia Settlements and Infrastructure Guideline (Standards Australia 2011), the Green Building Council of Australia's Green Star Rating system (GBCA 2012), and the Australian Green Infrastructure Council Sustainability Rating Scheme (AGIC 2012) which have adaptation expectations embedded; and the UK local government National Indicator 188, until recently a mandatory adaptation reporting regime (DEFRA 2010).

***Strategy 4.1**: Adaptation process products be developed and maintained as national common or 'core' products, and the next steps review whether these can be based:*

- *for entry level support, initially on a minor customisation of the UKCIP Wizard product to the Australian context*
- *for more complex decision making support, initially on extension of the guidelines developed for the HCCREMS (Hunter region councils) and SECCCA (Westernport region councils) under the DCCEE funded Climate Adaptation Decision Pathway Project program*
- *for assurance products, initially based on review of good adaptation principles and practices in conjunction with the current development by Standards Australia Guidelines for Settlements and Infrastructure and other relevant adaptation standards and benchmarks/ratings.*

In each case, the above strategy would include demonstrating how the product conforms with current risk management standards; a review of the product capabilities with a range of end users to confirm acceptability as a core product; and modification as necessary to be more generic across sectors; but with the capacity to add extra components over time (based on identified best practices or sector/jurisdictional specific needs).

> ***Strategy 4.2****: The common or 'core' national adaptation process products be used to inform other national adaptation process standards and guidelines in existence or under development, with a view to these standards/guidelines progressively reflecting the core product approaches, whilst adding specific sectoral needs where necessary. Examples include national standards/guidelines being developed for settlements and infrastructure (Standards Australia 2011), emergency management (AGD 2013) and natural resource management (potentially by DCCEE/DSEWPaC and national resource management bodies under the Clean Energy Futures package). They would also replace the current DCCEE (AGO 2006) Guide.*

This approach of building on products that either exist and are proven, or are currently under development and have been tested with a range of end users, is more likely to lead to quick cost-effective progress than the alternative of starting from scratch.

4.3.2 Best practice strategies

Good adaptation principles were summarised in Section 3.1 and used in the process product review criteria. There is less clarity on the next level down 'best practices' as these are still emerging. However the growth of recent practical experience provides an opportunity to develop more systematic approaches and methodologies (Preston and Kay 2010, Webb at al. 2013). Based on the stakeholder discussions and literature review the following priorities have been identified as projects that would usefully distil emerging best practices. The outcomes would provide extra guidance for adaptation initiatives and be incorporated progressively in future product development.

Adaptation framing, goal setting, monitoring and evaluation

The need for effective framing is clear but there is limited guidance on how to do this in practice, especially as there are many alternative framings that are quite valid depending on context (e.g. whether to frame the adaptation intent as being to address current risks, future risks, to build resilience, or to bring about sustainable development and transformational change (McGray et al. 2007)). Effective framing can also require better understanding of stakeholder values and preferences, and leadership and institutional issues, which all help shape adaptation objectives and goals. There is then a clear link to effective monitoring and evaluation as this is based on goals and related indicators. There is an opportunity to bring together many strands of recent work to provide more practical guidance in these related areas, which also tend to be the least developed in most current process products. Sources include various research studies and practical experience on framing (e.g. Brown et al. 2011; Fuenfgeld et al. 2012), products such as UK Climate Impact Programme's AdaptME (UKCIP 2012d), and the

UK Government's National Adaptation Programme which is also developing an approach to measuring and monitoring adaptation progress (DEFRA 2012a).

Adaptation options assessment and decision making

A major challenge has been moving from risk and vulnerability assessment to decision making and action. Whilst some of the barriers flow from leadership, framing and institutional issues, there is also a need for greater guidance on appropriate options assessment and decision making support. Issues have included how to choose the appropriate methodologies and data appropriate to the local context including the types of decisions likely to be involved; and how to handle potentially complex interdependencies, varying spatial and time scales and significant uncertainty. Useful approaches can be distilled from relevant current research projects and case studies, as well as some current and emerging products. Examples include:

- current and planned support products e.g.(Willows and Connell 2003, PROVIA 2012) and various UK Climate Impact Programme products at UKCIP 2012a (e.g. AdOpt; Costing; Decision making under uncertainty);
- application of various conventional evaluation techniques to adaptation (scenario planning, cost benefit analysis/multi-criteria analysis/real option tools);
- insights from recent Australian adaptation initiatives e.g. various NCCARF funded projects (e.g. Randall et al. 2012); and as already referred to, a number of the DCCEE funded Climate Adaptation Decision Pathways projects (DCCEE 2012c).

Integrated regional adaptation assessment and planning approaches

Adaptation assessment and planning at the regional scale (smaller than state, bigger than local government) can provide extra insights and leverage to support moving to action. It can provide integrated and strategic context for other initiatives at other levels, and also generate organisational collaboration to address institutional fragmentation and management of complex interdependencies. There is an opportunity to distil the learning from a range of Australian regional projects carried out in recent years (e.g. the NSW Integrated Regional Vulnerability Assessments (NSWOEH 2012); South Australia's Integrated Climate Change Vulnerability Assessments (GoSA 2012); Tasmania's Regional Climate Adaptation projects (STCA 2013); the South East Queensland Climate Adaptation Research Initiative (CSIRO 2011); Western Australia's Peron Naturaliste Group Regional Initiative (PNP 2013)). The South Australian approach also provides an example of coordinated regional governance approaches on a state wide basis.

Strategy 4.3: *The national adaptation process products be progressively enhanced based on emerging best practices distilled from practical experience, research and some other products. Three priority topics are recommended for immediate best practice projects covering:*

- *adaptation framing, goal setting, monitoring and evaluation*
- *adaptation options evaluation and decision support*
- *integrated regional adaptation assessment and planning*.

4.4 Data and information products

These products have been mapped to several sub-categories (see Figure 4.1) including:

- climate information and scenarios
- socio-economic information and scenarios
- hazard, exposure and impact data
- risk and vulnerability information
- adaptation options information.

They represent the data that end users may need to access at various points in the adaptation process.

By definition, much of the information in these products is specific to location and context so that, compared with the intrinsically more generic process products there is less value in comparing products from different jurisdictions. There could be some learning from other products on the best approaches to developing, accessing and presenting the data, but this was beyond the scope and resources of this project. However the following conclusions have been developed based on stakeholder discussions and inspection of some of the products currently available.

Climate information and scenarios

Currently national climate information is provided by the Bureau of Meteorology for historical data and through CSIRO and the Bureau via Climate Change in Australia (CSIRO and BOM 2007) and the OzClim on-line projections tool (CSIRO 2012c).

Feedback from stakeholders indicates that it is not always clear what climate information users really need to make effective decisions, and how to interpret and appropriately use the information (especially projections) currently available. There is also a lack of information at appropriate regional and local scales and access/interpretation could be more user-friendly.

An integrated approach to the next generation of climate information services for Australia, based on the Intergovernmental Panel on Climate Change Fifth Assessment Report (IPCC AR5) modelling (CMIP 2012), and including end user portal access, is under discussion and development via Coalition of Australian Governments processes, coordinated by DCCEE, CSIRO, and the Bureau of Meteorology with the states and territories. This will incorporate work commissioned under the Clean Energy Futures funded Natural Resource Management program (DCCEE 2012e). A prototype of the proposed methodology and user interface is that developed and released for use by Pacific Island nations (CSIRO 2012d).

It is too early to know to what extent these planned initiatives will meet user needs. However lessons for the next wave of climate services should be drawn from Australian and overseas experience (e.g. state-led downscaling such as Tasmanian Climate Futures (ACECRC 2013a) and the NSW/ACT NARCLiM initiative (NSWOEH 2012b 2012); relevant NCCARF funded projects on climate information needs for decision making (e.g. Verdon-Kidd et al. 2012, Randall et al. 2012); and internationally the

national UK projections UKCP09 (DEFRA 2012b), and Cal-Adapt (California Energy Commission 2011). For example, Verdon-Kidd et al. (2012) confirm the need for realistic expectations on the extent that climate science will reduce uncertainties and an understanding that useful decisions can nevertheless still be made; much better assistance for end users on how to interpret and use climate information (including a potential role for knowledge brokers to package, translate and transform climate information), and on the availability and use of tools and methods that allow for uncertainty; and more usable natural variability and baseline climate information. These findings are all consistent with the feedback from the current project consultations and the identified good adaptation practices (e.g. better variability and baseline information would support engaging stakeholders through an understanding of current and local climate issues).

***Strategy 4.4**: Current planning for future climate information services (by DCCEE, CSIRO, Bureau of Meteorology under the auspices of the Coalition of Australian Government, and the related DCCEE-managed component of the Natural Resource Management programs) will incorporate climate information based on the IPCC Fifth Assessment Report (AR5) modelling, into a new generation of climate services/portal products, with a view to developing a consistent set of scenarios and projections for use at national, state and regional/local levels. It should be confirmed that these products will clarify how to appropriately interpret and use the climate information, and reflect user insights synthesized from recent state based and international product developments and NCCARF research projects, and also include current climate, trends and variability.*

Socio-economic information and scenarios

Current and trend socio-economic information is increasingly important as it is appreciated that adaptation is at least as much a social as a scientific and technical issue.

Many adaptation projects develop current local socio-economic profiles and trends as context and to provide insights on adaptive capacity and potential vulnerabilities. Some guidance on the most useful indices and sources of data would be helpful as these are often rediscovered by each project.

Future socio-economic scenarios are also important to integrate with climate and environmental scenarios. The IPCC (2012) is developing a new set of scenarios for the Fifth Assessment Report (AR5) and CSIRO is developing a set to be integrated with the above-mentioned climate scenarios for Australian regions (Stafford Smith 2012). However the UK Climate Impact Programme has advised that their socio-economic scenario product has had relatively low uptake.

Strategy 4.5: *In conjunction with the previous recommendation, review the needs and options for development of related socio-economic scenarios, taking account of the UK Climate Impact Programme experience of low uptake of such a product. Also review potential for greater guidance on appropriate indices and sources of data for local socio-economic profiling, based on the Australian adaptation project experience to date in this area.*

Climate hazard, exposure and impact information

These products can be segmented into translation of raw climate data into more useful parameters for impact assessments (e.g. UNSW (2012); ACECRC developed sea-level rise products (ACECRC 2013b); biophysical and hazard data (e.g. flood inundation/bushfire mapping); exposure data (e.g. assets at risk) and impact information (e.g. combining hazard with exposure). There are also a large number of sector specific databases that are important in assessing potential impacts and responses. Examples of some of the sources of key data sets are at Appendix 4.4 which demonstrates the diversity of data potentially relevant for adaptation initiatives.

Stakeholder discussions revealed a number of concerns with current data sets including coverage, accessibility, consistency, provenance (supporting credibility), and ability to properly interpret. As an example, the proposed Geoscience Australia National Flood Risk Information Portal (Geoscience Australia 2012) was seen as a useful step, but concern was expressed that data contribution is still voluntary and will not address the inconsistency of approaches at the council level; and that national approaches should also cover other hazards.

Confirmation of the highest priority data sets and improvements would provide a basis for future national investment, and assist identification of key data products to be accessible via the proposed National Adaptation Portal. This can also leverage off current initiatives such as those covered in Appendix 4.4, including those of Geoscience Australia covering a number of hazard and exposure databases, the Bureau of Meteorology on water and environmental data, and a number of Australian National Data Services (ANDS)-funded projects (e.g. climate data downscaling for impact analysis (UNSW 2012) and the Adaptation Information Hub (Griffith University 2012)).

Strategy 4.6*: Develop an overview of the available and most sought-after national climate hazard, exposure and impact data for linkage via the proposed National Adaptation Portal. This will improve visibility and access to this data, and help prioritise future initiatives to improve the coverage, consistency, credibility and interpretation of key data sets.*

Risk and vulnerability information

Organisations need to develop their own risk and vulnerability assessments but many would also benefit from access to a consolidated view of assessments that already exist especially in potential 'analogue' locations.

In the medium/longer term it may be possible to consider the development of a more consistent and comprehensive national/state/regional assessment along the lines of the recently completed UK Climate Change Risk Assessment (DEFRA 2012c) and the current US National Climate Assessment (USGCRP 2011) processes. However a more immediate and practical measure in the Australian context would be to develop a database of existing assessments and associated risk register to be made available through the proposed National Adaptation Portal (see Strategy 3.4). Sources would include the DCCEE-funded sector-based National Regional Vulnerability Assessments and Local Adaptation Pathways Program programs (DCCEE 2012a,b), primary industry studies (DAFF 2012), studies such as the Marine Report Card (CSIRO, NCCARF and FRDC 2012), and various State impact assessments including a current NCCARF-funded synthesis project for state governments.

Adaptation options information

As for risks and vulnerabilities, whilst each organisation needs to carry out its own adaptation options assessment, stakeholder discussions have indicated interest in an accessible database of projects and case studies, and a register of typical adaptation options and their characteristics. This can help end users accelerate and test the framing and options most relevant to their situation (a form of 'fast iteration'); provide a starting point for end users new to adaptation and with limited resources; and facilitate sharing of experience including through development of networks of practitioners (referred to here as communities of practice). Whilst some of this might be done nationally and across sectors, this might also be complemented by work done by or for individual sectors (e.g. SMEC 2010) as an example for local government). There could be an initial focus on priority areas with more extensive recent experience (e.g. coastal projects).

> ***Strategy 4.7:*** *Develop a database of significant Australian climate risk, vulnerability and adaptation projects at the national, state, regional and local levels, including brief scope, outcomes to date, and current contacts; to be placed on the proposed National Adaptation Portal. Over time this may also lead to a set of case studies and a 'register' of typical climate risks and adaptation options.*

4.5 Knowledge portal products

Section 3.6 concluded that portals should be a foundation of any adaptation product strategy and proposed that a National Adaptation Portal be developed as a source of, and navigation aid to, commonly sought process guidance, data and knowledge as a shared service. This could be for direct access by end users or for incorporation into other sector, jurisdictional/spatial or functionally specific portals.

A set of Australian and international knowledge portals have been reviewed against the desired product features and related criteria. The summary of this review is at Appendix 4.5. Even more so than other categories, individual portals can have a quite distinctive focus in terms of scope (international, national, regional, sector, function) and target audience (decision makers, professionals/practitioners, researchers, policy makers, communities). Therefore it is natural they have specific strengths depending on their objectives.

Of the international products reviewed, the EU-Climate Adapt portal (European Commission 2012) most resonated with the concept of a National Adaptation Portal in terms of scope, coverage, audience and intent, as well as ease of use and navigation.

In Australia, currently available examples include the NCCARF Local Government Portal (NCCARF 2012c) and the West Australian Local Government Association Climate Change Management Toolkit (WALGA 2012), but currently the broadest in intent and scope is the VCCCAR-funded RMIT-developed Adaptation Navigator, which also has a user interface specifically designed for flexible entry and navigation (RMIT 2012). Although published to date as a Proof of Concept and initially targeted at local government in Victoria, it is a good starting prototype, especially for the user-interface, from which a more comprehensive National Adaptation Portal could be developed.

There are several other relevant product initiatives under development or planned in Australia. These include the proposed National Climate Change Information Services Portal referred to in Strategy 4.4 (DCCEE 2012e), the NSW/ACT Government climate information and impacts portal (NSWOEH 2012), the Adaptation Information Hub (Griffith University 2012), a South Australian Government-funded portal intended for all sectors in that state (Hamden 2012), a potential natural resource management portal associated with the Commonwealth Governments Clean Energy Fund package (DSEWPaC 2012; DCCEE 2012d) and a primary industry portal or portals (CCRSPI 2012). In addition, NCCARF is intending to upgrade its' Local Government Portal and is also developing a Business Portal (Rissik 2012, pers. comm.). Some of these are scoped nationally, some by sector and some by jurisdiction. Of these portals currently under development, the Adaptation Information Hub is of particular interest as, whilst still being scoped and designed, it has the potential to span end user interfaces, adaptation process and knowledge functions, data and tools all within a structured and reusable information and technical architecture.

Whilst most of these products are addressing a distinctive audience and need, the challenge going forward is to ensure that they are genuinely complementary and to see if collectively, they can offer more than the sum of the parts, for example by sharing design concepts and access to adaptation resources.

***Strategy 4.8**: The recently released Proof of Concept for a portal for Victorian Councils (the Victorian Centre for Climate Change Adaptation Research (VCCCAR)-funded RMIT-developed Adaptation Navigator) and the Australian National Data Service (ANDS) –funded Griffith University-led Adaptation Information Hub (currently under development) be considered as potential architectural bases for a National Adaptation Portal. The Adaptation Navigator has an imaginative end user interface with intuitive structure and flexible entry points and navigation paths, whilst the Adaptation Information Hub has a design concept with the potential to integrate end user interface, adaptation process support, data sources and modelling tools into a consistent architecture supported by a sustainable metadata and technology infrastructure.*

The design of the proposed National Climate Change Information Services Portal also provides an opportunity to support a broader National Adaptation Portal approach.

This strategy would include confirming that the design of these products would provide an acceptable base for a broad range of end users and for future product development priorities.

More specific tasks to validate the extent to which the Adaptation Navigator and Adaptation Information Hub designs could, between them, provide an appropriate architectural base would be to:

- clarify and confirm with key product audiences, the objectives and scope of a National Adaptation Portal in the Australian context; including the most valued functions to include
- confirm that the products could be readily enhanced to:
    - cover content relevant to all sectors of interest and a national perspective
    - incorporate the full range of potential portal functions if required
    - incorporate a clearer linkage between the current functions planned within the portals and the proposed national adaptation process products (see Section 4.3.1)

This approach is likely to lead to faster development of a national portal than the alternative of starting from scratch, as the products have already had a significant degree of design input from end users and other stakeholders. Even if changes and enhancements are required to meet a broader range of user needs, development starting with such prototypes is likely to be a more practical and cost-effective path.

To support this approach of building on existing initiatives wherever possible, and encouraging collaboration between initiatives, the project convened a workshop in December 2012 of representatives of many of the relevant current and planned knowledge and data portal products in Australia, including all of those referred to earlier in this section. As well as being a first opportunity to share plans and experience across all of the products, the workshop concluded that there are a number of collaboration opportunities and that these should be progressed through a continued

process of networking and sharing across the initiatives. This would clearly be facilitated if the other strategic proposals in this report are adopted and implemented, as they would provide a clear national framework within which individual proposals could progress, with benefits to both the individual initiatives and to the collective solutions.

The workshop also identified the potential to support a more coherent approach through development of a more formal 'adaptation product registration' process, building on the Australian National Data Services (ANDS 2012) approaches, experience and infrastructure. This is shown diagrammatically in Figure 4.4 which maps the various categories of products and their relationship to end users, and the potential for national registration, metadata development and infrastructure programs to provide a degree of cohesion across the various products and levels. Collaboration at the research level (including data acquisition and analysis) can also be facilitated by the National eResearch Collaboration Tools and Resources program (NeCTAR 2012)

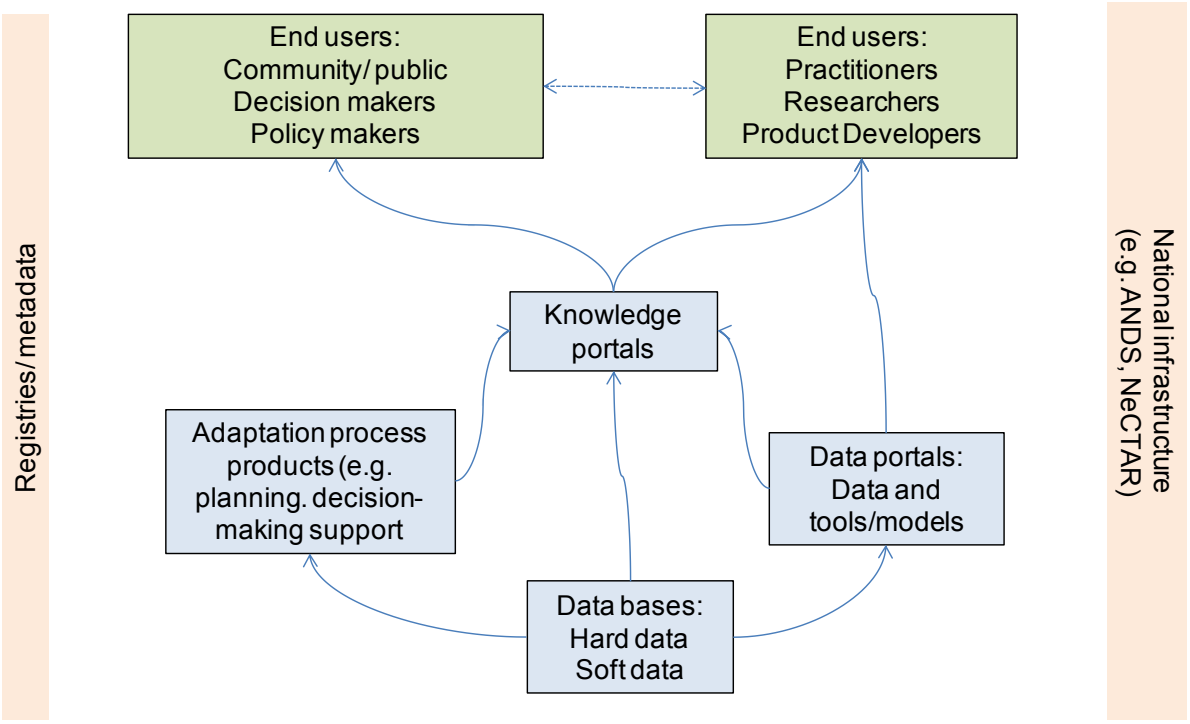

Figure 4.4 Adaptation knowledge and data products, and the potential for national registration and collaboration

Advantages of this approach would include clarifying and validating the 'provenance' of the product (enhancing user confidence), facilitating and encouraging re-use (improving discovery and access and avoiding unnecessary duplication and proliferation), facilitating integration and connections across different products (adding new value) and supporting a more coherent approach across institutions. It could also link to the ongoing development and maintenance of the Product Database created as part of this project.

Strategy 4.9: *The opportunity presented by the current and planned development of a number of national/state/sector adaptation portals be used (through a design sharing group) to establish opportunities for collaboration and shared learning, and approaches that will enhance both the proposed national solutions (such as a National Adaptation Portal) and each of the other initiatives. Design ideas can also be drawn from some of the most developed international adaptation portals (e.g. EU Climate-Adapt).*

Strategy 4.10*: Map existing and planned adaptation portal products (including sector, jurisdictional, functionally specific portals) to the overall national architectural framework (see Figure 3.7), both as a navigational guide for end users and to identify coverage and gaps.*

Strategy 4.11*: Investigate the potential for more formal product registration, metadata and infrastructure support processes to underpin other product strategies (see Figure 4.4) drawing on Australian National Data Services (ANDS) experience, portal products currently under development, and the Product Database developed as part of this current (LAPS) project.*

4.6 Sourcing of content for a National Adaptation Portal

To the extent possible the functions and content in a National Adaptation Portal would draw on existing resources. Figure 4.5 shows the ten functions identified previously as possible content for adaptation portals and now also indicates some of the potential sources of content where already available or as proposed in this report.

There are three groupings of functions:

- relevant sources already exist with some modification
- new content needs to be created
- the nature and need for the function requires significant clarification.

Relevant sources already exist with some modification

The proposed sources of core Adaptation Process Products (Function 2 in Figure 4.5) and Data and Information Products (Function 3) have been covered in previous sections of this report (i.e. for adaptation process and data products).

The Adaptation Product Database, including specific purpose analytical tools (Function 4) could build on the Product Database developed for this project to provide a searchable database to navigate to relevant product and tools. It would also be useful to identify any special purpose tools that might be scoped and promoted for national support and adoption to realise their full potential. Several have been identified or suggested in the course of this project (e.g. ACECRC's Canute for sea level rise impacts (ACECRC 2013b)); Pitt and Sherry's Climate Asyst for infrastructure (Pitt & Sherry 2010); an asset management tool (Balston at al. 2012), and a health and heat wave management tool (Bell 2012) that have been developed for councils; the Insurance Council of Australia-funded Building Resilience Rating Tool (BRRT) for dwellings (ICA 2012)). The database would also point to the sources of more general tools and techniques that might warrant greater use in the adaptation context (e.g.

scenario planning, agent based modelling, choice modelling and other techniques to assist in social and behavioural aspects of adaptation assessments).

For the Research Database (Function 7), the NCCARF-funded University of Southern Queensland managed iClimate initiative (USQ 2012) is an excellent basis, provided it is resourced for ongoing update.

New content needs to be created

The Adaptation Background and Facts (Function 1), which would also include introduction to the National Adaptation Portal concept, and links to other relevant portals; the projects Database and Case Studies (Function 5); Key Contacts/Communities of Practice/Events Database (Function 6); and Relevant Policy and Programs for the Commonwealth Government (Function 10); would all need to be developed specifically for the portal as required. The current DCCEE website already has some relevant material for Functions 1 and 10.

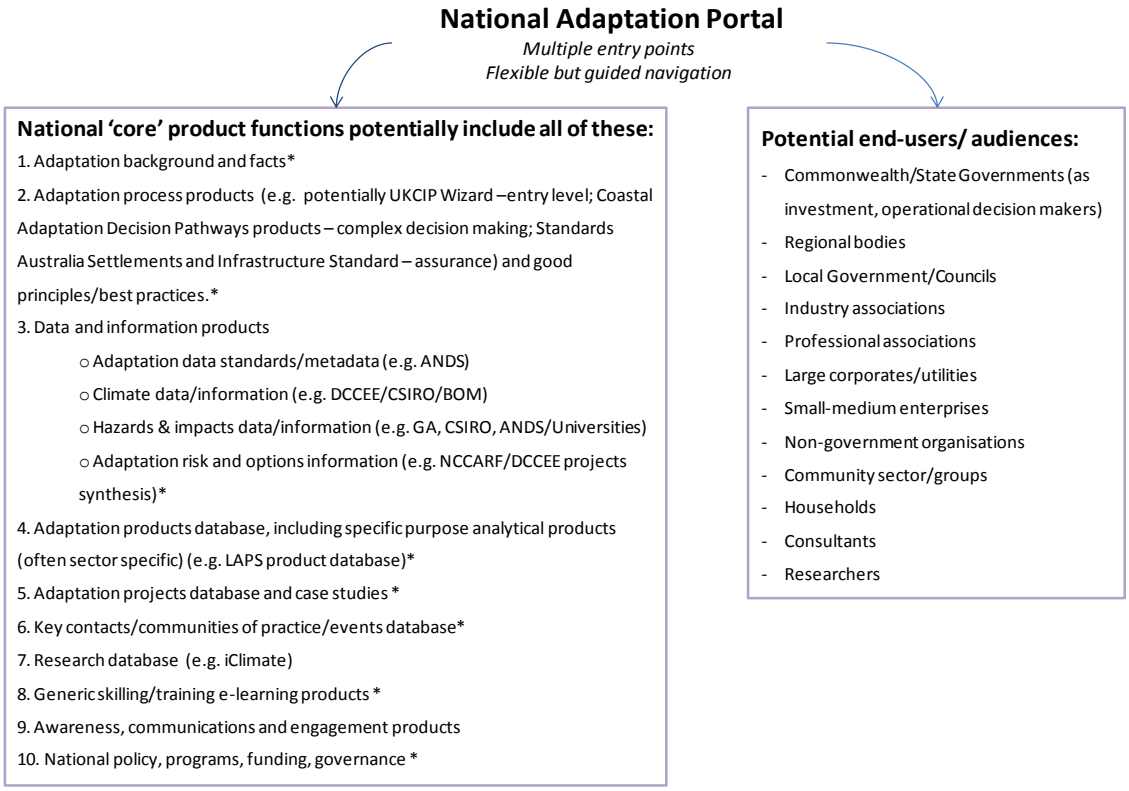

Figure 4.5 Core functions and potential sources for a National Adaptation Portal

Asterisked functions are likely to be at least in part developed and 'owned' by the national portal owner. The other functions are likely to have other national owners with links from/to the National Adaptation Portal.

The nature and need for the function requires significant clarification

The need for skilling and training products (Function 8) and communication and engagement products (Function 9) was raised often in stakeholder discussions, but it is less clear in these cases what might be helpful at the national level.

A limited number of training and skilling products were identified. The type of support offered could be divided into in-person or tailored support in the form of workshops and training programs; or indirect, generic support through online seminars ('webinars', discussion forums) and self-directed online tutorials. One of the advantages of online learning is that it has broader reach. Hence, this form of training/skilling was more often employed by organisations with user groups in multiple countries, such as those in the development sector. ICLEI was one of the main providers of in-person support (e.g. ICLEI Canada (2012a); and through participation in the capacity development packages delivered through the European CHAMP Local Response to Climate Change Project (CHAMP 2012)).

In Australia the DCCEE-funded Climate Change Adaptation Skills for Professionals Program (DCCEE 2012a) provided tertiary education, training institutions and professional associations with the capacity to revise or develop professional development and accreditation programs, especially targeted at architects, planners, engineers and natural resource managers. Another example is the Victorian Department of Sustainability and Environment's Future Coasts Program Training Package, which consists of a half to one day training workshop on climate change and coastal adaptation planning (Victorian Government 2012b).

Also identified were a limited but diverse range of products which aim to promote awareness, and facilitate communication and stakeholder engagement with climate change adaptation issues. Approaches employed include social media (such as twitter, facebook, and blogs), online newsletters, discussion forums and events. Some examples of interest include the Harden Up initiative (Green Cross Australia 2012), which aims to raise awareness of natural hazard exposure through an interactive website; the Victorian Government's Department of Primary Industry's Climate Dogs animation series (DPI Victoria 2010), which uses short animations of sheep dogs to explain the drivers of climate change to farmers; and VCCCAR Think Tank events (VCCCAR 2011), which aimed to facilitate communication and exchange of knowledge between scientific, policy and stakeholder communities.

Learning from the above and other examples would help identify the potential for skilling and communication products for a national portal.

> ***Strategy 4.12:*** *Confirm readily available sources for priority functions in the proposed National Adaptation Portal and clarify need and potential sources and design concepts for other functions.*

The product review in this chapter has been based on extensive search, analysis and engagement. However there will need to be validation and further development of some aspects as the proposed strategies are progressed. In this respect the proposed approach of fast prototyping of existing products with end users, rather than starting from scratch is likely to lead to the quickest and most cost effective outcomes.

5. RESULTS AND OUTPUTS: GOVERNANCE AND ENABLING STRATEGIES

5.1 Governance issues, options and strategies

The proposed product strategies, and in particular development and support of common or 'core' products and shared services (such as a National Adaptation Portal) require some form of national governance and coordination arrangements, including definition of roles and responsibilities and organisational arrangements to put these into effect.

At the national level, potential roles, none of which exist as nationally recognised and ongoing functions at the moment, could include:

- developing, delivering and maintaining the National Adaptation Portal and associated products and services
- developing collaboration and relationships with other providers
- maintaining adaptation principles, best practices, standards, quality assurance and benchmarks
- supporting communities of practice and skilling, including an overall national knowledge broking role to practitioners and other end users
- distilling and incorporating learning and user feedback
- promoting innovation and an informed market in products and services
- connecting practice to research and policy
- advocacy for improved adaptation support based on practical experience and evidence

This includes national product development and maintenance but equally importantly coordination and relationship-building with others responsible for providing complementary national functions and data (e.g. DCCEE, Attorney General's Department, NCCARF, CSIRO, Bureau of Meteorology, Geoscience Australia, and other government agencies) and the likely providers (public, private and community sectors) of complementary and more tailored products to specific sectors, jurisdictions or regions.

It also includes a number of enabling roles. A significant finding from the consultations and workshops was that the context within which products are used is at least as important as the products themselves. Examples of this range from the provision of greater confidence and assurance through various forms of 'accreditation' of products and practitioners, to availability of effective support through training, skilling, development of communities of practice and a knowledge broking capability. For example, the importance of a knowledge broking role was stressed by the wide range of public and private sector representatives in the multi-stakeholder Informing Adaptation Policy workshop (Webb 2012) with a suggestion that this capability should be at regional as well as national level; and by Verdon-Kidd et al (2012) which refers to the potential for national and state-based roles especially (but not only) in the context of interpreting climate-related data and information for end users. The proposed enabling strategies are covered more explicitly in Section 5.2, but it is sufficient to note here that they would benefit from a national drive and coordination.

It is possible to envisage a spectrum of options for a national coordinating entity to carry out the above roles (see Figure 5.1) with the options ranging from relatively 'light' (lower resourcing commitment, more flexible institutional arrangements) to 'heavy' (higher resourcing commitment, more formalised institutional arrangements)

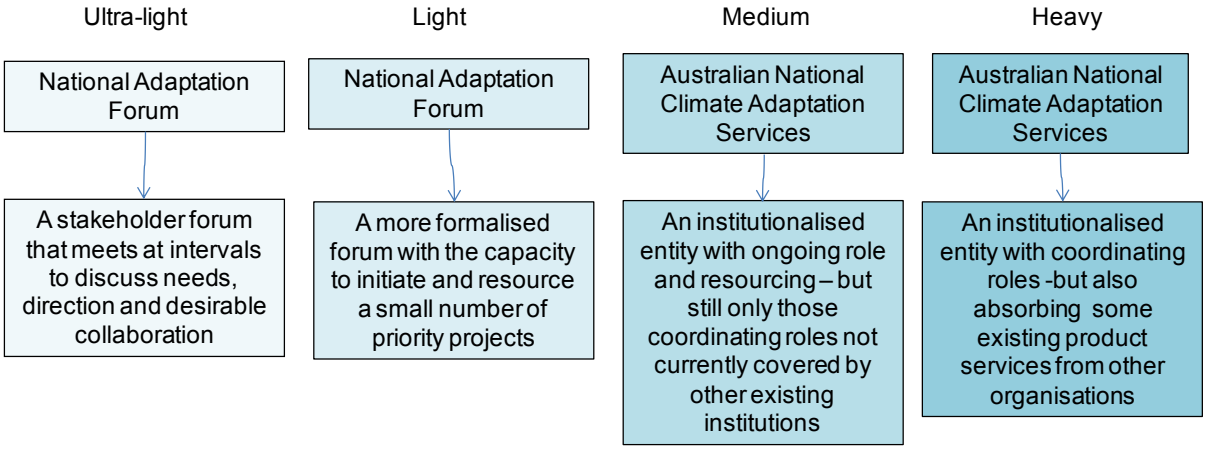

Figure 5.1 A spectrum of potential organisational arrangements

At the simplest level, a forum (labelled here a National Adaptation Forum) of private, public and community sector stakeholders could meet on a regular basis (say twice a year) to discuss direction and seek voluntary collaboration. However this is unlikely to meet the sense of urgency and need for a more coordinated and intentional approach, including development of national products, reflected in this report.

An extension of this would be for such a forum to develop the capacity and arrangements to initiate agreed priority projects, including responding to some of the key strategies in this report. This would have the advantage that a range of stakeholders could build confidence in working together, whilst making progress on some of the priorities. However, over time, it would still not reflect the need for sustained maintenance and development of the main strategies and core products.

At the other end of the spectrum is an approach that establishes a new entity (labelled here the Australian National Climate Adaptation Service or ANCAS) specifically to carry out the full range of coordinating roles. The lighter version of this includes only the essential national coordinating roles and associated core product development and support identified in this report. In the heavier version, the entity could also absorb some current product development activities carried out by other organisations. However, all of the currently existing organisational roles and products identified as part of this project are complementary to, rather than overlapping with the strategies proposed in this report. Therefore, there is little merit in absorbing any of these other roles provided collaborative arrangements are put in place.

Given the starting position and wide range of interested stakeholders (including public, private and community sectors; practitioners and researchers) the formation of a National Adaptation Forum with the capacity to initiate some priority projects (labelled the 'light' option in Figure 5.1) could be a viable and pragmatic initial step. Indeed a number of key private and public sector stakeholders engaged through the project have supported this idea and, facilitated by the project team, formed a steering group for

development of a National Adaptation Forum. One of the roles of such a forum would be to establish whether and how a more institutionalised entity such as the proposed 'ANCAS' might be developed.

Based on the needs expressed by stakeholders and end users, creation of the lighter form of the ANCAS entity (labelled the 'medium' option in Figure 5.1) seems likely to be most effective over time. It would provide the ongoing coordination, commitment and continuity currently missing and, through focusing only on those elements not already being performed, do this in a cost-effective manner, building on and complementing the current roles of other organisations.

The following discussion is therefore based on the 'medium' option as a desirable end state, bearing in mind the potential to evolve towards this solution. This option is shown diagrammatically at Figure 5.2. The shaded boxes in the bottom half of the chart are examples of the activities that would continue to be performed by others, as now.

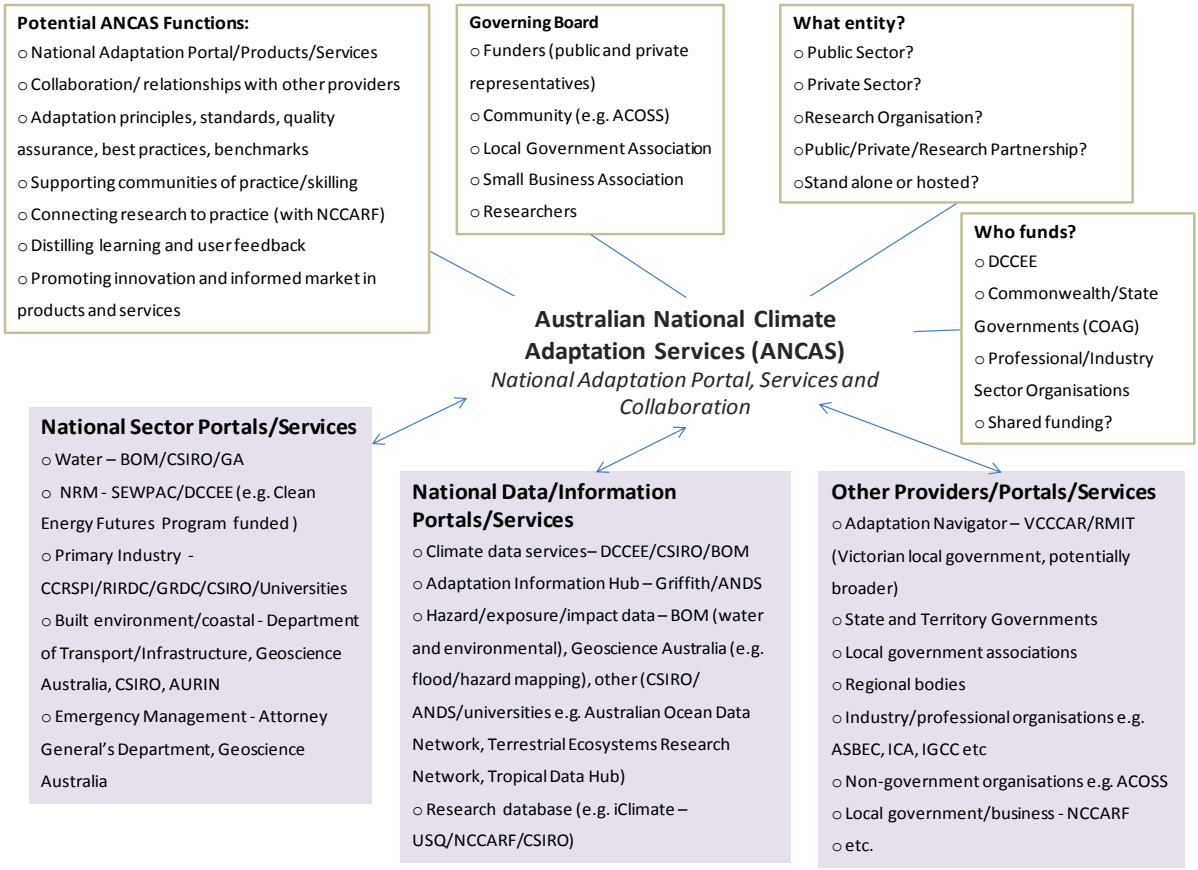

Figure 5.2 A National Climate Adaptation Service: institutional options

Note that the shaded boxes are not part of the proposed ANCAS but should be key partners.

Some desirable characteristics of such an entity would be that it:

- be positioned as clearly national and cross-sectoral
- reflect the intrinsically shared nature of the adaptation challenge, fostering a collaborative approach between the public, private and community sectors

- be responsive to ongoing adaptation learning, and evolving stakeholder needs and feedback over time
- link practice to both policy and research
- have a degree of independence from the political cycle, to ensure sustained strategy over time.

A key question is the appropriate balance of public and private sector responsibilities for delivering such a role. A level of government resourcing and role in governance is appropriate to reflect the public-good nature of many of the services, and the critical contribution of government sourced information. The current level of market maturity and knowledge in adaptation is such that a supportive government approach is needed at least until end users are in a better position to make confident and informed choices. All sectors are calling for clearer and more consistent approaches in key areas and a number of common needs have been identified.

Having said that, the overall strategy, which encourages other levels (sub-national and sector specific) products and services to meet specific audience needs, is very open to demand-driven and in some cases market-driven approaches, and many sectors stand to benefit from a more coordinated and shared approach. The shared nature of the adaptation issue is also reflected in current government documentation (Commonwealth of Australia 2012c).

At the national level this suggests adaptation support is intrinsically a shared public-private sector issue and so should not be left to either sector alone, which has implications for what sort of entity might be best placed to take up the ANCAS coordinating role.

It is natural to look at existing organisations first. In the public sector, the DCCEE has provided invaluable program and funding support to date, but it is essentially a policy rather than a service organisation, and understandably needs to reflect the direction of the government of the day. The private sector has much to contribute to and benefit from a more coordinated approach but there is no obvious candidate with a natural overarching role. As a third alternative, a research based organisation such as NCCARF, CSIRO or a university would provide the advantage of strengthening the links between practice and research, provided the role was carried out in a way that incorporated public, private and community sector interests.

If on the other hand a new entity were to be developed it could be established as a public-private partnership with joint board governance and funding. To be most effective Commonwealth and state/territory governments would desirably support such an initiative (preferably through COAG). The entity could in principle stand-alone (e.g. as a new incorporated not-for-profit entity) but could also be 'housed' with a larger existing organisation provided it could maintain the level of independence necessary to reflect shared funding and governance. For example, the host organisation could be an adaptation research organisation to foster the links between research and practice. In this case, and whilst the government position on future national adaptation research funding is not yet clear, a national adaptation research body such as NCCARF, if established with built-in cross sector collaboration mechanisms, could be a candidate,

with a fall back option to hosting in the CSIRO or a university if a national adaptation research facility were not to be continued.

Establishment of a semi-independent entity housed within a research organisation would have some similarity to the way the UK Climate Impact Programme has successfully operated for most of its' life, as a form of 'boundary organisation', in this case linked to Oxford University; although the option discussed above would more formally incorporate cross sector interests and governance. Indeed in developing the ANCAS role it would be helpful to draw on insights from some comparable experiences (e.g. in the UK, but also from the approaches in some other developed countries, and from some potential Australian analogues – examples that have been raised in consultations and workshops include Cooperative Research Centres, the Green Business Council of Australia, and the Australian Institute of Health and Welfare).

Because of the need to develop a high degree of stakeholder buy-in and confidence in an agreed direction, it is premature to assume which of the above options for establishing an ANCAS entity is most appropriate. However the need for such a role is evident if the needs and strategies identified in this report are to be met and progressed in a sustained way. The project team has initiated discussions with key stakeholders to explore how such an option might be progressed including creation of a National Adaptation Forum as a first step.

Strategy 5.1: A national adaptation services development and delivery organisation be created with the role summarised in Figure 5.2 including developing, supporting and continuously improving the common or 'core' national products incorporated into a National Adaptation Portal (see Figure 4.5), and building relationships with other product and service providers, who will often deliver the direct services and support to end users. This organisation (referred to in the report as the Australian National Climate Adaptation Services – ANCAS) will preferably be established as a distinct entity with both public and private sector resourcing, and joint governance arrangements, but could potentially be housed within an existing organisation to provide synergies. Establishment of a less institutionalised National Adaptation Forum should be established as a stepping stone if it is not possible to move straight to the above approach.

Strategy 5.2: The ANCAS should be resourced to a level that can meet initial priorities and sequencing of activities agreed with stakeholders, based on detailed implementation planning. To make sustained and significant progress in a reasonable time this is unlikely to be less than 5 people plus some product development funding, but the appropriate level should reflect agreed priorities and can be modified with experience. It is anticipated that the level of investment would be more than justified by the avoidance of wasted and duplicated effort, and by the cumulative and consistent delivery of products, services and outcomes that otherwise would not be achieved. Over time consideration could be given to charging for certain added value products and services where there is clear potential for private benefit.

Strategy 5.3: In progressing the above governance strategies, experience and lessons from other relevant approaches be brought to bear (e.g. other national approaches in UK, EU, Canada, US and NZ; and with potential analogues in Australia such as Cooperative Research Centre models, the Green Business Council of Australia, the Australian Institute of Health and Welfare, others).

Strategy 5.4: The ANCAS work with international agencies to promote an international community of practice to share practical experience and research findings. Initially this could include the UK Environment Agency and UK Climate Impact Programme, the EU and its Climate-Adapt/Mediation programs, NZ National Institute of Water and Atmospheric Research, ICLEI (regional representatives), UNEP/PROVIA, UNDP and the World Bank.

5.2 Enabling issues and strategies

The *product* strategies in Chapters 3 and 4 need to be complemented by *enabling* strategies. Products and tools, whilst an essential aid to effective decision making, do not replace decision making judgment and learning. Capability development relies as much on the personal, organisational and institutional context within which they are supported and used as the products themselves.

Enabling needs and strategies were discussed with stakeholders including at the key workshops. The strategies below draw on these and other sources such as the UK Climate Impact Programme experience (UKCIP 2011).

One of the most consistent themes was the value of learning from others, including potential for development of communities of practice to share experience, complemented by more hands-on knowledge brokers to assist in the translation and interpretation of adaptation knowledge, processes and data into specific end user contexts and projects. Desirably these would be decentralised. For example, one suggestion at the Informing Adaptation Policy workshop organised by the project was that knowledge brokers might be aligned with the growing focus on regional collaboration through Regional Organisations of Councils, Regional Development Authorities and Natural Resource Management (or Catchment Management) agencies. Certain professional, industry and other representative associations may also choose to support their constituency in this way, as have some local government associations. At the national level, the proposed national adaptation services organisation would also have a brokerage role but primarily via supporting other distributed providers rather than providing direct end user support. Complementary to the above, it would be useful to identify and engage with the key sources of influence over, and intermediaries to, a broader range of communities and end users (e.g. through the professions advising decision makers; insurance brokers working with small businesses and individuals; councils working with their communities) and target skilling/understanding to these points of high leverage in their own language.

A second theme was that decision makers, being mostly unfamiliar with climate adaptation issues, desire some form of quality assurance over the processes and data they are being advised to adopt, and indeed confidence in the relevant knowledge and experience base of external advisers. Section 4 discussed how provenance and

credibility of portal, process and data products could be enhanced through the development of 'core' products continuously informed by emerging standards and good practices, and potentially by a products registration process. This could be extended by training, skilling, prequalification and accreditation processes for those delivering and using certain products and services.

Another theme was the current lack of access to some potentially useful products and data sets. Reasons that interested end users had been given for access being denied, ranged from national security (e.g. data and modelling on some infrastructure vulnerabilities and interdependencies), through commercial confidence (e.g. detailed utility services usage information by type of household), to the data owner's concern about the sensitivity of the information if made more publicly available (e.g. some councils' concern about the implications of releasing hazard mapping information). Whilst there may well be validity in withholding information in some circumstances, the concern was that the default was generally to err on the conservative side rather than seeking ways in which the data could be used whilst addressing any legitimate concerns, especially as the collection of the data was often in effect publicly funded.

The benefits of mainstreaming or integrating adaptation efforts and decisions with existing business roles and processes was referred to in Section 3.2.2, provided careful consideration is given to the best timing for this, and that a coordinated view of climate issues is maintained where necessary. A progressive move to mainstreaming was widely supported, with a suggestion that governments could show leadership in this by setting out clear expectations for adaptation planning and responses by their own agencies and operations, possibly drawing on similar national government approaches in the UK and US.

A final consistent theme from stakeholders was the potential to improve the connection between adaptation practice, policy and research, and to address inconsistent policy directions across and between levels of government. Settlement and infrastructure planning was the most frequent, though by no means the only example of the latter. Whilst institutional barriers clearly contribute to these issues, some of these disconnects are also understandable given the novelty and emergent nature of many of the issues. However, the adaptation knowledge and experience base has grown so significantly in recent years that improved connectedness and consistency of approach should be achievable provided institutional issues are able to be addressed in parallel. Whilst this theme has much broader implications, improvement in these areas would clearly enhance the environment in which the other strategies proposed in this report could be progressed, and the project has itself been carried out in a way that has aimed to enhance understanding and collaboration across practice, policy and research stakeholders.

Based on these insights from the consultation and workshop processes the following enabling strategies are proposed. As mentioned in Section 5.1 these could also be supported and promoted by the proposed national adaptation services organisation.

Strategy 5.5*: Identify key natural leverage opportunities and roles to promulgate and promote understanding of good adaptation principles and practices into broader end user and decision making communities, supported at the practical level by practical advice including through 'knowledge brokers' and 'communities of practice'.*

Strategy 5.6: *Develop networks of knowledge brokers and communities of practice, through local government, industry or other representative associations, and/or through various regional bodies, supported by the proposed national adaptation services organisation. These can especially provide entry level support and assurance. More complex decision making support will in some instances require more specialised professional or consulting expertise. This network-building approach can also exhibit ongoing resilience in the event of political or other external changes. There are also links to the assurance product strategies and the skilling programs and products (see Chapter 4).*

Strategy 5.7*: Identify additional potential for standards and quality assurance processes to benchmark and progressively enhance the overall level of adaptation capability including prequalification and accreditation requirements for use and delivery of certain products and services. There are also links to the assurance and skilling product strategies (see Chapter 4).*

Strategy 5.8*: Encourage progressive mainstreaming/integration of the adaptation planning, products and services into other (non-climate change) processes and organisational roles. For governments this could be enhanced by establishing clear responsibilities for adaptation planning and reporting by agencies and other key organisations, as in the mandatory reporting requirements established in the UK and USA.*

Strategy 5.9*: Identify the need and potential for improved public access to some key products and data that are currently not generally accessible.*

Strategy 5.10*: Foster stronger practice, policy and research linkages. In particular practical experience and associated research can inform progress in a number of areas of adaptation policy that currently present a barrier to adaptation progress (e.g. a more consistent national and states/territories approach to settlement and infrastructure planning).*

6. GAPS AND FUTURE RESEARCH

The findings and proposed strategies in this report have been based on considerable research, analysis and engagement but there are some areas identified that could benefit from additional knowledge development. The following issues should be considered for future funding opportunities:

- better understanding and validation of specific end user needs through research and development including product 'prototyping' (see also Chapter 7 on next stage detailed planning for some of the proposed product strategies)
- distillation of emerging best practices in a number of areas (some priority examples were identified in Chapter 4)
- research in areas that represent challenges to effective adaptation decision making and where there is currently very limited experience or understanding to draw on, especially in the areas of social, institutional and political behaviours as they affect adaptation (e.g. social priorities and values, acceptable levels of risk, institutional issues)
- research into the proposed enabling strategies to be clear as to how these crucial complementary strategies can be most effective
- research into how to make the best use of existing and emerging information and communication technologies (including social media)
- research into how the strategies can be delivered in a way that most enhances the linkages between practice, policy and research.
- consider the relevance of the findings to other countries, including learning across developed/developing countries experience

Strategy 6.1 *Review the identified knowledge gaps with key interested stakeholders with a view to seeking or promoting funding of priority research and development tasks*

7. DISCUSSION AND NEXT STEPS

The review and analysis has evidenced that whilst experience in practical adaptation projects has grown, there is a significant capability and information gap for end users and decision makers across all sectors. In Australia and internationally there is a large number of current and proposed products. However the current fragmentation of support products, tools and data is confusing to many end users and lacking in transparent quality assurance. This does not support confident and effective decision making; and is unlikely to be cost-effective or sustainable. There are in addition some notable product gaps.

There is a significant opportunity to distil the Australian adaptation learning from the last five years, and to consolidate investment and support through a smaller number of complementary, best practice and well-supported common or 'core' national products. Some relevant products are under development and planned within Australia and there is also potential to draw on overseas products and experience.

At the same time, meeting the diversity of user needs requires:

- the ability to customise, add to, or complement nationally supported core products, according to jurisdictional and sector specific need
- further clarification of the intended user-bases, scope and objectives of proposed core and ancillary products
- products that are flexible to a range of possible entry points and that facilitate navigation to useful components according to user need and context
- development of product legitimacy and credibility with end users, and continuing learning and innovation as part of any future approach.

Chapters 3 and 4 have identified findings and product strategies that address the above issues. They have the potential to shape future investment directions, build on what already exists or is planned, and address current fragmentation of effort, whilst at the same time enabling necessary customisation, ownership and innovation.

Chapter 5 has analysed and proposed complementary governance and enabling strategies that are necessary to facilitate the effective development, uptake and ongoing usage of support products.

The recommended strategies could be seen as aspirational given the current starting position and future resourcing constraints. They represent a significant evolution (even transformation in some respects) from current approaches. The next steps should therefore be treated as the initial stages in a significant change process. In particular such aspirational or transformational change requires:

- demonstrating and promulgating a clear vision of why and how things might be different; with agreement on a 'preferred' future to materially assist more immediate direction and prioritisation. This requires distillation and promulgation of the proposed strategy, intent and rationale to key stakeholders

- development of a guiding coalition of key stakeholders from the private, public and community sectors, establishing alignment of interests, priorities and commitment. The project has commenced this through formation and facilitation of the Steering Group for development of a National Adaptation Forum
- confirming how the proposed strategies can build on, or be integrated with, current national, state/territory and sectoral adaptation directions and initiatives wherever possible. The project has commenced this through a workshop of leaders of current initiatives where it was agreed to continue a process of sharing insights and pursuing potential areas of collaboration. This could be facilitated by an overall program approach to mapping projects in order to support the change process (see Figure 7.1 as a draft example)
- offering a path forward that builds confidence through delivery of practical quick wins via 'bite-sized' projects, taking advantage of current natural opportunities and incremental steps; whilst laying the foundation for the longer term goals. This includes stakeholder driven prioritisation of proposed initiatives
- encouraging a 'fast learning cycle' approach through proof of concept prototypes, piloting and testing.

In conjunction with this report there is a need for a summary statement of vision, objectives, proposed strategy, and rationale for discussion with stakeholders including Commonwealth/state/territory/local governments, key private and community sector coalitions and representatives, research institutions and product developers.

Included in this should be identification of how, within an overall program, initial confidence building projects, drawn from those proposed in this report, can be initiated in priority areas. In this context, there will also be the need for a business case and detailed implementation planning for individual initiatives. In some instances (for example to take some of the more specific product strategies to the next stage), this will require more detailed evaluation of user needs and proposed solutions.

The project has combined research with strategy development. The frameworks and methodologies developed to guide the analysis are original. They can continue to be used in the progression of strategies at a more detailed level in the Australian context, and may also be of value to the development of approaches in other countries. The research findings will therefore also be promulgated to professional and research bodies and conferences in Australia and overseas, and through relevant publications, in order to contribute to an international network and community of practice in this increasingly important area.

The development of this report has drawn on extensive input from a large number of stakeholders. The degree of consensus on the diagnosis is remarkably high, including that the timing is right for a significant intervention. The research findings and proposed strategies provide the basis for developing a coherent and cost-effective response in the Australian context, as well as insights and approaches that may be of interest more broadly.

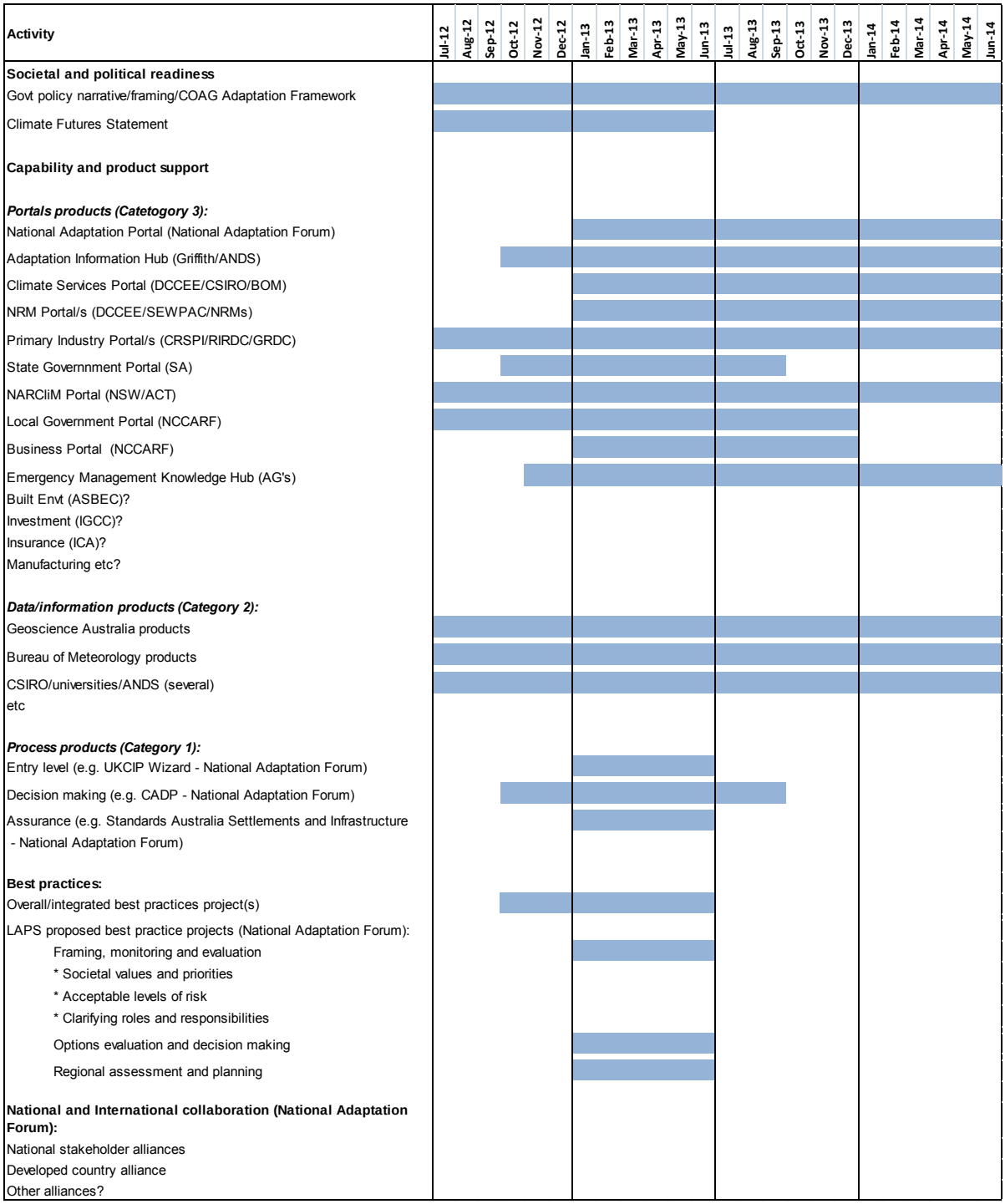

Figure 7.1 Example overall transition program

Shows how a range of projects (some actual, some proposed) relevant to a national adaptation support strategy) could be positioned within an overall program (under development).

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Appendix 1.1 LAPS Project: Project Reference Group Membership

A project reference group was established at the outset of the project to provide input, advice and guidance through regular meetings, workshops and ad hoc (as needed) processes. The group had representatives with directly relevant experience from each level of government, a non-government organisation, the private sector and research institutions:

Martin Brennan (ICLEI Oceania)

Steve Dovers (Fenner School of Environment and Society, Australian National University)

John Higgins (Commonwealth Department of Climate Change and Energy Efficiency)

Rob Kay (Adaptive Futures)

Rod Keenan (University of Melbourne and Victorian Centre for Climate Change Adaptation Research)

Chris Lee (Office of Environment and Heritage, NSW Government)

Guillaume Prudent-Richard (AECOM)

Tim Smith (University of Sunshine Coast)

Mark Stafford Smith (CSIRO)

Josh Thompson (Australian Local Government Association)

Daniel Voronoff (Department of Human Services, Victorian Government)

Bob Webb (Fenner School of Environment and Society, Australian National University; and LAPS Project Leader)

Steve Wilson (Hunter and Central Coast Regional Environment Strategy)

Appendix 3.1 LAPS Project: Stakeholder Engagement

Stakeholder engagement included semi-structured individual and small group discussions with a range of stakeholders and end users, especially to better understand issues, needs and priorities; through to multiple participant workshops to further test and develop findings and emerging proposals . Focusing questions were developed at an early stage to guide each form of stakeholder interaction, and these questions evolved in scope and detail throughout the project as the central issues became clearer. All key stakeholder interactions were documented. The workshops proved especially crucial as they enabled development and validation of collective as well as individual views at key stages. The project reference group was used as a consistent sounding board on progressive findings.

1. Group workshops and meetings:

Project reference group (six formal meetings, workshop preparation and participation, ad hoc discussions as required, key document reviews)

Workshops/joint meetings:

- Key Stakeholders' Workshop (including all levels of government, regional national resource management bodies, range of private sector representatives, community sector, consultants, researchers)
- Hunter Region Stakeholder/Councils Workshop
- National Governance Options Workshop and follow-up meetings (range of public and private sector stakeholders)
- Australian Adaptation Portals Workshop (range of knowledge and data portal initiative representatives)
- Consult Australia members group teleconference
- Investor Group on Climate Change (IGCC) members group teleconference.

An Informing Adaptation Policy Workshop (Webb 2012) was also run by the project team during the life of the project. This was under separate DCCEE, NCCARF and ANU sponsorship but many of the findings were directly relevant to the project, and have been referred to in the report. The two day workshop and follow-up process also involved a significant number of representatives from the organisations identified below.

2. Organisational/individual meetings and contacts:

Engagement with representatives from the following organisations took place during the life of the Project. In many cases it was with several people from an organisation, and involved follow-up contacts, and for many, also included participation in key workshops.

International:

ICLEI Canada, Europe, Asia, Oceania

UKCIP

UNEP/PROVIA

World Bank

Consultancy sector:

Consult Australia

Adaptive Futures

AECOM

Climate Risk

Edge Environment

SGS

Australian/state government sectors:

Attorney Generals Department

Department of Agriculture, Forestry and Fisheries

Department of Climate Change and Energy Efficiency

Department of Infrastructure and Transport

Geoscience Australia

Bureau of Meteorology

Standards Australia

Australian National Data Services

ACT Government(ESDD)

NSW Government(OEH)

South Australian Government(DEWNR)

Tasmanian Government (DPaC)

Victorian Government(DSE)

WA Government (DEC)

Research sector:

NCCARF

CSIRO(Climate Adaptation Flagship, Marine and Atmospheric Research Unit)

Australian National University(FSES)

Griffith University (Climate Change Response Program)

RMIT(Climate Change Adaptation Program; School of Computer Science and IT)

Uni of Melbourne (VCCCAR)

Uni of New South Wales (ACCARNSI)

Uni of South Australia(Barbara Hardy Institute)

Uni of Sunshine Coast(Sustainability Research Centre)

Uni Technology Sydney (Institute for Sustainable Futures)

Australian Centre for Excellence in Local Government

Local government sector:

Australian Local Government Association

Local Government Association of Queensland

Local Government Association of Tasmania

Local Government South Australia

Municipalities Association of Victoria

HCCREMS (Hunter region)

SECCCA (Westernport region)

NRM sector:

Central West Catchment Management Authority

Eye Peninsula Natural Resource Management

Community sector:

Australian Council of Social Services

Private sector:

Insurance Council of Australia

Investor Group on Climate Change

Australian Sustainable Built Environment Council

Australian Institute of Architects

Property Council of Australia

Housing Industry Association

Australian Institute of Landscape Architects

Green Building Council of Australia

Australian Green Infrastructure Council

National Farmers Federation

Appendix 3.2 Climate change adaptation initiatives – local government

There is no single source of information on all local government climate change adaptation activities in Australia but a starting indication is those councils which have received the benefit of Department of Climate Change and Energy Efficiency (DCCEE) funded programs in recent years:

- The Local Adaptation Pathways Program (LAPP):
    - LAPP 1: 32 projects covering 60 councils
    - LAPP 2: 7 projects covering an additional 35 councils
- The Integrated Assessment of Settlements (IAS) Program: 5 projects covering 27 councils (23 of these in addition to those above)
- The DCCEE-funded ICLEI Climate Change Program: 15 projects covering 15 councils (10 of these in addition to those already covered above)
- The Coastal Adaptation Decision Pathways (CADP) Program: 13 projects covering 50 councils (21 of these in addition to those already covered above) including some 30-40 case studies

This makes a cumulative total of around 150 councils directly supported one way or another by these DCCEE programs.

Other local government focused activities that need to be taken into account are:

- Adaptation risk assessment and planning programs in NSW (Statewide Mutual) and South Australia (LGA Mutual Liability Scheme) supported by their respective insurance providers which has covered a large proportion (in South Australia most) of the councils in those states
- Adaptation risk assessment and planning programs driven by state and territory governments, in some cases aiming to cover all councils through a regional approach. Key examples are the NSW Integrated Regional Vulnerability Assessment (IRVA) program that has completed the assessment for one region (South East NSW) and is part way through a second region as part of an overall plan for the state; the Tasmanian Regional Climate Adaptation Program (RCAP) with all councils grouped into one of three regional assessments; and the South Australian Integrated Climate Change Vulnerability Assessments (ICCVA) planning to cover all regions in the state with collaboration between Regional Organisations of Councils, Regional Development Authorities and Natural Resource Management bodies for each region. Victoria has in some cases used its Greenhouse Alliance regional structures in a similar way.
- Adaptation programs and products delivered via the state local government association bodies or equivalent. These vary significantly from state to state, and in some cases have been very active, though vulnerable to resourcing uncertainty and changes

There are also a few councils and regional organisations of councils other than those covered above who have commenced adaptation under their own initiative; and many

NCCARF and CSIRO research projects have drawn on and extended the above work, but understandably tend to focus on those councils that are already somewhat engaged or committed

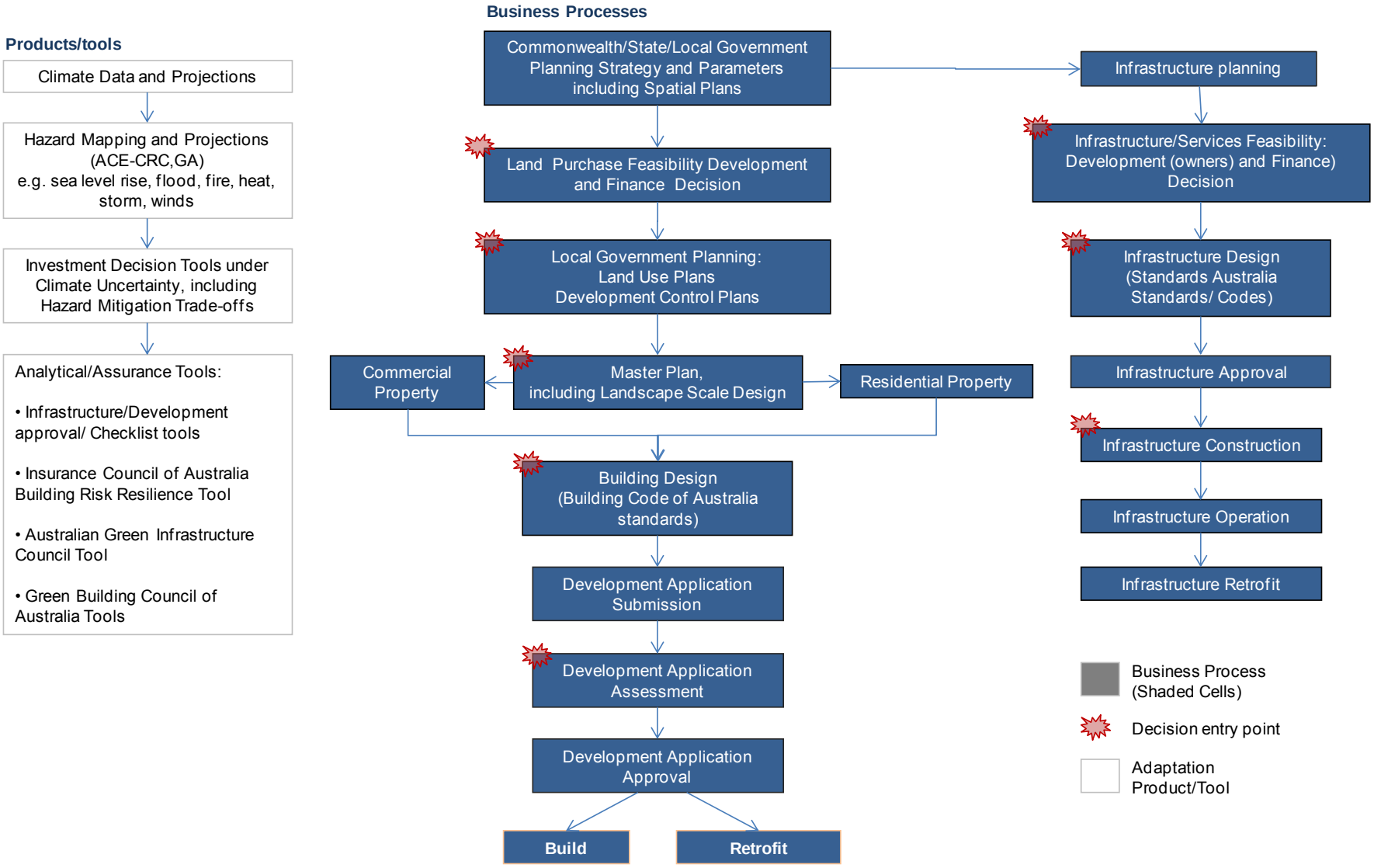
As another indicator the surveys of councils on use of climate change adaptation tools and processes (run by the NCCARF Settlements and Infrastructure Network (ARCCANSI) managed by UNSW) received responses from 115 councils.

The overall picture is that a quite high percentage of Australia's 560 local governments have been involved in some form of adaptation risk assessment or planning, though to date this has mostly been in the nature of first pass assessments and awareness-raising with much fewer examples of movement to significant adaptation response and action. On the latter, numerous challenges have been identified. Generally speaking coastal councils have progressed further than inland, rural and remote councils, but still with a long way to go. As a general rule those councils who have progressed as part of regional groupings and who have won funding grants, appear to have gained most traction.

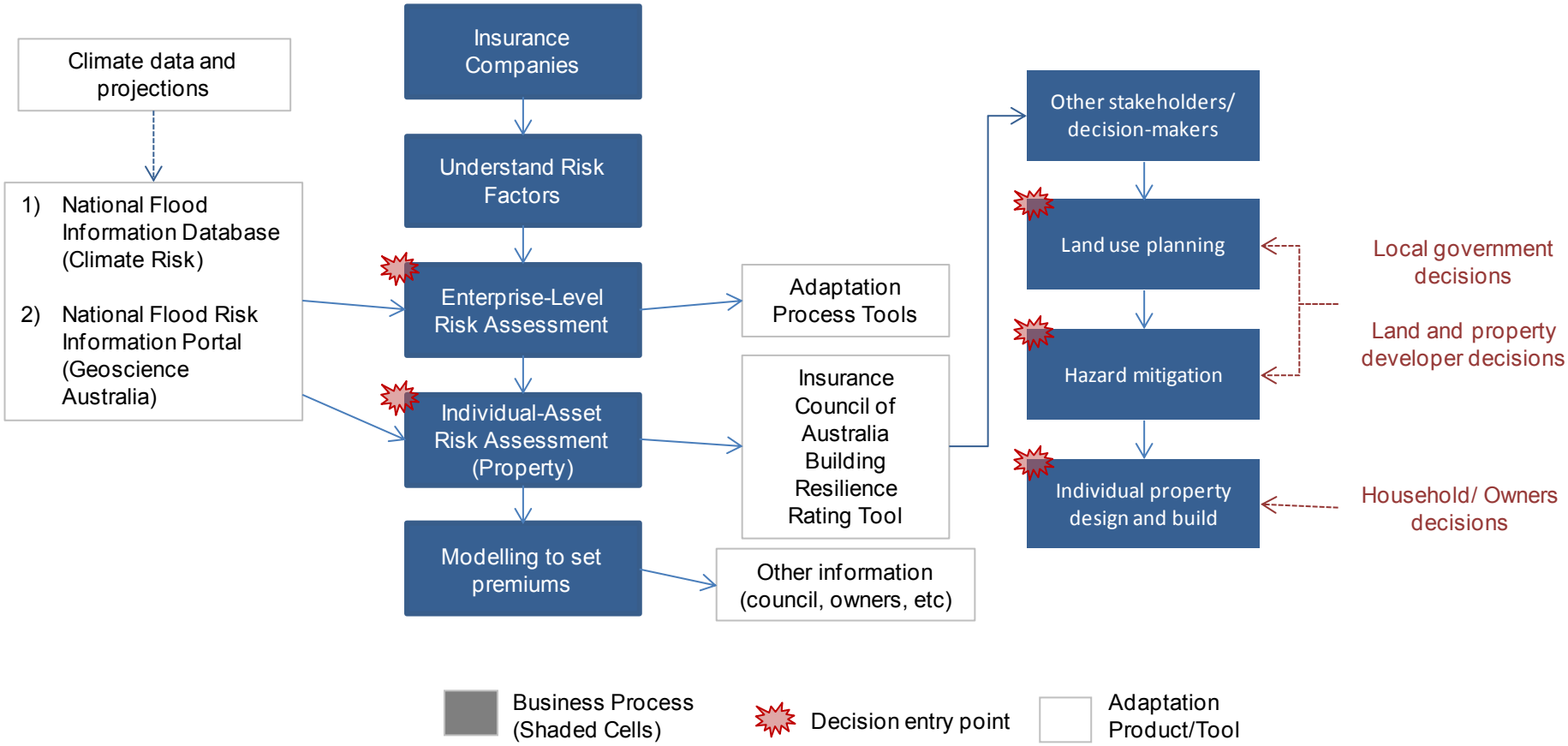
Appendix 3.3: Sector adaptation decision charts

These charts are included as example mappings of relevant business process, adaptation decision entry points and support products for the relevant sectors. Along with Figure 3.3 in the body of the report (the equivalent chart for the local government sector) they demonstrate that the business processes and the nature of the adaptation decisions are often quite specific to each sector; but that underlying the different sectors there can still be common needs in terms of at least some of the support products, including process and data/information products. The charts were also direct outputs from the project's user-needs methodology, being based in each case on relevant stakeholder input and review. As such, they represent a proposed replicable methodology for extending user-needs analysis in more detail within each sector and to other sectors.

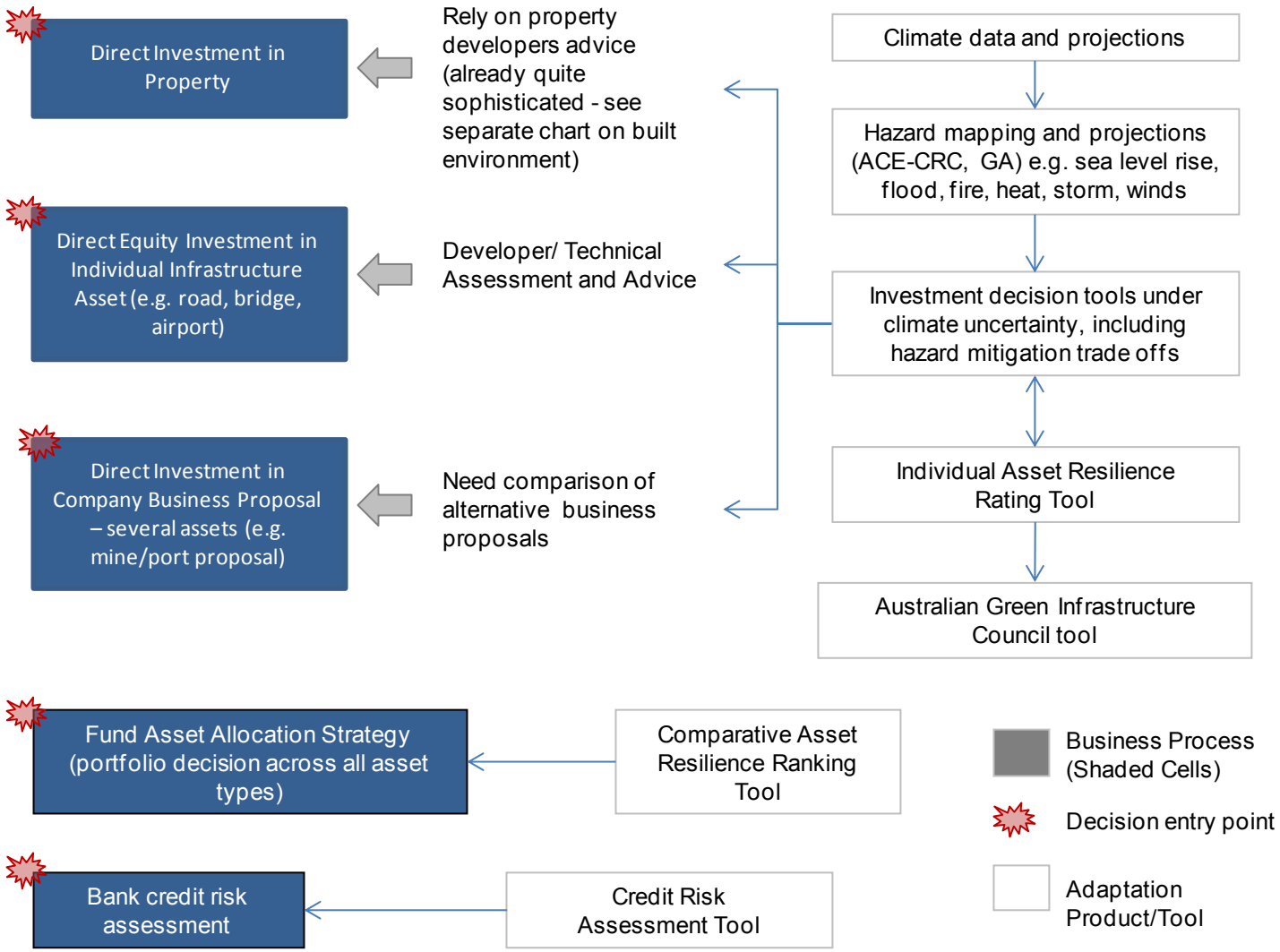
Appendix 3.3.1 Business processes and decision entry points: Built Environment (Private Sector)



Appendix 3.3.2 Business processes and decision entry points: Insurance Sector

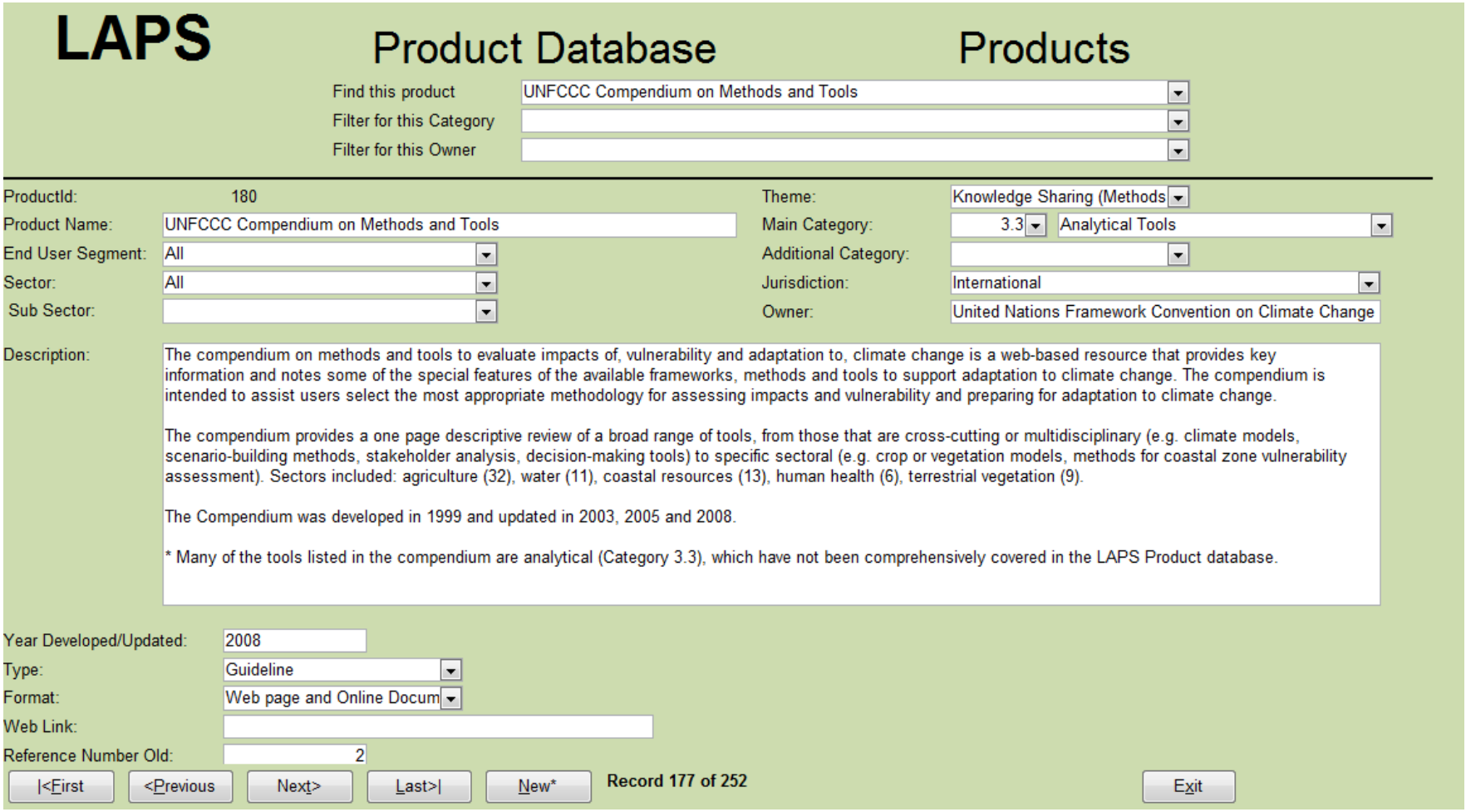


Appendix 3.3.3 Business processes and decision entry points: Fund/Banking Investors Sector



Appendix 4.1 Example of LAPS Adaptation Product Database entry and report

The LAPS Project Adaptation Product Database developed in the course of this project, has over 300 adaptation support product entries at the time of project completion. This is a sample database entry for one such product, followed by an extract from a typical report generated from the data base.


LAPS
Product Database
Products
Find this product
UNFCCC Compendium on Methods and Tools
Filter for this Category
Filter for this Owner
ProductId:
180
Product Name:
UNFCCC Compendium on Methods and Tools
End User Segment:
All
Sector:
All
Sub Sector:
Theme:
Knowledge Sharing (Methods
Main Category:
3.3
Analytical Tools
Additional Category:
Jurisdiction:
International
Owner:
United Nations Framework Convention on Climate Change
Description:
The compendium on methods and tools to evaluate impacts of, vulnerability and adaptation to, climate change is a web-based resource that provides key information and notes some of the special features of the available frameworks, methods and tools to support adaptation to climate change. The compendium is intended to assist users select the most appropriate methodology for assessing impacts and vulnerability and preparing for adaptation to climate change.
The compendium provides a one page descriptive review of a broad range of tools, from those that are cross-cutting or multidisciplinary (e.g. climate models, scenario-building methods, stakeholder analysis, decision-making tools) to specific sectoral (e.g. crop or vegetation models, methods for coastal zone vulnerability assessment). Sectors included: agriculture (32), water (11), coastal resources (13), human health (6), terrestrial vegetation (9).
The Compendium was developed in 1999 and updated in 2003, 2005 and 2008.
* Many of the tools listed in the compendium are analytical (Category 3.3), which have not been comprehensively covered in the LAPS Product database.
Year Developed/Updated:
2008
Type:
Guideline
Format:
Web page and Online Docum
Web Link:
Reference Number Old:
2
|<First
<Previous
Next>
Last>|
New*
Record 177 of 252
Exit

Product By Category

Code	Jurisdiction	Segment	Sector	Sub-Sector	Theme	Name	Year	Product Description	Type	Format
1.0	PROCESS									
	International	Researchers and Practitioners	All		Adaptation Planning (Vulnerability Assessment)	PROVIA Guidelines for vulnerability, impacts and adaptation	2012	Guidelines (under development) to replace IPCC Guidelines 1994 and UNEP Handbook 1996. The document will provide guidance on assessing climate change vulnerability, impacts and adaptation (VIA), in addition to guidance on implementing, monitoring and evaluating adaptation. Seeks to provide a coherent framework which integrates the many activities that comprise VIA and recognises the utility of multiple entry points.	Guideline	Online Document
	International (Asia)	Local Government, Community organisations	All		Adaptation Planning	ICLEI Europe - Asian Cities Adapt, International Climate Initiative	2010	Brings together science and policy in order to identify the impacts of climate change and to develop local adaptation strategies in four cities in India and four cities in the Phillipines. The project is part of the International Climate Initiative (German Bundestag). Proposes and tests a path to adaptation based on five steps (Baseline development, Adaptation Strategy and Generic Action Plan, Securing Political Endorsement, Detailed action plan, implementation and monitoring, Evaluation and Reporting). NB. Reconcile with Steve Gawler discussion	Project	Project and Web page
	International (Canada)	Local Government	All		Adaptation Planning	ICLEI Canada - Adaptation Initiative	2010	A program to assist councils with the implementation of the 'Changing Climate, Changing Communities: Guide and Workbook for Municipal Climate Adaptation'. Tools and support are provided by ICLEI to faciliate informed decision making and highlight opportunities to integrate adaptation planning with other planning processes. The program follows a five milestone framework to assist local governments create an adaptation plan and includes webshops, in-person workshops, networking opportunities, and ongoing technical support from ICLEI Canada staff. The program runs for 2 years.	Program	Program

Appendix 4.2 Product review criteria (detailed)

This chart shows the review criteria that were used to help assess the identified products for relevance in the context of a proposed Australian product strategy. Criteria (or features) have been developed for each of the three overall product categories. Whilst in this project the criteria were used to provide a first pass review of products, in the context of this report, it is also suggested that these or similar criteria could be used for more detailed individual products assessment and development, bearing in mind that the emphasis given to certain criteria may well depend on the objective and context.

	Criteria for Assessing Products and Tools	3.0 Knowledge Portals	1.0 Process Support	2.0 Data & Information Provision
A	**FUNCTIONAL COVERAGE FEATURES: Meets User Needs**			
1.0	***Adaptation Process Support (incorporated in 3.2 below)***			
1.0	Overall end to end adaptation process (e.g. Risk Management Cycle)	✔	✔	
1.1 - 1.10	***Specific stages in the process (e.g. decision making)***			
1.1	Initiation and Framing	✔	✔	
1.2	Roles and Responsibilities	✔	✔	
1.3	Objectives and Decision-Making Criteria	✔	✔	
1.4	Risk and Vulnerability Assessment	✔	✔	
1.5	Identify Options	✔	✔	
1.6	Establish Thresholds and Triggers	✔	✔	
1.7	Assess Options	✔	✔	
1.8	Manage Risk and Uncertainty	✔	✔	
1.9	Decide and Implement	✔	✔	
1.10	Monitor Evaluate and Review	✔	✔	
2.0	***Data and Information Provision (incorporated in 3.3 below)***			
2.1	Climate and socio-economic data	✔		✔
2.2	Impact data	✔		✔
2.3	Risk/vulnerability information	✔		✔
2.4	Adaptation options information	✔		✔
3.0	***Knowledge Management and Other***			
3.1	Adaptation background and facts	✔		
3.2	Adaptation process product (1.0)	✔		
3.3	Data and information products (2.0)	✔		
3.4	Special purpose analytical products (sector specific)	✔		
3.5	Australian projects database and case studies	✔		
3.6	Key contacts database	✔		
3.7	Research database (e.g. NCCARF/CSIRO)	✔		
3.8	Skilling/training product (e.g. e-Learning)	✔		
3.9	Engagement and communications products (sector/jurisdiction specific)	✔		
3.10	Relevant policy, programs, funding, governance	✔		

B	DELIVERS USER ORIENTED FEATURES			
1	Functional coverage and depth	✔	✔	✔
1.1	Range of potential function covered	✔	✔	✔
1.2	Provides level of detail to assist user in practical application; May include additional resources e.g. workshop templates	✔	✔	✔
2	Currency: being actively maintained and continuously improved (evident to user i.e. some form of notification, newsfeed etc)	✔	✔	✔
3	Accessibility: Open Access/ Online	✔	✔	✔
4	Flexible navigation: encourages multiple/flexible entry points, easily navigable, useful search capability	✔	✔	✔
5	Ease of use and interpretation: self-explanatory processes and outputs	✔	✔	✔
6	Support available: user guidance, support services available	✔	✔	✔
7	Clarity and authority of underpinning knowledge and sources	✔	✔	✔
8	Stakeholder/user engagement in product development and improvement	✔	✔	✔
9	Proportion customisable to Australian national (and potentially sub-national) context	✔	✔	✔
C	**REFLECTS EMERGING GOOD ADAPTATION PRINCIPLES**			
1 & 2	Emphasises sustained leadership and stakeholder engagement		✔	
3	Encompasses balance of social, economic, environmental and institutional objectives		✔	
4	Encourages learning from other adaptation initiatives		✔	
5	Proposes adaptive management approaches		✔	
6	Encourages explicit and agreed framing and scoping		✔	
7	Addresses various spatial and temporal scales		✔	
8	Encourages integrated systems view of interdependencies (across climate and non-climate issues)		✔	
9	Guides the user through options assessment and decision-making processes		✔	
10	Proposes articulation of clear (and feasible) vision, intent, goals		✔	
11	Guides user to appropriate adaptation frameworks, methodologies, (and assessment) methods and tools		✔	
11.1	Clarifies how to make best use of climate information (for both local current climate issues and projected climate perspectives)		✔	
11.2	Guides how to select and iterate assessment approaches (according to types of decisions and practical capacities)		✔	
11.3	Guides for decision-making under uncertainty		✔	
11.4	Encourages cumulative knowledge management		✔	
11.5	Guides to appropriate mainstreaming strategies		✔	
11.6	Facilitates flexible adaptation process ‘user entry points’ and navigation		✔	

Appendix 4.3 Adaptation process support products – Summary review

Using the criteria identified in Appendix 4.2 this table reviews each product on a scale of 1 to 4 according to the extent of coverage. A 'blank' means that the product did not appear to have this feature in scope. A higher number means that on desk review by the project team the product appears to have greater coverage. It should be stressed that this review is in the context of identifying features and products that may be of particular interest in developing a product strategy for Australian use and is therefore in no sense an assessment of the extent to which the product meets its own objectives. Also for a more detailed review, and with time and resources, including an end user review and trial usage of specific products would be an important part of the process.

PRODUCT FEATURES	ADAPTATION PROCESS PRODUCTS																	
	State			National				International										
	Adapting to Climate Change: A QLD Local Government Guide	LG of SA A Guide for Councils Developing a Climate Change Adaptation Plan	WALGA Climate Change Management Toolkit	AGO Climate Change Impacts & Risk Management, A Guide for Business and Government	Draft Standard AS 5334: CCA for Settlements and Infrastructure	HCCREMS/Marsden Jacob, Decision Support for Coastal Adaptation	ICLEI Oceania Local Government CCA Toolkit	UKCIP Adaptation Wizard	UKCIP Risk Framework	NIWA A Toolbox-Based Decision Framework for Climate Change Adaptation	Climate Adapt Process Tool	ICLEI Canada Guide and Workbook for Municipal Climate Adaptation	UNDP Adaptation Policy Framework	CARE Climate Vulnerability and Capacity Analysis Handbook	PROVIA Guidance on Assessing Vulnerability, Impacts and Adaptation (VIA)		
Description, Emphasis and Main Function	High level guide through 4 step process to developing an adaptation plan. Level 2	High level descriptive overview of process. Insufficient detail provided to assist with implementation. Level 2	Checklist for developing an adaptation strategy. Level 2	High level guide. Overview of key stages of process. Level 2.	Principles and generic guidelines on the management of the climate risks to settlements and infrastructure.	Detailed guidance through 10 stage process. Includes both Handbook and Guide. Level 3	Relatively detailed guidance. Includes tools e g. Workshop templates.	Guides user through 5 stage process. Also a guide to information, tools and resources available from the UKCIP.	Detailed guidance framework on which the UKCIP Wizard is based.	Outlines a three staged, risk-centred approach to decision making for CCA.	Guides user through 6 stage process. Provides brief overview of each stage then guides user to other guidance, tools, further reading. Key recommended products: Guiding principles for adaptation in Europe and UNDP Policy Framework	Detailed guidance through 5 stage process. Includes workbook but guide can be taken as standalone. Level 3.	Framework and roadmap for adaptation assessment, planning and implementation.	Outlines a methodology for Community-Based Adaptation. Presents a set of guiding questions for information analysis and provides guidance on facilitating a participatory process.	Detailed guidance framework. Outlines four stage adaptation learning cycle. Level 3			

PRODUCT FEATURES		ADAPTATION PROCESS PRODUCTS															
		State			National				International								
		Adapting to Climate Change: A QLD Local Government Guide	LG of SA A Guide for Councils Developing a Climate Change Adaptation Plan	WALGA Climate Change Management Toolkit	AGO Climate Change Impacts & Risk Management, A Guide for Business and Government	Draft Standard AS 5334: CCA for Settlements and Infrastructure	HCCREMS/Marsden Jacob, Decision Support for Coastal Adaptation	ICLEI Oceania Local Government CCA Toolkit	UKCIP Adaptation Wizard	UKCIP Risk Framework	NIWA A Toolbox-Based Decision Framework for Climate Change Adaptation	Climate Adapt Process Tool	ICLEI Canada Guide and Workbook for Municipal Climate Adaptation	UNDP Adaptation Policy Framework	CARE Climate Vulnerability and Capacity Analysis Handbook	PROVIA Guidance on Assessing Vulnerability, Impacts and Adaptation (VIA)
	FUNCTIONAL COVERAGE FEATURES																
1.1	Initiation and Framing																
1.2	Roles and Responsibilities																
1.3	Objectives and Decision-Making Criteria																
1.4	Risk and Vulnerability Assessment																
1.5	Identify Options																
1.6	Establish Thresholds and Triggers																
1.7	Assess Options																
1.8	Manage Risk and Uncertainty																
1.9	Decide and Implement																
1.10	Monitor Evaluate and Review																

PRODUCT FEATURES		ADAPTATION PROCESS PRODUCTS															
		State			National				International								
		Adapting to Climate Change: A QLD Local Government Guide	LG of SA A Guide for Councils Developing a Climate Change Adaptation Plan	WALGA Climate Change Management Toolkit	AGO Climate Change Impacts & Risk Management, A Guide for Business and Government	Draft Standard AS 5334: CCA for Settlements and Infrastructure	HCCREMS/Marsden Jacob, Decision Support for Coastal Adaptation	ICLEI Oceania Local Government CCA Toolkit	UKCIP Adaptation Wizard	UKCIP Risk Framework	NIWA A Toolbox-Based Decision Framework for Climate Change Adaptation	Climate Adapt Process Tool	ICLEI Canada Guide and Workbook for Municipal Climate Adaptation	UNDP Adaptation Policy Framework	CARE Climate Vulnerability and Capacity Analysis Handbook	PROVIA Guidance on Assessing Vulnerability, Impacts and Adaptation (VIA)
	USER ORIENTED FEATURES																
1	Functional Coverage and Depth																
	a) Range of potential function covered																
	b) Provides level of detail to assist user in practical application; May include additional resources e.g. workshop templates																
2	Currency: being actively maintained and continuously improved																
3	Accessibility: Open Access/ Online																
4	Flexible navigation: encourages multiple/flexible entry points, easily navigable, useful search capability																
5	Ease of use and interpretation: self-explanatory processes and outputs																
6	Support available: user guidance, support services available																
7	Clarity and authority of underpinning knowledge and sources																
8	Stakeholder/user engagement in product development and improvement																
9	Customisable to Australian national (and potentially sub-national) context																

	PRODUCT FEATURES	ADAPTATION PROCESS PRODUCTS															
		State			National				International								
		Adapting to Climate Change: A QLD Local Government Guide	LG of SA A Guide for Councils Developing a Climate Change Adaptation Plan	WALGA Climate Change Management Toolkit	AGO Climate Change Impacts & Risk Management, A Guide for Business and Government	Draft Standard AS 5334: CCA for Settlements and Infrastructure	HCCREMS/Marsden Jacob, Decision Support for Coastal Adaptation	ICLEI Oceania Local Government CCA Toolkit	UKCIP Adaptation Wizard	UKCIP Risk Framework	NIWA A Toolbox-Based Decision Framework for Climate Change Adaptation	Climate Adapt Process Tool	ICLEI Canada Guide and Workbook for Municipal Climate Adaptation	UNDP Adaptation Policy Framework	CARE Climate Vulnerability and Capacity Analysis Handbook	PROVIA Guidance on Assessing Vulnerability, Impacts and Adaptation (VIA)
	GOOD ADAPTATION PRINCIPLES																
1 & 2	Emphasises sustained leadership and stakeholder engagement																
3	Encompasses balance of social, economic, environmental and institutional objectives																
4	Encourages learning from other adaptation initiatives																
5	Proposes adaptive management approaches																
5a	Multiple entry points																
5b	Non-linear, iterative and learning process																
6	Encourages explicit and agreed framing and scoping																
7	Addresses various spatial and temporal scales																
8	Encourages integrated systems view of interdependencies (across climate and non-climate issues)																
9	Guides the user through options assessment and decision-making processes																
10	Proposes articulation of clear (and feasible) vision, intent, goals																
11	Guides user to appropriate adaptation frameworks, methodologies, and assessment methods and tools																
11.1	Clarifies how to make best use of climate information (for both local current climate issues and projected climate perspectives)																
11.2	Guides how to select and iterate assessment approaches (according to types of decisions and practical capacities)																
11.3	Guides to decision-making under uncertainty																
11.4	Encourages cumulative knowledge management																
11.5	Guides to appropriate mainstreaming strategies																
11.6	Facilitates flexible adaptation process 'user entry points' and navigation																

Appendix 4.4 Data products: sources of national adaptation-relevant data sets and models

The listing of adaptation-related data sets below does not claim to be complete, but is included as indicative of the broad range of data that can be relevant depending on the focus of the adaptation initiative. One of the proposed strategies in the report is that an overview of the available and most sought-after national climate, hazard, exposure, impact and vulnerability datasets be developed for linkage via the proposed National Adaptation Portal or equivalent. This will improve visibility and access to this data, and help prioritise future initiatives to improve the consistency, credibility and quality of key data sets.

CSIRO/Bureau of Meteorology – climate data

- climate projections
- weather projections (short and medium term)
- historical climate data (including trend and variability)

University of NSW – Climate data

- climate projections (including for NSW and ACT Regional Climate project NARCLIM)
- climate downscaling data for impacts research (ANDS-funded ClimDDIR project)

Antarctic Climate and Ecosystems Cooperative Research Centre

- sea level rise modelling and data

Bureau of Meteorology – national water data

- infrastructure design rainfall data
- hydrological spatial data (Geofabric)
- national atlas of groundwater dependent ecosystems (GDE Atlas)
- national water account and water resource assessments (flow and stores)
- short and medium term flood forecasts

Bureau of Metoerology – national environmental data

CSIRO

- water/hydrology/stream flow/run off (Sustainable Yields projects)
- environmental change impact data (National Reserves Systems II project)
- agricultural productivity/yield data
- built environment engineering exposure data
- Infrastructure Statistical Local Area level exposure data (DCCEE funded project)

Geoscience Australia

- GIS and data standards
- topographic and digital elevation modelling (DEM) data – National Elevation Data Framework (NEDF)
- National Coastal Geomorphology Database (NCGD)
- National Dynamic Land Cover Dataset (NDLCD)
- marine and coastal data sources (bathymetric, backscatter, sediments, geomorphic habitats, species data) and OzCoasts portal
- groundwater data
- hazard data and models (e.g. National Flood Risk Information portal (NFRIP), flood and inundation (ANUGA) modelling, bushfire mapping (Sentinel))
- exposure data (e.g. National Exposure Information System (NEXIS) assets exposure data by LGA, SLA)

National Collaborative Research Infrastructure Strategy (NCRIS)/ANDS supported data and information projects

- Earth Sciences Portal – AuSCOPE
- Integrated Marine Observing System IMOS and Australian Ocean Data Network Portal (Uni of Tasmania)
- Terrestrial Ecosystems Research Network TERN and Portal (Uni of Queensland)
- Integrated Biological Systems - Atlas of Living Australia (CSIRO)
- Tropical Data Hub – James Cook University
- Australian Urban Research Infrastructure Network Portal - AURIN

ABS, NATSEM and special purpose research surveys and studies- Socio-economic data

- A range of regional/local/household/individuals survey and other research-based data that would assist:
    - resilience, adaptive capacity, vulnerability assessments

- analysis of stakeholder values, perceptions, awareness and understanding

Griffith University

- Adaptation Information Hub (ANDS-funded planned adaptation data and information portal), which will provide metadata structure and links to some of the above and other adaptation relevant data and information

Australian National Data Services (ANDS)

- provides metadata, infrastructure and project support for progressive development of an Australian Research Data Commons (ARDC) including Research Data Australia (RDA) access facility

Appendix 4.5 Knowledge portal products – Summary review

Using the criteria identified in Appendix 4.2 this table reviews each product on a scale of 1 to 4 according to the extent of coverage. A 'blank' means that the product did not appear to have this feature in scope. A higher number means that on desk review by the project team the product appears to have greater coverage. It should be stressed that this review is in the context of identifying features and products that may be of particular interest in developing a product strategy for Australian use and is therefore in no sense an assessment of the extent to which the product meets its own objectives. Also for a more detailed review, and with time and resources, including an end user review and trial usage of specific products would be an important part of the process.

PRODUCT FEATURES	PORTAL PRODUCTS																	
	State		National	International														
	WALGA Climate Change Management Toolkit (WA)	Climate Change Adaptation Navigator (VIC)	NCCARF Local Government Portal	UK Climate Impacts Program Website (UKCIP)	New Zealand National Institute of Water and Atmospheric Research (NIWA) Website	CLIMATE-ADAPT Platform (Europe)	Mediation: Methodology for Effective Decision-making on Impacts and Adaptation	weADAPT	Climate & Development Knowledge Network (CDKN)	Climate Adaptation Knowledge Exchange (CAKE)	Ecosystem Based Management Tools Network	Climate Change Adaptation in Asia and the Pacific	World Bank Climate Change Knowledge Portal	UNDP Adapation Learning Mechanism	UNEP Climate Change Website
Description, Emphasis and Main Function	High level guidance for Local Governments. Structured around checklist for developing an adaptation strategy, Directs users to resources developed by others.	Flexible guidance framework, recognises multiple entry points in adaptation process. Suitable for range of end-users with different levels of experience/background.	Repository of information/updates on adaptation work/ projects/resources relevant to Australia. Simple search capability.	Aims to help users at each stage of the adaptation process. Developed and structured around the risk management framework. UKCIP products/tools map to each stage.	NIWA - is a government owned research and consultancy company . Funds research with focus on sustainable management of New Zealand's aquatic resources and environments.	Comprehensive database of tools and resources for EU countries. Includes Adaptation Process Support Tool.	A project which aims to develop an integrated methodology for decision making. Website is still under development; currently contains workpackages, case studies, project outputs.	Comprehensive knowledge sharing, learning, networking platform and research database.	Website for CDKN projects, research, events. Supports/funds/designs climate compatible development projects. Contains a resource library of CDKN reports, guides etc.	Shared knowledge base for natural systems management. Four components: Virtual Library, Case Studies, Contacts Directory, Recommended Tools.	EBM tools database includes best practices for using and developing tools. Includes case studies and other tool resources, and online learning e.g. Webinars.	Substantial database of projects, resources for adaptation in Asia and the Pacific. Includes newsletters and events calendar.	Climate information, data and reports. Allows user to query, map, compare, chart and summarise key climate and climate-related information. Contains links to other types of resources.	Knowledge sharing and learning platform for development. Contains database of resources, country profiles, news and discussion forums.	Adaptation information organised by theme. UNEP news, projects, activities, resources.

PRODUCT FEATURES		PORTAL PRODUCTS														
		State		National	International											
		WALGA Climate Change Management Toolkit (WA)	Climate Change Adaptation Navigator (VIC)	NCCARF Local Government Portal	UK Climate Impacts Program Website (UKCIP)	New Zealand National Institute of Water and Atmospheric Research (NIWA) Website	CLIMATE-ADAPT Platform (Europe)	Mediation: Methodology for Effective Decision-making on Impacts and Adaptation	weADAPT	Climate & Development Knowledge Network (CDKN)	Climate Adaptation Knowledge Exchange (CAKE)	Ecosystem Based Management Tools Network	Climate Change Adaptation in Asia and the Pacific	World Bank Climate Change Knowledge Portal	UNDP Adapation Learning Mechanism	UNEP Climate Change Website
	FUNCTIONAL COVERAGE FEATURES															
1	Adaptation background and facts															
	Adaptation process support															
2	Adaptation process product															
	Data and information provision															
3a	Climate and socio-economic data															
3b	Impact data															
3c	Risk/vulnerability Information															
3d	Adaptation Options Information															
	Other Knowledge Portal Functions															
4	Special purpose analytical products (sector specific)															
5	Adaptation projects database and case studies															
6	Key contacts database															
7	Research database															
8	Skilling/ training product (e.g. e-Learning)															
9	Engagement and communications products (sector/jurisdiction specific)															
10	Relevant policy, programs, funding, governance															

PRODUCT FEATURES		PORTAL PRODUCTS																
		State		National	International													
		WALGA Climate Change Management Toolkit (WA)	Climate Change Adaptation Navigator (VIC)	NCCARF Local Government Portal	UK Climate Impacts Program Website (UKCIP)	New Zealand National Institute of Water and Atmospheric Research (NIWA) Website	CLIMATE-ADAPT Platform (Europe)	Mediation: Methodology for Effective Decision-making on Impacts and Adaptation	weADAPT	Climate & Development Knowledge Network (CDKN)	Climate Adaptation Knowledge Exchange (CAKE)	Ecosystem Based Management Tools Network	Climate Change Adaptation in Asia and the Pacific	World Bank Climate Change Knowledge Portal	UNDP Adapation Learning Mechanism	UNEP Climate Change Website
	USER ORIENTED FEATURES																	
1	Functional Coverage and Depth																	
1.1	Range of potential function covered																	
1.2	Provides level of detail to assist user in practical application; May include additional resources e.g. workshop templates																	
2	Currency: being actively maintained and continuously improved (evident to user i.e. some form of notification, newsfeed etc)																	
3	Accessibility: Open Access/ Online																	
4	Flexible navigation: encourages multiple/flexible entry points, easily navigable, useful search capability																	
5	Ease of use and interpretation: self-explanatory processes and outputs																	
6	Support available: user guidance, support services available																	
7	Clarity and authority of underpinning knowledge and sources																	
8	Stakeholder/user engagement in product development and improvement																	
9	Proportion customisable to Australian national (and potentially sub-national) context																	

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Queensland Government

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University of the Sunshine Coast Queensland, Australia

MACQUARIE UNIVERSITY

QUT

THE UNIVERSITY OF NEWCASTLE AUSTRALIA