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VCCCAR project: Framing Adaptation in the Victorian Context

Local climate change adaptation planning

A guide for government policy and decision makers in Victoria

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1. Introduction

This section provides information on:

- the purpose and target audience for this guide
- climate change projections for Victoria
- government's role in climate change adaptation in Victoria.

The earth's climate is continuously changing but accelerated rates of climate change over the last century are of significant concern. Increases in average temperatures have been seen around the globe and there is new and stronger evidence that most of the warming observed in the last 50 years is due to human activity.

Climate change is a global issue. It will affect people and places in different parts of the world, including in Victoria. There will always be some degree of uncertainty over the precise scale and timing of climate change taking effect. In Victoria, current trends and projections suggest a warmer, drier future, with an increasing likelihood of more extreme events such as heatwaves, bushfires, flooding, and coastal storm surges. The nature and magnitude of the impacts not only depend on climate change, but also on local geographic and socio-economic factors, and on how well individuals, communities and organisations are prepared and able to adapt to climate change impacts – both to sudden events and gradual changes.

At the local and regional scale, adaptation interventions are most successful if they are based on a thorough understanding of local context. This includes understanding the characteristics of ecosystems, the social fabric of communities, the key industries and sectors operating in an area, and the institutional capacities of the individuals and organisations involved in responding to climate change impacts. It is important that governments take local factors into account when making decision on adapting to climate variability and change.

1.1 Purpose of this guide

The purpose of this document is to provide local and state government officials with guidance on the process of effectively considering climate change impacts in policy development and delivery, with an emphasis on place-based adaptation. The guide is an introduction to a suite of widely applicable processes and methods relevant for assessing and responding to existing and potential future climate change impacts on Victoria's communities, natural and built assets.

The process of adapting to climate change impacts is not new to most organisations. Businesses, governments and whole sectors have always managed risks and adapted their operations in response to changing weather patterns and climatic conditions. However, with more rapid climatic change and an increasing understanding of the potential future changes to our climate, planned and proactive adaptation has become more critical to ensure local communities, economies and ecosystems remain viable into the future.

At first glance, what climate change adaptation means for government can be abstract, complex and subjective, and it may be difficult to know where to start with adaptation planning. This guide can support all levels of government, irrespective of sector, in working out how climate change impacts may affect their respective services and programs, and how to best prepare for and respond to current and future climatic changes. It seeks to be flexible and consider the complexity and diversity of adaptation challenges across the state – and across various government organisations and agencies. It provides an overview of different approaches essential for place-based adaptation planning at the local level, which can be tailored to specific circumstances and needs.

The guide does not present a 'one size fits all' approach to adaptation because the challenges and variables associated with climate change adaptation are too diverse (e.g. the variety of landscapes, potential climate change impacts, differences in government capacities, diverse socio-economic conditions) to allow for one single, standardised approach to be effective.

1.2 Process of developing this guide

This guide has been developed with significant input from a range of stakeholders. It is a collaborative effort that involved input from researchers based at RMIT University, Monash University, the Victorian Centre for Climate Change Adaptation Research (VCCCAR), and staff of the Department of Environment and Sustainability's (DSE) Environmental Policy and Climate Change division. Specifically, the guide has drawn substantially from research prepared as part of the following projects:

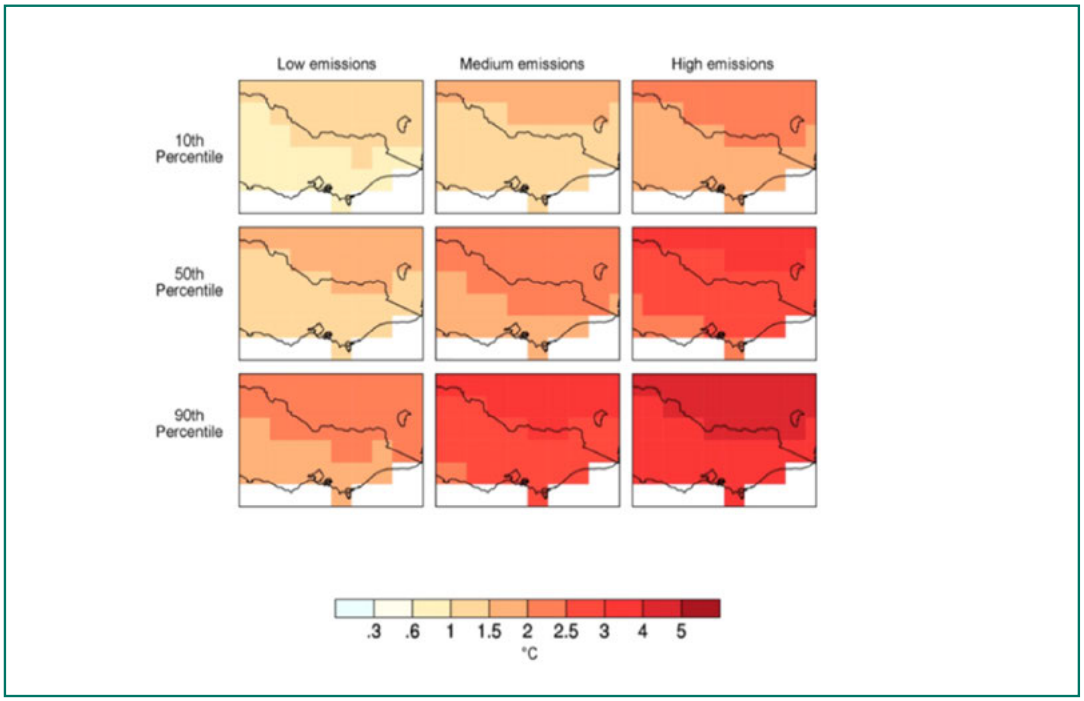
- Framing multi-level and multi-actor adaptation in the Victorian context (research project funded by VCCCAR)
- DSE coordination and integration at place analysis (DSE action research, carried out by RMIT University)
- Port Fairy local context, drivers and issues analysis (DSE social research project, carried out by Monash University in collaboration with VCCCAR)

Sections of this guide were first developed as discussion papers and disseminated among key stakeholders involved in governmental climate change adaptation processes. Focus group discussions were held with government stakeholders to collect feedback on the discussion papers, which was then incorporated into the guide. In addition the material was informed by focus groups conducted as part of the VCCCAR research project mentioned above.

1.3 Climate change in Victoria

Australia's warmest year on record was in 2005, where the average temperature was 1.09°C above the 1961-1990 average. This was followed closely by 2009, which was 0.9°C above the average. In Victoria, 2009 was a year of weather extremes, where maximum temperatures reached 48.8°C, the state's highest temperature on record. The occurrence of days reaching these extreme temperatures is projected to increase both in frequency and intensity, with the largest increases expected in inland areas. Urban areas and city centres will particularly feel the heat as a result of the growing number of hard surfaces and buildings, which lead to additional increases in temperature (urban heat island effect). Melbourne's central business district, for instance, can be up to 7°C hotter than the surrounding suburbs. This increases the vulnerability of people in urban areas to heat stress.

Figure 1: Projected annual mean temperature change in Victoria for 2070



Source: CSIRO / Australian Bureau of Meteorology (2012): Australia's future climate - Victoria Temperature change, Climate Change in Australia, http://climatechangeinaustralia.com.au/victemp1.php (accessed 15 October 2012).

Over the next 60 years, average temperatures in Victoria are projected to increase by between 1.4°C and 2.7°C, under a low and high emissions scenario respectively. Figure 1 illustrates these projections. The low, medium and high emissions scenarios are drawn from the Intergovernmental Panel on Climate Change's (IPCC) Special Report on Emission Scenarios and relate to the projected amount of greenhouse gas emissions in the atmosphere. The percentiles are taken from the lowest 10 per cent and highest 10 per cent of the spread of model results, which provides the full range of uncertainty.

Rainfall totals in Victoria have decreased over the past decade and annual averages are expected to decrease further in the future. The best estimate (50th percentile) rainfall projections show a decrease of between 6 and 11 per cent by 2070, under low and high emissions scenarios.

Rainfall reductions combined with warmer temperatures are likely to increase the frequency and duration of drought. Drought and reduced rainfall are prolonged effects of climate change, rather than one-off events such as a heatwave or a flood. Drought causes significant pressures on water supply, and business owners and residents have already made large reductions in water consumption. Although this level of understanding is beneficial, it will be difficult to reduce consumption further with the additional strain of population increase and climate change.

1.4 Potential impacts of climate change on government

Climate change can be considered a 'wicked problem', where social, environmental and technological factors interact on various levels of decision-making, involving a multitude of stakeholders from different backgrounds.

The impacts of climate change are manifold and have the potential to cut across a large proportion, if not all, of government departments and responsibilities.

If Victorian local and state governments are to have an active role in supporting place-based adaptation activities whilst acknowledging the complexities outlined above, the organisations need to consider how they:

- provide consistent yet robust, flexible and practical methods to assess and respond to climate change impacts, risks and vulnerabilities
- understand the way natural and human systems interact at place, to influence climate change impacts, risks and vulnerabilities and to avoid maladaptive interventions
- support government bodies to work together to understand how cross-departmental and multi-level issues interact at place
- understand diverse perceptions regarding place-based community assets and values, and how these may be affected by climate change driven risks
- develop quality and genuine processes that enable local organisations and community members to effectively participate in adaptation planning.

2. Climate Change Adaptation Concepts and Approaches

This section provides information on:

- key definitions of climate change terms used in this guide
- a description of key characteristics of climate change adaptation processes
- an explanation of different approaches used for climate change adapt

2.1 Key definitions

Due to the subjective and abstract nature of terms and concepts associated with climate change adaptation, the following provides a list of defined terms as they are applied in this guide. Most of the definitions are drawn from the glossary in the IPCC Third and Fourth Assessment Reports, the United Nations Development Program Adaptation Policy Framework, or from research outputs produced by VCCCAR. Although commonly accepted definitions exist, it is worth noting that different disciplines and sectors tend to interpret and apply these terms differently.

ADAPTATION

Adaptation is the adjustment in natural or human systems in response to current or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation.

RISK

Risk is a function of the likelihood of an event occurring and its expected consequences, i.e. climate risk equals the probability of a climate impact occurring, multiplied by a given system's sensitivity to that impact.

HAZARD

A physically defined climatic event with potential to cause harm, such as heavy rainfall, drought, flood, storm, or long term change in mean climate variables, such as average temperature.

VULNERABILITY

Vulnerability is the degree to which a social or ecological (or a combined socio-ecological) system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extreme weather. Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.

RESILIENCE

Resilience is the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, its capacity for self-organisation, and its ability to adapt to stress and change.

ADAPTIVE CAPACITY

Adaptive capacity is the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

EXPOSURE

Exposure refers to a system being subject to experiencing climatic hazards, such as changing rainfall patterns, increasing average temperatures, and changes in the frequency of extreme weather events.

SENSITIVITY

Sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g. a change in crop yield in response to a change in the mean, range or variability of temperature) or indirect (e.g. soil degradation caused by an increase in the frequency of coastal flooding due to sea-level rise).

CLIMATE CHANGE IMPACT

The effects of climate change on social and ecological systems. These are sometimes distinguished as direct or indirect climate change impacts.

DIRECT CLIMATE CHANGE IMPACTS

Direct climate change impacts are biophysical effects on natural and human systems resulting from a change in climatic parameters, such as temperature, rainfall, wind speed, humidity and evapotranspiration. Examples of direct climate change impacts are drought, flooding, storms, and heat waves.

INDIRECT CLIMATE CHANGE IMPACTS

Indirect climate change impacts are biophysical or social impacts on natural and human systems that take place as a result of biophysical changes to climatic parameters. Examples of indirect climate change impacts are bushfires, species extinction, habitat loss, migration, social unrest, and economic growth or downturn.

MALADAPTATION

Maladaptation describes adaptation interventions taken to avoid or reduce vulnerability to climate change that increase rather than decrease the vulnerability of systems, sectors or social groups.

2.2 Characteristics of adaptation processes

There are many ways of adapting to climate change and no single blueprint can satisfactorily capture all facets of adaptation. There are, however, a number of key considerations that are characteristic to most local adaptation processes. These characteristics are outlined below. It can be useful to think through and discuss these characteristics prior to starting an adaptation initiative, in order to clarify the meaning and purpose of the undertaking.

DEFINING WHAT ADAPTS

Prior to implementing adaptation interventions, the stakeholders involved typically construct boundaries around natural or human (social and economic) systems. These boundaries may be geographic – a system could be a town, region or state, a component of a biological environment such as marine ecosystem – or a system boundary may be drawn around a sector or service, such as the agricultural sector or health services (see Box 1 for examples). Such boundary setting is an important part of the scoping process for adaptation.

As part of scoping, and before selecting specific methods, it is important to define and describe the system that is in need of adaptation. This is an important step to help focus adaptation efforts right from the beginning. Defining and gaining an understanding of the adapting system are crucial because it can affect a range of parameters of the adaptation initiative, including:

- the scope of work carried out
- how adaptation goals are defined
- the data inputs required
- how risks and vulnerabilities are interpreted
- the type of adaptation measures that are considered
- who is involved in developing adaptation options and interventions
- who decides on what adaptation measures are implemented
- what the actual adaptation outcomes will be.

Some adaptation approaches seek to look at multiple systems and the interactions within and between systems, while other approaches focus the analysis on a singular system. In many instances, adaptation planning needs to acknowledge that natural systems cannot be separated from human systems and their social, political and economic processes.

For this reason so called 'coupled socio-ecological systems' are frequently referred to as systems of concern in adaptation. A good example is *the city* as a coupled socio-ecological urban system, where natural system elements, such as topography, drainage patterns and vegetation cover interact with human system elements, such as residents, the built environment, land use, and behavioural aspects such as human mobility and economic activity.

Box 1: System boundaries in different adaptation initiatives

REGION: WESTERN PORT

The Climate Change Impacts and Adaptation Western Port scoping study was initiated in 2005 by the Western Port Greenhouse Alliance (WPGA) and funded by DSE. The project examined the future impacts of climate change on Western Port, to assist the region in preparing for and adapting to the impacts of climate change. At the focal point of the regional response were a series of eight 'priority cross-sectoral issues'. These included marine biodiversity and habitats, housing, infrastructure and water supply. This project is an example of an adaptation process where the adaptation boundary crossed and intertwined with different sectors,while being primarily a geographical boundary relating to the make-up of the area of the Western Port region.

Web: http://www.seccca.org.au/project_summary.asp?data_id=11

SECTOR: RAIL

The heatwave of January 2009 created temperatures in excess of 45°C, lasting three consecutive days. These extreme temperatures caused railway tracks to buckle, resulting in service disruption to the network. CSIRO researchers assessed the probability of heatwaves causing buckling failure to railway tracks in Melbourne. The assessment used the railway network in Melbourne as its system boundary to provide an adaptation framework to assist railway authorities to plan and manage railway network services.

Web: www.csiro.au/science/adapt-heatwave-rail

ECOSYSTEM: MARINE

The Marine Ecosystems and Adaptation Report Card was the first-ever Australian benchmark of climate change impacts and adaptation options on marine ecosystems. The report examines the marine biodiversity for all of Australia's waters, thus using an extensive geographical system boundary. It provides observations over the past decade, projects forward to 2030 and 2100 with assessments of likely status and confidence ratings, and offers adaptation responses that can inform policy makers.

Web: http://www.oceanclimatechange.org.au/content/index.php/site/welcome/

PLACE-BASED FOCUS

Although adaptation occurs at a number of interconnected contexts and scales where interventions in one context may affect outcomes in another, impacts will predominantly manifest locally and differently across Victoria. This is a result of different geography, demographics, weather patterns and the varying ability of local communities, industries and governments to plan for and respond to change. A place-based approach highlights the need for planning and responding to climate change impacts based on this diversity.

Small scale, place based adaptation approaches enable an understanding of how diverse climate change impacts are and will be across different landscapes, natural assets, ecologies, communities, institutions and businesses. They make it easier to understand climate change adaptation from a whole system point of view – by examining the interactions between system parts and the drivers of climate change related risks in a particular place. In turn, a better understanding of the system can help avoid unexpected consequences or maladaptation.

Community development research and practice demonstrates that communities have the strongest association with place at small scales and therefore are more likely to participate in environmental or community activities initiated at this level.

MULTI-DISCIPLINARY ANALYSIS

There is a growing body of experience, research, and advice on the methods for responding to current and expected climate change impacts. This knowledge stems from various sectors, disciplines, and institutions. Often a particular method is used because an organisation has applied it in the past, or because there is a lack of awareness about the range of possible methods, their strengths and weaknesses, and consequently a lack of understanding about what method is most 'fit for purpose'.

A planner, biologist and community worker may define climate change and potential impacts at a particular location differently. For example, in a coastal community a planner may be inclined to focus on how indirect climate hazards will affect the built environment; a biologist may look how at increasing ocean temperatures will affect a specific species; and a community worker may be most interested in how particular members of the community are prepared for extreme events.

These different foci have resulted in the development and application of diverse methods to assess impacts, and subsequently to different adaptation solutions. Some of these methods are formalised within disciplines (e.g. risk assessment) while others are not (e.g. vulnerability assessment). The existence of multiple methodologies to analyse impacts has made it increasingly difficult to determine which methods are most fit for purpose and will most likely meet identified adaptation needs. The question of 'what method is best for what purpose' is further complicated when disciplines and sectors attempt to come together to achieve an integrated analysis of climate change impacts.

Different methods use different data to determine what climate change impacts are or might be. It is important to acknowledge that understanding the diversity of impacts, their drivers and interactions, requires drawing information and data from diverse sources and from multi-disciplinary analysis. This includes primary and secondary data, qualitative and quantitative data, and data on social, economic, and environmental characteristics.

THE ROLE OF VALUES IN ADAPTATION

Communities will respond to climate change in complex and diverse ways, depending on their needs, values, cultures, capacities, institutional forms and environmental features. Values subjectively influence what adaptation actions are considered to be desirable and prioritised. As part of robust adaptation planning and decision-making, there is a need to understand the diversity of existing values – in the community, within an organisation, and among the political leaders involved.

In the context of climate change, value differences come to the surface in how individuals or communities regard assets that are at risk from climate change, such as coastal properties, houses in bushfire-prone areas, or natural habitat under threat from rising mean temperatures (Box 2). Challenges can arise where trade-offs or compromises between different adaptation options need to be negotiated by the parties involved (e.g. the decision to place human safety concerns over ecological and altruistic values). The values associated with such decisions change over time – what is considered an acceptable decision today may not be considered acceptable into the future.

For these reasons it is essential to gain an understanding of diverse values that underpin adaptation; who holds what kind of values; how these values are communicated and negotiated in the public domain; and how they have changed over time.

Box 2: The role of local values: Port Fairy's river and beaches

The river and beaches are Port Fairy's most valuable assets for tourism, recreational yachting and the commercial fishing industry. In the words of one respondent: 'The water is the reason why everyone is here'. Beyond that, the surrounding environment is of great importance to the residents of Port Fairy on many levels. The intimate knowledge of the land and seascapes are an essential part of the local identity. This sense of belonging has a strong emotional force and is the source of belief in the deep value of local knowledge and a sense of responsibility for the land and future generations in Port Fairy.

Source: VCCCARFraming Adaptation project: 'Local Context, Drivers & Issues Analysis in Port Fairy – project report, October 2011.

2.3 Approaches to adaptation

Keeping the characteristics mentioned in section 2.2 in mind, there are a number of ways of going about planning and developing an adaptation initiative or intervention. It may be useful to reflect, at an early stage of adaptation planning, on different conceptual approaches that can be adopted as part of adaptation initiatives.

At a conceptual and policy development level, two key approaches to climate change adaptation can be identified:

1. approaches that mainly view adaptation as an outcome (or end point) of 'being adapted', that governments and communities can work towards
2. approaches that mainly consider adaptation as a continuous process of learning and institutional change, in response to emerging knowledge on climate change and changing situations.

ADAPTATION AS AN OUTCOME

Outcome responses to climate change are primarily concerned with developing 'hard', technological solutions, to move toward a state of 'being better adapted' to a future climate. Being adapted is seen as the primary goal and outcome of investment into adaptation (see Box 3).

Box 3: Adaptation as an outcome: replenishing Noosa Beach

Noosa Main Beach has intermittently suffered from erosion during cyclones and heavy sea conditions. In 2008 the Sunshine Coast Council gained approval for a permanent installation of a sand recycling system to rehabilitate the beach. The building and pipeline of the system is now complete and early indications show that sand recycling would overcome the environmental concerns associated with dredging, that it is not disruptive to beach users and it would be a cost-effective option with fewer risks than 'built' solutions.

Source: Sunshine Coast Council (2011): Noosa Beach Erosion and Sand Recycling, http://www.sunshinecoast.qld.gov.au/sitePage.cfm?code=noosa-beach-sand-recycling (accessed 15 October 2012).

This approach gravitates from a sound understanding of future climate change, in order to devise solutions that can reduce any impacts to human and/or natural systems. For this reason, outcome-focused approaches usually take on the perspective that better information on the expected changes to climatic parameters (e.g. temperature, rainfall and humidity) can be generated providing sufficient resource investment, and that such additional information on climatic risk will enable robust decision-making on climate change mitigation and adaptation.

'Information' can refer to:

- scientific data about past and projected climatic changes in a given area
- modelling data on non-climatic events and their effects (e.g. the global financial crises, natural disasters, and processes such as peak oil)
- additional data on local environmental, social and economic conditions.

Outcome approaches require significant input from experts, such as climate scientists, economists, and ecologists, who are able to generate the required data using a combination of observation, analysis of existing data (e.g. on recent extreme events, demographics, environmental parameters), and scientific models that allow for making projections into the future and technical assessment of options being considered.

Outcome approaches tend to align well with existing linear decision-making processes due to their focus on cause-effect type information, modelling and quantification, all of which help reduce political risks associated with making decisions in the face of uncertainty. Outcome approaches are therefore often the preferred option for supporting top-down planning processes (see Box 4).

Box 4: Which type of approach for place-based adaptation?

Relying mainly on scientific climate change information for adaptation may be best suited to awareness raising and adaptation plan¬ning at national and international levels. Recent research using case study narratives from Europe and Southern Africa demonstrates that scientific data is less important for adaptation planning and decision-making at the local scale. More important for local decision-making was, for example, an awareness of cli¬mate change impacts brought about by the direct experience of climatic shocks or trends. For example, the European heat wave in 2003 changed local risk perceptions and resulted in the development of local heat wave strategies in several countries across Europe.

Source: Hinkel et al. 2010: Learning to adapt: Re-framing climate change adaptation. In: Hulme, M. and H. Neufeldt (eds.) Making climate change work for us: European perspectives on adaptation and mitigation strategies. Cambridge: Cambridge University Press.

Improved and more detailed climate change related information can be very relevant to strategic decision-making, in particular in the context of national or sectoral adaptation planning. In place-based adaptation, however, the extent to which such information can guide adaptation initiatives is limited by factors such as:

- the **complexity** of climate change as an issue influenced by a multitude of social, political, environmental and economic factors
- the **residual uncertainty** surrounding scientific climate data and information on future social, economic and political change, which are impossible to predict with great accuracy
- the **ability of scientific experts to communicate** new information and the **capacity of decision-makers** to interpret and make use of the information provided.
- Examples of where adaptation initiatives are typically driven by an outcome approach are:
- national climate projections being 'downscaled' to a regional level using statistical processes
- assessing flood risk in a given area by drawing on a combination of biophysical catchment data, hydrological and meteorological observations, climate projections, and infrastructure and demographic data.

ADAPTATION AS A PROCESS

Process-type approaches to adaptation emphasise that the most appropriate solutions to climate change adaptation may not be knowable yet and that gradual and iterative change of systems, institutions, communities and individual behaviour is required to effectively deal with changing climatic parameters and their impacts, now and into the future (see Box 5). Such 'systemic change' can include the following processes:

- individual and institutional **learning and capacity-building**
- **adjustment of current decision-making models** and processes, including planning timeframes, stakeholder involvement, and internal organisational structures
- **transformational change** of institutions, organisations and sectors to reflect changing climatic as well as changing environmental, social, economic conditions.

Approaches that focus on the *process* of adapting to climate change assume that adaptation is essentially a social issue and highly dependent on the capacity of individuals, social groups, and organisations to learn and drive change.

In place-based adaptation, process-based approaches focus on gaining an increased understanding of:

- the aspects of their natural and man-made environment people value most
- what people's key concerns are regarding climate change impacts
- people's capacity is to respond to climate change impacts and how this can be strengthened
- how a process of participatory learning and continuous stakeholder engagement can lead to transformational social and institutional change.

New and additional information is mainly produced in the form of qualitative data resulting from participatory processes and social research. This type of information can support technologically driven adaptation measures as well as lead to 'soft', non-technological interventions.

Process approaches readily lend themselves to place-based adaptation because they support bottom-up, participatory, networked planning and decision-making processes to explore local knowledge and find local solutions.

Adaptation-as-process approaches can be challenging to implement due to constraints such as:

- adaptation becoming bogged down in the **diversity of local perspectives and opinions**
- a **mismatch** between the **information needs** of decision-makers and planners and the mostly qualitative information generated by bottom-up processes
- learning processes getting stalled due to the **inherent resistance of systems to adjustment and transformation**

Box 5: Examples: Institutional learning and capacity-building in organisations UKCIP

The UK Climate Impacts Programme, or UKCIP, is a UK government-funded organisation that prides itself on being a learning and capacity-building organisation. UKCIP provide resources free of charge to help organisations understand what changes to the climate may mean for them, and offer guidance on how to prepare for these. In turn, UKCIP learn from working with organisations and share the knowledge with others to improve climate change adaptation plans and decisions.

SECCCA

The South East Councils Climate Change Alliance (SECCCA) is a network of eight Councils in Victoria making a regional response to climate change. They have decided that they can make more effective responses to the impacts of climate change when they work in unison.

Sources: UKCIP, 2011, http://www.ukcip.org.uk SECCCA, 2011, http://www.seccca.org.au (accessed 15 October 2012).

DEVELOPING AN APPROACH TO ADAPTATION

The above considerations regarding process and outcome are theoretical concepts that can help make sense of the purpose, goals and methods of adaptation. In practice, however, it is likely that place-based adaptation approaches will need to contain both outcome and process aspects to be effective. Considering both the process and outcome aspects of adaptation is useful for pointing to adaptation opportunities otherwise left unnoticed, and to examine the full range of adaptation options, from 'hard' infrastructure solutions through to 'soft' measures that enhance adaptive capacity.

3. Working Collaboratively on Adaptation

This section provides guidance on:

- the importance of understanding adaptive governance and collaboration
- understanding where an organisation or group sits within different stages of collaboration
- the key ingredients to working collaboratively
- using collaboration to achieve better adaptation outcomes.

3.1 Adaptive Governance

Climate change adaptation as a policy issue has many aspects that challenge the way the public sector governs and makes decisions. Climate change impacts affect multiple sectors, places and people in different ways. The risks created by climate change are often exacerbated by non-climatic drivers within social and economic systems, such as changes in migration patterns, or global market conditions. Interactions and interdependencies between multi-sector and portfolio-specific risks can lead to climate change interventions with unforeseen consequences or maladaptation.

Box 6: Governance

'Governance determines who has power, who makes decisions, how other players make their voice heard and how account is rendered.'

The need for governance exists anytime a group of people come together to accomplish an end. Where a group is too large to efficiently make all necessary decisions, it creates an entity to facilitate the process. Group members delegate a large portion of the decision-making responsibility to this entity. In voluntary sector organizations this entity is the board of directors. In a public sector context this may be a board of directors, a committee or a project management team. One simple definition of governance is "the art of steering societies and organizations." Governance is about the more strategic aspects of steering, making the larger decisions about both direction and roles.

Source: Institute on Governance, 2012, http://iog.openconcept.ca/en/about-us/governance/governance-definition (accessed 15 October 2012).

Adaptive governance can help address the challenges outlined above. Adaptive governance approaches are typically collaborative, iterative, and informed by diverse perspective. Their iterative nature means that policies are appraised continuously and enable ongoing technical, institutional and social learning. Issues and solutions are determined collaboratively, using various forms of information i.e. multidisciplinary, technical, non-technical, formal and informal sources.

3.2 Understanding and actioning collaboration

Collaboration, or working collaboratively, is common in the language of business and government and increasingly recognised as an important tool for working effectively in climate change adaptation. Cross-divisional working already occurs in organisations and substantive tasks are usually achieved through project work. However, if the groups involved do not understand and take on the benefits of working collaboratively then the work they produce is likely not to reach its full potential. It is therefore important that organisations understand and develop the skills required for collaboration, as opposed to merely using it as a corporate buzz word.

Table 1: Skills leading to successful and poor collaborative working

Successful collaboration	Poor collaboration
Purposefully designed and supported cross-portfolio collaboration	Unplanned and /or poor cross-portfolio collaboration; poor protocols for collaboration
Common purpose and identification with a 'whole of organisation' approach.	Lack of cross-divisional ownership
Trust and networks	Failure to make new links
Structural and cultural support for commitment	Structural and cultural impediments
Good communication, learning and education	Lack of collaborative skills and capabilities
Understanding of other groups, community and stakeholders	Lack of understanding about the nature of other groups

Table 1 illustrates that there are some simple skills that can be developed to improve collaboration. These should be learned with a deliberate attempt to create and develop a culture of collaboration, in support of climate change adaptation.

STAGES OF COLLABORATION

Three stages of collaboration can be identified to help groups think about where they are placed in the overall development of collaboration:

1. **Pre-collaboration:** Parties still primarily hold to their own agendas and stress the limits of their own resources, driven primarily by their own dynamics. Overall group organisation may be loose or limited in its authority. A sense of identity and authority is gained from knowledge of their own 'home group' agenda. There may be negotiated agreement about the overall group task, but primary identification with the collaborative group is minimal[1].

2. **Transitional:** most or all parties not only accept but are identified with the primary task of the collaborative group. They understand and are committed to the overarching purpose of the group and begin to take up roles in relation to this. The group begins a more dedicated commitment to its own organisation.

3. **Collaboration:** each of the parties is identified with the purpose and tasks of the group. They each have a strong role to play in the work of the group. They collectively work on a task and achieve outcomes (this does not mean they agree on everything – difference is important in any working group). Identification with the group is strong and less of a challenge to original identifications with groups of origin. Members are comfortable, in general, with both.

[1] Long, S. and W. Harding (2012). *Collaboration for adaptation to climate change: facing risks through collaboration.* Conference paper. International Society for the Psychoanalytic Study of Organizations (ISPSO) Annual Meeting, San Diego CA, 4-12 June 2012.

WORKING COLLABORATIVELY

Collaborative working is a starting block to better understanding how climate change impacts may affect an organisation and its respective services, and to further develop a climate adaptation plan. There are a number of basic activities that should be undertaken at the outset to ensure you get as much out of the impacts and adaptation process as possible. These key ingredients for successful collaboration are outlined in Box 7.

Box 7: The key ingredients to collaborative working

1. Know and understand the process and bigger picture to ensure you have a sense of what is involved and how you can maximize its value.
2. Engage your colleagues. Gather a small team of people around you who can work with you throughout the process. Getting the right people on board from the outset will lead to a better product. Bear in mind that you will need to review this team as you move through the process as different skills sets and knowledge bases may be needed at different stages of the process. Also aim to match your team to the scope of your assessment.
3. Obtain senior management buy-in and support for this process. Assessing climate impacts and identifying adaptation options will have resource implications which may require the support or approval of senior management. Furthermore, the adaptation measures identified through the process are more likely to be successfully implemented if the process has high level support from the outset. Time spent building support for climate adaptation at the inception of the process can be invaluable in delivering successful outcomes.
4. The adaptation options you identify may initially be implemented through your organisation's existing procedures. Make sure you have a good understanding of these to help you look for ways of mainstreaming your adaptation measures later in the process.
5. Consider how change can be affected in your organisation. Addressing some climate risks may call for a fundamental review of your organisation's activities and processes. Having a sense at the outset of how transformations might take place will help in the implementation phase.

Source: Step 1 of UKCIP's Adaptation Wizard. UKCIP (2010). The UKCIP Adaptation Wizard V3.0. UKCIP, Oxford, UK, http://www.ukcip.org.uk/wizard/ (accessed 15 October 2012).

USING COLLABORATION FOR BETTER ADAPTATION OUTCOMES

It is common for large organisations or different sectors working together to discover that there are differences in culture, emphasis and drivers. Despite these differences, there are many opportunities for collaboration as well as barriers to its effective development. Table 2 identifies recommendations in the areas of organisation and leadership, and project management and suggests actions required in order to achieve them.

Table 2: Recommendations and suggestions for better adaptation outcomes

Organisation and leadership	How
Develop ways to create management support for collaboration	Report on the success of collaborative endeavours in the department. Design and run management meetings collaboratively, use mentors, the model for collaboration, and independent facilitators.
Build in collaboration as a value and set of expectations	Build into job descriptions, the corporate plan, projects, and divisional budgets and develop support mechanisms.
Provide education on collaborative practice, skills and development	Include in existing courses such as project management and engagement. Share learning through information sessions, communities of practice, peers/mentors.
Strongly support cross portfolio collaborative projects through organisational structure and culture	Communicate the conceptual, policy and practical links between the work of divisions and the overarching aims and purposes of the organisation and its stakeholders. Include time for process development in projects as well as time for the development of the substantive work task. Consult staff about the development and design of collaborative cross-portfolio work.
Project management	**How**
Acknowledge that all groups operate differently and practice new ways of doing things	Recognise that a new project group is a new 'temporary organisation' that needs all the structural, administrative, staff and line supports given an organisation. Think up reflective questions and practice reflection.
Explore the difference between collaboration versus good project management	Partnerships vary along a continuum from networks to coordination to cooperating through to collaborating. The factors that vary include the degree of commitment involved, the kind of change required, the risk involved, the level of trust achieved, the use or abuse of power and the willingness to 'share turf'. Good project management has a clear TOR which outlines agreed roles and responsibilities and is reviewed regularly in light of a changing environment. Governance structures and decision making processes are clear.

Source: Modified from Messer N. and Ph. Townsley (2003): Local institutions and livelihoods: Guidelines for Analysis. Food and Agriculture Organization of the United Nations. Rome: FAO

4. Establishing the Local Context

This section provides guidance on:

- the importance of understanding the local social, economic and environmental context in which adaptation is to take place
- the role social research can play in place-based adaptation
- engaging local stakeholders adaptation initiatives
- how to develop a community profile
- how to communicate climate change issues.

Apart from gathering quantitative data on climate change and its impacts, qualitative social research can play a crucial role in local adaptation planning – to understand local perceptions of risk, to explore the adaptive capacity of individuals and groups, to harness local knowledge, and to enable tailored engagement. Investing in qualitative social research as part of adaptation initiatives can enable government to:

- garner support for and participation in its activities
- prioritise and tailor programs to facilitate, build, harness and or conserve adaptive capacity
- enhance the design of programs through inclusion of local knowledge or by fostering co- delivery models
- increase local awareness of and ability to manage private risk
- clarify roles and responsibilities to avoid duplication.

The stories of change elicited by local social research provide insights into the values and perceptions, practices and knowledge in regard to past and anticipated local change. By producing a more holistic picture of local communities, qualitative social research can enable governments to better understand local contexts and needs, and therefore deliver specifically tailored programs and policies that are 'fit for purpose'.

Research conducted by VCCCAR suggest that there is a significant opportunity for co-developing strategies for community engagement in conjunction with already existing social and environmental community initiatives, and to strengthen structures of deliberative decision-making and participatory action on climate change adaptation. Facilitating exchange and mutual understanding between community sections and government authorities and other administrative agencies can help avoid community confusion and frustration with top-down planning processes.

4.1 Working with local stakeholders

Succeeding in adapting to climate change at the local level requires gaining a thorough understanding of the local socio-economic, environmental and institutional context. For governments and their agencies working in local contexts, it is important to combine top-down adaptation planning processes that result from statutory government responsibilities with a concerted effort towards understanding which aspects of climate change matter to local people, businesses and civil society groups.

Ensuring early and active engagement of local stakeholders is critical to allow for truly place-based adaptation, where local stakeholders take co-ownership and share responsibility in the directions being taken. Stakeholder participation should reflect the ethnic, cultural, political and socio-economic diversity of local communities.

Due to the complexity of climate change adaptation, it may not always be obvious to community members what adaptation means in real terms and why adaptation is a priority for governments. Planning adaptation interventions as participatory processes from the outset allows for stakeholders to contribute to important aspects of the adaptation process, such as goal setting, exploring different adaptation options, and designing and agreeing on adaptation interventions suited to the local context and values existing in the community.

4.2 Communicating climate change adaptation

Climate change adaptation policy can greatly benefit from working closely with a number of community agencies in order to identify and reduce social vulnerabilities. However, for place-based adaptation efforts to be effective and successful, government and other administrative agencies need to ensure they develop their capabilities to communicate issues relating to climate change in an appropriate way and provide people with the experience of being genuinely listened to.

Knowledge exchange and shared learning between government authorities and the community, as well as between culturally and socio-economically diverse community sections, can strengthen the community's ability to develop informed opinions, take responsibility and build the capacity to act. However, as VCCCAR research findings suggest, communicative structures and spaces that aid such exchange are often still underdeveloped, and governments need to make a concerted effort to set up appropriate communication structures and processes for climate change adaptation. In particular, this means developing and strengthening communication structures that allow for discussion, knowledge exchange and consensus building.

Credible information and accessible, salient language, storylines, 'tangible' examples, and scenarios are needed to better engage the community with adaptive actions in the face of possible climate change impacts.

To date, climate change adaptation policy in Australia relies on definitions of vulnerability, resilience and adaptive capacity as provided by the Intergovernmental Panel on Climate Change (IPCC). However, social research conducted by VCCCAR in Port Fairy and the City of Melbourne (Box 8) shows that the use and interpretation of these and other key concepts need to be reflected upon in a local context by all actors involved. In particular, a good understanding of local communities' everyday lives, needs and concerns must be the basis of a critical and responsive reframing of climate change adaptation concepts for successful policy and practice.

Box 8: How do people interpret local climate change mitigation and adaptation?

Findings from empirical social research in the city of Melbourne

In research exploring the social narratives of climate change adaptation in the city of Melbourne, the majority of respondents were confident that they were already witnessing the effects of global climate change in Australia and overseas. While opinions were divided on whether climate change was due to exclusively human causes or part of natural cycles, there was general agreement that human activity negatively impacts the planet and the climate. Accordingly, most respondents were of the opinion that adaptation measures should include mitigating responses. Saving water and energy, recycling and consuming in environmentally sensitive ways were mentioned as their existing everyday practices by almost all participants. However, in this context participants expressed the need for improved infrastructure allowing for adaptive as well as mitigating behaviour, such as recycling; cycling; public transport; retrofitted buildings; access to alternative energy sources and the expansion and improved accessibility of urban green spaces.

Source: Paschen, J.-A. and R. Ison (2011). Exploring local narratives of environmental change and adaptation. A report on Work Package 4 of the VCCCAR project 'Framing multi-level and multi-actor adaptation responses in the Victorian context. Melbourne: VCCCAR/Monash Sustainability Institute.

For example, in adaptation policy discourse the notion of resilience is often used as an affirmative term towards actions such as in the building of 'climate resilient communities'. When relating the resilience concept to social processes of climate change adaptation, at least three different meanings can be found in the literature:

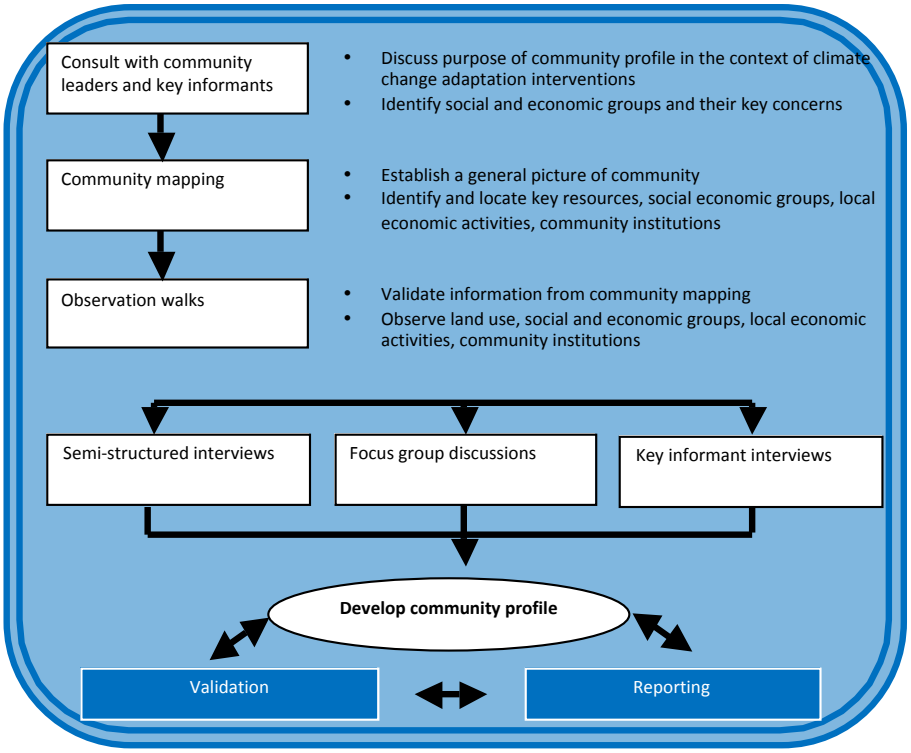
- resilience understood as response to disturbance
- resilience understood as a system's capacity to self-organise
- resilience as the capacity to learn and adapt.

In order to capture the manifold factors influencing individual and collective resilience in urban communities, definitions of such concepts may need to be reviewed within the local and demographically diverse contexts of their application. Socio-cultural perspectives on resilience approaches, for example, can be expanded by focussing on the importance of a number of factors, including, but not limited to, socio-economic and socio-psychological factors, access to education and information particularly in culturally and linguistically diverse communities, and other motivational factors, such as the sense of belonging to place, personal responsibility and the ability to act collectively and autonomously if this is needed.

4.3 Developing a community profile

To articulate community perceptions, values and concerns regarding climate change impacts, it can be useful to develop a community profile as part of a participatory, collaborative adaptation planning process. A community profile is a summary of the history, present conditions and anticipated future of a local area. It is a bottom-up process for establishing the local context for an adaptation initiative, which can help to kick-start conversations about climate change impacts and visions of the future held by members of a community or group.

Figure 2: Process for developing a community profile



Source: Modified from Messer N. and Ph. Townsley; 2003; Local institutions and livelihoods: Guidelines for Analysis. Food and Agriculture Organization of the United Nations. Rome: FAO.

Community profiling has a strong tradition in community-based adaptation and community development work in developing countries, and is also used in community impact assessment practices in some industrialised countries. For adaptation planning, community profiling can be carried out using the process outlined in Figure 2.

The following methods are commonly used for community profiling. These can be complemented by other participatory and discussion-based methods as appropriate.

- **Community mapping:** Maps can provide invaluable insights and a visual reference for discussions on climate change adaptation priorities with local stakeholders. Existing official maps can be used (e.g. topographical maps, land use and zoning maps, flood risk maps, tourist maps, etc.) and modified during discussions to capture concerns about climate change impacts. Alternatively mental maps can be created by individuals or groups. Often a combination of factual official maps and mental maps created by local stakeholders are best suited to effectively capture and convey climate change adaptation issues. Maps should capture a range of local issues, including:
  - » population distribution and density, including socio-economic distribution
  - » key sites of local economic activity (industrial areas, shopping centres, agricultural land, etc.)
  - » locations of community services (health facilities, schools and childcare centres, council services, essential services)
  - » areas considered most at risk of suffering from climate change impacts (sea level rise, flooding, heat waves, etc.)

It is important that local individuals play an active role in the development and refinement of community maps, explaining to the 'outsiders' how they see their community, as opposed to simply answering questions.

As part of the mapping process, it is useful to identify transects through the area for observing different ecological areas and natural resources, different groups within the community, and different local economic activities.

- **Observation walks:** The community mapping exercise should generate a general picture of the community, which can then be verified via observation walks through local areas to get a practical understanding of natural resources, local economic activities and the diversity of social, economic, ethnic and cultural groups identified through the mapping. It is essential that external stakeholders, such as government representatives, complete observation walks together with local stakeholders and encourage local stakeholders explain key aspects of the local community.

Observational walks are particularly useful for:

- » verifying the information given during the community mapping exercise
- » directly observing the different resources and economic activities that people have referred to during the mapping exercise
- » obtaining a more detailed understanding of the resources, land uses and economic activities by asking probing questions about the people involved (who?), the way resources are used and activities carried out (how?), the seasonality and timing (when?) and location (where?) of resource use and the reasons behind particular patterns of use (why?)
- » identifying particular groups of households associated with particular social or economic activities and noting where they live.

- **Interview techniques:** A range of interview techniques can be used to deepen the understanding of community structures and processes, including people's concerns and views regarding climate change adaptation. With the permission of the participants, interviews can be recorded on audio devices and analysed and interpreted at a later stage.

- **Semi-structured interviews,** where a simple list of preliminary topics or issues (instead of a formal questionnaire) is used to lead an individual or small group of local stakeholders through a conversation. Semi-structured interviews are dialogues, rather than traditional one-way interviews. Topics for discussion depend on the scope of the adaptation intervention but most commonly, they are drawn from previous engagement with local stakeholders, such as the community mapping and observation walks. This allows for emergent issues to be explored in more detail, where different stakeholders can shed light on the issues and voice their own opinion. Semi-structured interviews typically last from 20 to 60 minutes.
- **Focus group discussions,** where topical discussions are organised involving a particular group of local stakeholders that have a common interest or share a particular understanding of issues related to climate change adaptation. Like semi-structured interviews, the discussions can be facilitated along a key topic and question. At all times it should be ensured that the participants, not the facilitator or organiser, lead the discussion, and the conversation should be allowed to evolve freely. Focus group discussions typically involve four to eight participants and are scheduled for 40 to 90 minutes duration.
- **Key informant interviews** can be used to collect additional information from an individual who, because of their experience, local role, age or position, is likely to hold particularly broad or in-depth knowledge about the community or parts thereof. Key informants are usually identified as part of other community profiling activities, and they may well reside outside of the local area. Key informant interviews are conducted in the same way as semi-structured interviews, with an emphasis on preparing trigger questions that tap into the individual knowledge and experience of the key informant.

Table 3 provides a checklist that can be used throughout the development of a community profile, to ensure that the main aspects that characterise a community are captured. This checklist should be constantly updated and used as a source for developing more detailed checklists for individual interviews or questionnaires. Despite not asking about the impacts of climate change specifically, it can be expected that the key questions listed in the checklist will elicit information on climate variability and change, as well as social, economic and other environmental drivers of change.

Table 3: Checklist for developing a community profile

LOCAL NATURAL RESOURCES • What are the principal natural resources available to the community? • Who uses them and how are they used? • Where are they located?
LOCAL ECONOMIC ACTIVITY • What are the different local economic activities in the community? • Who is involved in those activities (men/women, young/old, different social and economic groups) and how many people and households depend on them? • When do those activities take place (time of day/month/seasons) and where?
COMMUNITY STRUCTURE • How many people and households live in the community? • What is the gender composition and age structure of the community? • What different social, economic, ethnic, cultural and political groups are there in the community? • How are those groups defined? • Where do those different social, economic, ethnic, cultural and political groups live?

LOCAL INSTITUTIONS

- What formal organisations and associations are there in the community?
- What rules, regulations and customs are in place?
- Who is affected by these rules, regulations and customs, and how?

COMMUNITY INFRASTRUCTURE

- What services are available in the community (transport, power and water supply, markets, rural extension, health, education, etc.)?
- Who has access to these services?
- How expensive are the user fees for these services?

COMMUNITY HISTORY

- How long has the community been in existence and how was it founded?
- When did different social, economic, ethnic and cultural groups settle in the community?
- How has the community changed over time and what has caused those changes?

Source: Modified from Messer N. and Ph. Townsley (2003): Local institutions and livelihoods: Guidelines for Analysis. Food and Agriculture Organization of the United Nations. Rome: FAO.

Most commonly a community profile is compiled using the following parts:

- **A map or a set of maps**, depicting physical characteristics, administrative boundaries, different types of land uses, public facilities and commercial and industrial centres. These can be printed topographical and thematic maps as well as illustrative maps developed during community workshops. Often topographical and land use maps are modified by community stakeholders to illustrate areas of particular concern, e.g. areas at high risk from adverse climate change impacts.
- **Narrative text and stories** that describes both quantitative and qualitative characteristics of the community, including population dynamics and demographic information, economic and social history of a place, and qualitative information on what natural and non-natural assets the community values most, perceptions of climate change risk, and scenarios for future development of the area. Collective community memory can be represented as stories retracing important events and incidents.
- **Tables and graphs** that support the narrative text, explaining quantitative data as well as visualising qualitative information, gathered for example as part of qualitative social research.

5. Assessing Current and Future Climate Change Impacts

This section provides guidance on:

- what data and information is needed for assessing climate change
- the main methods used for climate change assessment, their similarities and their differences
- step-by-step information on how to implement various assessment methods.

One of the key steps in most climate change adaptation initiatives (whether following an outcome or a process approach) is to gain an understanding of what the potential climate change impacts may be within a given system of concern. A range of methods exists for assessing climate change impacts, which are summarised in this section. This section firstly outlines the most common methods for assessing climate change impacts, including their strengths, limitations, data inputs and typical applications. It then examines how some of these methods align with adaptation as an outcome and adaptation as a process.

5.1 Data and information for climate change assessment

There are at least two types of climate information required to undertake a climate change assessment. Firstly, information is required on the past and current climate and secondly, information is required on the projected future climate and the likely local and regional effects. Both types of information are required to better understand a system's vulnerability to climatic variability and change.

DATA DESCRIBING THE CURRENT CLIMATE

Understanding current climatic conditions and their variability will make it easier to consider how future climate change may affect a system of concern. Local, regional and national meteorological and hydrological data generated through on-the-ground or satellite observation can be used for this purpose. In addition, data on responses to past events may also be relevant for pointing to appropriate adaptations to future climate.

Often, local stories relating to past impacts may be useful for raising awareness and engaging stakeholders in understanding current climate and climatic variability. It is important to identify how particular types of weather, including extreme events, have affected a community, local area or sector in the past and what the consequences of those events were. Where possible, thresholds should be identified which, when exceeded, brought unacceptable losses to a system, or, on the contrary, opened up new opportunities. It is important to evaluate how well the system coped with those events in the past, and consider how characteristics of a community or the event itself, influenced that response.

PROJECTION OF FUTURE CLIMATE

Information on how Australia's and, more specifically Victoria's, climate is expected to change is required to assess how climatic changes could affect a system of concern in the future.

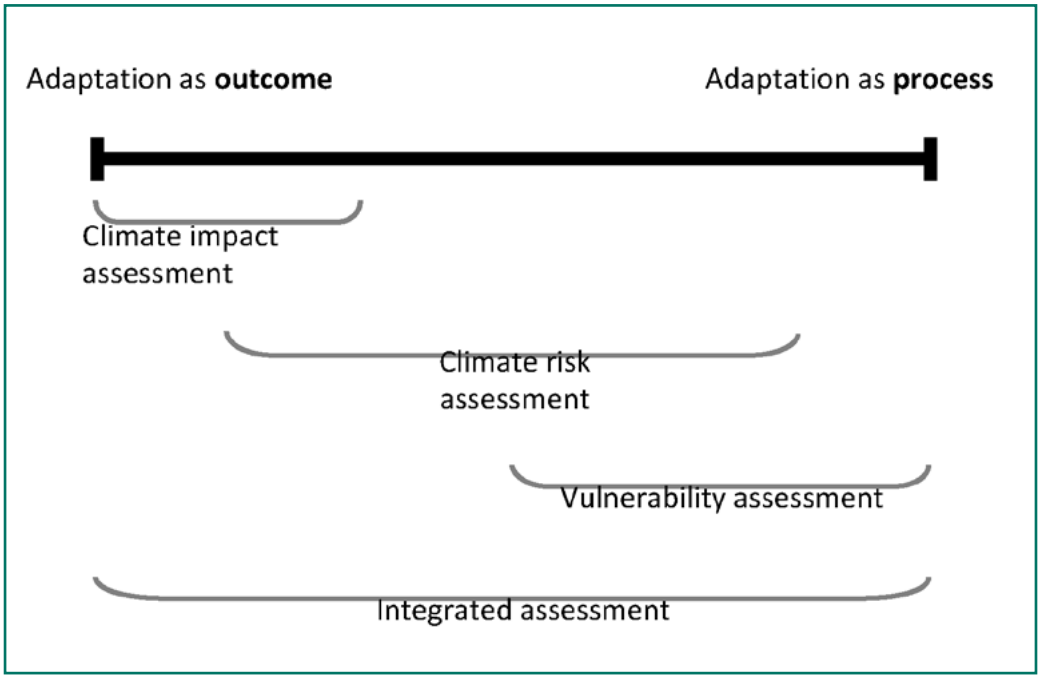
Using high-level data on climate change projections (as provided by CSIRO, for example), discussions can be held to identify those aspects of climate change and variability most material to the system of concern. These high-level considerations should also take non-climate related risks into account. It will then be possible to use this information as an input into one of the various climate change assessment methods described below.

5.2 Common climate change assessment methods

The discussion of outcome and process approaches to climate change adaptation (see section 2.3) illustrates the wide spectrum of possible methodological perspectives that can be applied to place-based climate change adaptation.

The same differentiation applies to climate change assessments. Some of the most common methods used for assessing the current and future impacts of climate change follow an outcome approach more closely, whereas others are more concerned with examining climate change impacts in the context of ongoing learning and change processes.

Figure 3: Outcome-process spectrum of climate change assessment methods



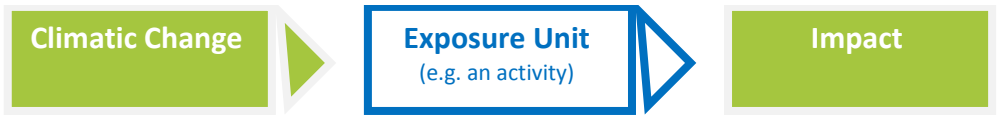
Due to the many variations in their application, outcome-focused assessment methods, such as standard climate impact assessment, may incorporate significant aspects of process-based methods, and methods primarily focused on contextual learning and change, such as vulnerability assessment, often draw on information typically used in outcome-based adaptation (e.g. climate observations and projections). Integrated assessments combine various aspects of outcome-based and process-based approaches. The array of methods for climate change assessment can best be understood by way of a continuum (Figure 3). Each of these methods for climate change assessment is discussed in more detail below.

IMPACT ASSESSMENT

Climate impact assessments focus on how changes in climate affect a particular 'exposure unit'. An exposure unit may be an activity, group, region or resources (human or natural) exposed to significant climatic variations. Impact assessments can be carried out at various scales (national, regional or local) and rely significantly on quantitative data on climatic stimuli and climate change phenomena. This data is typically a combination of observational records and projections (or scenarios) derived from Global Climate Models (GCMs).

The 'standard impact approach' has dominated adaptation research and practice until recently. It assumes a cause-and-effect relationship between climatic stimuli and their impact on an exposure unit (Figure 4). The approach normally analyses a specific climate change impact and assumes a controlled environment where any non-climate effects are held constant.

Figure 4: Standard impact assessment model



The climate impact assessment approach has been heavily influenced by the 'seven steps model', published by the IPCC in 1994. Table 4 outlines this impact assessment model.

Table 4: Seven steps of climate impact assessment

No.	Activity	Description
1	Definition of the problem	Identifying the goals of the assessment, the exposure unit of interest, the spatial and temporal scope of the study, the data needs, and the wider context of the work.
2	Selection of the method	Selecting one or more methods for the assessment. These may include experimentation, impact projections, empirical analogue studies and expert judgement.
3	Testing the method	Testing the method using feasibility studies, data acquisition and compilation, and/or model testing.
4	Selection of scenarios	Establishing the present situation and selecting climate change scenarios for the assessment of projected impacts.
5	Assessment of impacts	Estimating impacts as differences between conditions projected to exist without climate change and those projected with climate change.
6	Assessment of autonomous adjustments	Carrying out experimental work to evaluate the effects of climate change on any exposure unit in the absence of any responses that may modify these effects.
7	Evaluation of adaptation strategies	Defining the objectives of an adaptation strategy; specifying the climatic impacts of importance; identifying the adaptation options; examining the constraints; quantifying measures and formulating alternative strategies; weighing objectives and evaluating trade-offs; recommending adaptation options.

A weakness in this approach is that multiple climatic and non-climatic stressors coexist in any given system or place, and that is practically very difficult to isolate an impact from such contextual factors. This issue is further complicated by the uncertainty associated with information on climate change and non-climatic stressors (e.g. uncertainty in demographic changes, policy context etc.). Due to these and other limitations of the seven steps model, most impact assessment applications now favour a more integrated approach (see 'Integrated assessment' below).

RISK ASSESSMENT

Central to risk-based methods for climate change assessments are the notions of uncertainty and perception. In management theory, risk has been defined as 'the effect of uncertainty on objectives'[2] . Climate risk assessment, as part of a risk management approach, provides a process for dealing with uncertainty. Although risk can be quantified using various formulas (see below), qualitative, perception-based approaches also inform risk assessments, in particular when socio-economic systems are the subject of risk assessments.

In organisational management, as well as in adaptation planning, risk is most commonly applied as a function of magnitude (or consequence) and probability (or likelihood) of expected impacts[3]:

Risk = Consequence x Likelihood

Where likelihood is used to describe the *probability* of a climatic change taking place at some point in the future and its expected frequency, and consequence refers to a climate change's expected *magnitude* of impacts on organisational goals and objectives.

In the field of hazards research, risk has also been defined as the product of hazards and vulnerability[4]:

Risk = Hazard (climate) x Vulnerability

This alternative definition underlines that vulnerability is a key condition for a particular climate stimuli having an actual effect on a system and its components.

Table 5 below outlines a typical process for conducting a climate risk assessment[5]:

Table 5: Phases of climate risk assessment

No.	Activity	Description
1	Establishing the context	Scoping of the risk assessment and clarifying the process to be used.
2	Risk identification	Identifying elements at risk, main climatic and non-climatic stressors; definition of acceptable levels of risk; identification of scenarios to be used.
3	Risk analysis	Analysing the likelihood and consequences of specific impacts occurring.
4	Risk evaluation	Identifying and prioritising appropriate mitigation and adaptation measures to address risks.
5	Treating risks	Implementing selected mitigation / adaptation measures; monitoring and review.

[2] Standards Australia (2009). Australian Standard AS/NZS ISO 31000:2009. Risk management - principles and guidelines, Standards Australia.
[3] McCarthy, J. J., O. F. Canziani, et al., Eds. (2001). Climate Change 2001: Impacts, Adaptation and Vulnerability. Cambridge, Cambridge University Press.
[4] Blaikie, P., T. Cannon, et al. (1994). At risk : natural hazards, people's vulnerability, and disasters. London, New York, Routledge; Wisner, B., P. Blaikie, et al. (2004). At risk: natural hazards, people's vulnerability and disasters. New York, Routledge; Downing, T. E. and A. Patwardhan (2005). Assessing vulnerability for climate adaptation. Adaptation policy frameworks for climate change: Developing strategies, policies and measures. B. Lim and E. Spanger-Siegfried. Cambridge, Cambridge University Press: 67-90.
[5] Adapted from Australian Government (2006). Climate change impacts and risk management: A guide for business and government. Australian Greenhouse Office. Canberra, Commonwealth of Australia; IPCC (2007). Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva, Intergovernmental Panel on Climate Change.

There are many advantages of risk assessments, including that they can enable decision-making despite uncertainty by assigning value-based criteria. They also tend to fit well with existing institutional structures and processes, in both the public and the private sector, including financial management processes.

One disadvantage is that risk assessment tends to focus on specific expected impacts, thereby treating these in isolation from each other. Also, risk assessment tends to have an inward focus on organisational risk, rather than looking outwardly towards climate change impacts on communities, ecosystems and other human or natural systems. Climate risk management is often primarily concerned with the financial impact of risks and with maintaining the financial sustainability of an organisation. Due to this affinity to questions of economic costs, cost-benefit-analysis and similar econometric tools are commonly used in conjunction with climate risk assessments.

VULNERABILITY ASSESSMENT

In the context of climate change, vulnerability assessment focuses on analysing which parts of a system (e.g. an ecosystem, a community, a sector or service) are most likely to suffer negative consequences from climate change and why. Vulnerability, in its broadest interpretation, includes both biophysical and social elements.

Vulnerability assessments typically consist of assessing the characteristics of a vulnerable system, the type and number of stressors affecting that system, and the effects these have or will have on the system. The three elements of exposure, sensitivity and adaptive capacity are used to describe vulnerability, and the following formula is often used to express vulnerability:

Vulnerability = Exposure x Sensitivity / Adaptive Capacity

Different notions of vulnerability are used by researchers and policy makers, and this diversity is reflected in the range of methods applied in vulnerability assessments. Contrary to impact assessment and risk assessment, defined processes for conducting vulnerability assessments are only just emerging. Table 6 outlines a stepped process that has emerged as broad guidance for vulnerability assessment[6]:

Table 6: Phases of vulnerability assessment

No.	Activity	Description
1	Structuring the vulnerability assessment	Clarifying the conceptual framework and analytical definitions of vulnerability being used for the assessment.
2	Identifying vulnerable groups	Defining the system chosen for the assessment, including who is vulnerable, to what, in what way, and where. System characteristics to be defined include sectors, stakeholders and institutions, geographical regions and scales, and time periods.
3	Assessing sensitivity and current vulnerability of selected system and vulnerable groups	Developing an understanding of the process by which climate outcomes (e.g. hydrological and meteorological variables) translate into risks and disasters. This includes identifying points of intervention and options for response to vulnerability.
4	Assessing future vulnerability	Developing a qualitative understanding of current drivers of vulnerability in order to better understand possible future vulnerability, including ways in which planned or autonomous adaptation may modify climate risks.
5	Linking vulnerability assessment outputs with adaptation policy	Relating vulnerability assessment outputs (2-4 above) to stakeholder decision-making, public awareness and further assessments.

[6] Adapted from Downing, T. E. and A. Patwardhan (2005). Assessing vulnerability for climate adaptation. Adaptation policy frameworks for climate change: Developing strategies, policies and measures. B. Lim and E. Spanger-Siegfried. Cambridge, Cambridge University Press: 67-90.

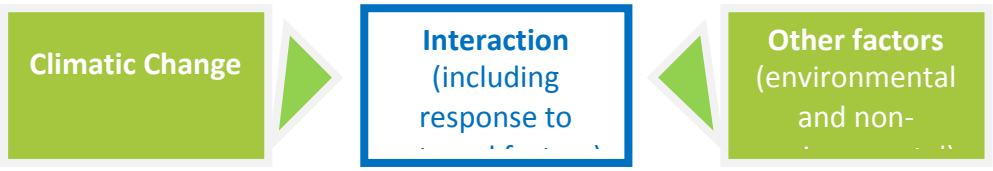
The strength of vulnerability assessments is that they build the case for climate change adaptation based on local knowledge and bottom-up information, thus helping ensure that adaptation options developed during planning processes are designed in response to actual local needs. Also, through the analysis carried out as part of vulnerability assessments, future climatic change can become directly linked to current social, economic and environmental drivers of vulnerability and help enable the identification of 'starting points' for adaptation.

One of the limitations of vulnerability assessments is that they rely to a significant degree on the collection of local data (e.g. on agreed qualitative indicators), which means that the assessment methodology will have to be adapted to accommodate a range of data sources and to include a wide range of local stakeholders. The largely qualitative nature of the assessment also means that it is difficult to compare the results from different vulnerability assessments.

INTEGRATED ASSESSMENT

Integrated assessments recognise that climate is only one of a set of factors that influence, or are influenced by, the exposure unit, and that climatic stimuli interact with other environmental and non-environmental factors (Figure 5).

Figure 5: Integrated assessment model



Methods for integrated assessments are derived from standard impact assessment (see above) but typically involve a combination of several models to analyse biophysical and socioeconomic climate change impacts and their interactions. Integrated assessments also use diverse types of data as inputs – quantitative and qualitative, environmental, social and economic data. Integration is also achieved by linking multiple assessment scales (e.g. local and regional) or sectors, and some integrated approaches combine impact and vulnerability assessment to achieve a balanced understanding of biophysical and socio-economic climate change impacts.

Many different ways of conducting integrated assessments exist, ranging from including socio-economic concerns in national climate impact assessments, to assessment models that assess complex interactions of climatic, socio-political and economic factors in a particular area or sector. In practice, the data available is often insufficient to conduct a full integrated assessment, and partially integrated assessments are normally undertaken. This applies in particular to integrated assessments at a smaller scale.

Table 7 summarises the climate change assessment methods described above, including their strengths, limitations and typical applications.

Table 7: Summary of climate change assessment methods

Assessment	Impact assessment	Risk assessment	Vulnerability assessment	Integrated assessment
Origins	Hazards research Seven-step assessment framework (Carter, Parry et al. 1994) IPCC Technical Guidelines for Assessing Climate Change Impacts and Adaptations, 1994	Hazards research Organisational management Risk management standards (Standards Australia 2004; Standards Australia 2009)	Range of origins, largely poverty eradication, community-based international development, and hazards research	Mainly climate impact assessment and vulnerability assessment
Key concepts	Climatic stressor Climate change impact Climate change scenario	Climate risk Climate change risk Uncertainty Likelihood Consequences	Social vulnerability Biophysical vulnerability Adaptive capacity Exposure Sensitivity	Climate change impacts Climatic and non-climatic stressors Vulnerability
Purpose	To evaluate the likely impacts of climate change under a given scenario and assess the need for adaptation and/or mitigation (IPCC 2007)	To manage uncertainty by identifying and evaluating risks and opportunities of climate change (Standards Australia 2004; Standards Australia 2009)	To evaluate the chances of a system or its parts being harmed by climate change impacts and to maximize benefits and minimize losses (Adger 2006)	To comprehensively assess climate change impacts, vulnerability and adaptation options by linking different spatial and temporal scales and combining assessment methods (IPCC 2007)
Level of participation	Top-down	Top-down or bottom-up, or combination of both Mainstreaming	Bottom-up	Combined top-down and bottom-up
Drivers	Expert-driven Single stressor	Stakeholder participation	Stakeholder-driven Contextual approach	Combination of expert-driven and stakeholder participation Multiple stressors Large variety

Data input & requirements	Downscaled climate change scenario data Socio-economic context data Technological context data	Climate change scenario data Socio-economic context data Technological context data Organisational-level data	Local knowledge Social research data Socio-economic context data Climate change scenario data	Climate change scenarios Socio-economic context data Technological context data Local knowledge Social research data
Uncertainty management	Significant uncertainties due to limits of prediction; managed through probabilistic methods and the use of thresholds.	Uncertainties managed by assigning levels of likelihood and consequence, and criteria/thresholds that link climate impacts to potential outcomes	Uncertainties managed through stakeholder engagement and participatory approaches, learning-by-doing.	Can be a combination of (1)-(3)
Typical application	High-level national or sectoral assessment of climate change impacts	Organisational assessment of risks resulting from climate change	Local assessment of vulnerable social groups, ecosystems, industry sectors etc.	Various; dependent on type of integration
Strengths	Can produce quantitative data Enhances understanding of the effects of climate change	Integrates well with organizational structures and processes Can be effective in dealing with uncertainty	Strongly contextual approach, focusing on local solutions Focus on bottom-up processes and local knowledge	Combining top-down and bottom-up knowledge Linking disciplines and groups of people
Limitations	Limited in providing guidance on responses	Criteria/thresholds for risk evaluation are value-laden	Transferability of assessment results difficult due to multitude of methods	Transferability of assessment results difficult due to multitude of methods

6. Developing Responses to Climate Change Impacts

This section provides guidance on:

- how to make adaptation decisions in the context of uncertainty
- setting clear and effective goals that can successfully direct adaptation efforts
- how to identify feasible adaptation options
- how to prioritise adaptation options and decide on implementing measures.

Once stakeholders have developed a better understanding on potential climate change impacts to their area or system of concern, they can move on to develop locally relevant goals for adaptation, explore all possible options for adaptation interventions, and make decisions on which local adaptation options to pursue. This section offers guidance on a number of key points relating to developing adaptation responses and weighing up different adaptation options.

6.1 Making decisions in the face of uncertainty

Climate change adaptation requires dealing with the significant uncertainty that is inherent to:

- emissions scenarios (e.g. how greenhouse gas emissions will change over time)
- climate change science information (e.g. scientific projections of climate change)
- the geographic distribution and exact time of occurrence of sudden-onset events (e.g. extreme weather events)
- how non climatic drivers (social and economic) of climate risk and vulnerability will change over time
- knowledge about how social and ecological systems will adapt to future climate change.

Making policy decisions in the face of uncertainty therefore requires a careful balancing of the need for quantifiable evidence, courage and political will, with a degree of flexibility in the decision-making process (to acknowledge that any decision may need to be revised at some point in the future).

In order for decision support tools to be effective in adaptation planning processes, they therefore need to have in-built capability for dealing with uncertainty. Tools can only provide a snapshot at any given point in time. They need to be re-applied periodically in order to capture changing characteristics of the social, political, economic, and environmental context in which decisions are made.

6.2 Setting adaptation goals

Because adaptation is a very broad field of policy action with a wide range of possible directions and outcomes, all adaptation initiatives benefit from having their scope clearly defined at the outset.

WHY CONSIDER ADAPTATION GOALS?

In most climate change adaptation processes, the overarching adaptation goal is described like this: '*to respond to future climate change impacts by reducing climate change related risks and vulnerabilities*'. Below this broad purpose, however, climate change adaptation can have different goals and scopes, such as:

- maintaining an organisation's business continuity and the ability to provide essential services
- enhancing the capacity of vulnerable places to cope with climate variability
- supporting an industry to harness new opportunities presented through a changing climate.

Gaining a clear understanding of the goal(s) and objectives of climate change adaptation is an essential strategic process required at an early stage of adaptation planning, and a way of determining the scope for the adaptation activities to follow. The way adaptation goal(s) are framed may influence the adaptation process and its outcomes, including:

- the breadth of climatic and non-climatic information taken into account
- methods and tools used for adaptation planning, (including what type of climate change assessment approach is used – see section 5.2
- range of adaptation options available for consideration.

CHARACTERISTICS OF ADAPTATION GOALS

Goals can either be aspirational and visionary in nature (e.g. 'building community resilience to climate change') or more specific, staking out the boundaries of the adaptation efforts (Examples above and in Box 9). Given that adaptation will need to take place as long as the climate continues to change, it is unrealistic to expect to reach a state of 'being fully adapted'. It is therefore useful for adaptation goals to focus on the process and give less emphasis to a particular predetermined outcome – although some of the adaptation actions may well focus on specific adaptation outcomes. The three goals above are process-driven. They focus on facilitating an active process of 'adapting' in particular organisations, geographic areas, or sectors.

The characteristics of goals and objectives depend to a large degree on the context of the adaptation initiative. Some considerations can help clarify how goals and objectives are best defined in order to suit the needs of the project or initiative (Box 9). In any case, goals should be aligned with existing organisational objectives. They also need to take available resources and constraints into account, such as financial and human resources.

Box 9: Different considerations for defining adaptation goals

- Sectoral focus: Determining if the adaptation efforts are targeted at one specific sector, multiple sectors, or non-sector-specific/cross-sectoral.
- Time-bound focus: Determining if the focus is on adaptation efforts that can be achieved within the short / medium / long term, or a time-frame spanning all of these. For example, a sea wall may relieve some immediate coastal risk, a capacity development program may help a council in the medium term to consider climate change information, and legislative changes may alter the way long term investments are made along the coast line.
- Conceptual focus: Deciding on a particular adaptation concept – or combination of concepts - to guide all adaptation efforts (e.g. risk management, vulnerability reduction or resilience building). The adaptation concept/s can then become the basis for the assessment and planning methods used. For example, the adaptation goal of 'ensuring the viability of small businesses in the Goldfields tourist region' can be partially addressed by the objective 'to assess and reduce the vulnerability of small businesses to climate change'.
- Adaptation as process or outcome: Determining the degree to which adaptation efforts will focus on achieving particular adaptation outcomes (e.g. 'being more adapted' to specific climate change impacts) versus ongoing process elements of adaptation (i.e. flexible adaptive management and organisational and individual learning). For example, changing the way an organisation makes decisions to ensure climate change considerations are embedded in an integrated way.
- Top-down/bottom-up continuum: Determining to what extent top-down, expert-based information and decision-making will be used in adaptation planning, and to what degree bottom-up, participatory knowledge and information will be used. For example the goal 'improving our understanding of the likely impacts of climate change on our organisation' may be tackled via the objective 'to develop an iterative, participatory process for climate change risk assessment owned by all staff members'.

SUCCESS FACTORS FOR DEVELOPING EFFECTIVE ADAPTATION GOALS

In order to identify effective place-based adaptation goals, it is necessary to have an understanding of the local socio-economic, environmental and political context and climate change related impacts. Goal-setting can involve a series of stakeholder discussions to help establish the broader context in which the adaptation planning process is going to occur. In most situations, it makes good sense for goal-setting to precede a detailed climate change assessment. The goal-setting process can help specify the scope for the assessment.

The process of developing and agreeing on adaptation goals can benefit from a participatory and multi-disciplinary engagement. Broad participation can facilitate buy-in of a wide range of stakeholders, ensuring that any subsequent adaptation activities (e.g. climate change assessments, identification of adaptation measures) are supported by those individuals and organisations who will be affected (positively or negatively) by climate change impacts and adaptation interventions. Participatory and multidisciplinary goal setting can also support a more integrated adaptation planning approach which considers climate change impacts on more than one systems or asset at a time.

6.3 Identifying adaptation options

Identifying or developing adaptation options means coming up with one or more adaptation interventions that respond to climate change adaptation goals and objectives in an effective, feasible and meaningful way that is not maladaptive[7].

The emergent literature on adaptation practice does not recommend any singular method for identifying adaptation options. The method used for identifying options is likely to be most successful if it is tailor-made, to ensure it is aligned with adaptation goal(s) and objectives.

The following provides a selection of approaches for identifying adaptation options that are commonly used. It is important to note that the classification of these is mostly theoretical. The approaches are not mutually exclusive and, in practice, are often blended into a customised approach that best suits local needs.

EXPERT-LED APPROACHES

Purely expert-led approaches align well with adaptation objectives that require a high degree of specialist knowledge, skill or experience, such as determining climate change impacts on a rare species, a coastal habitat, or a particular infrastructure project. Impact assessments, or specialised risk assessments, which are conducted by experts (ecologists, infrastructure engineers, social planners, etc.), can provide direct recommendations regarding the options for addressing identified impacts. These expert recommendations are typically based on scientific consensus (if existing) and academic peer-review.

Note, however, that the term 'expert' can refer to anyone with specialist knowledge on the topic and include a range of people from local experts and organisational leaders, to scientific experts. For example, if adaptation goals and objectives focus on increasing an organisation's understanding of climate change risks, this lends itself well to using experts from within the organisation to identify adaptation options following standard process defined in the risk management literature (e.g. AZ/NZS ISO31000:2009 and Australian Greenhouse Office 2006).

STAKEHOLDER AND PARTICIPATORY METHODS

Engaging a wide range of stakeholders in the process can help ensure that adaptation options reflect diverse stakeholder needs and are owned by those stakeholders.

Stakeholders may refer to anyone representing the interests of a sector, discipline, or industry. Stakeholders may also include representative members from the community to ensure adaptation options reflect the diverse views, capacity and needs of the community to which the adaptation intervention is targeted. If the adaptation planning process is well facilitated, having a diverse range of interests represented in developing adaptation options helps to ensure a balanced and more integrated approach is taken.

For example, if the adaptation goal is to reduce climate-change related community vulnerability, a bottom-up participatory approach, where key community stakeholders identify priority adaptation options, may best serve this goal. A range of participatory methods exist that can be used for identifying options, such as conceptual modelling, participatory vulnerability mapping, citizens' juries, and participatory scenario planning (see Box 10).

COMBINING EXPERT-LED AND PARTICIPATORY METHODS

It is important to note that participatory approaches do not preclude validation of identified options via experts or by using specific decision support tools. Due to the highly context-specific and pervasive nature of climate change adaptation, active collaboration between experts and other stakeholders can be a useful approach for identifying adaptation options. Experts can provide input (in the form of information, opinions and personal experiences) into the process of identifying options, while decision-making on priority options can be conducted in a participatory way.

[7] See the definition of maladaptation on p.13.

In climate risk management processes, for example, the climate change risk assessment results (identifying priority risks) are a key input in the development of adaptation options. For each priority risk, a number of possible adaptation options can be identified using a participatory approach that involves a broad range of stakeholders as well as key experts. Draft adaptation options can be evaluated by experts in order to produce a list of valid and effective preferred options for consideration by decision-makers.

Scenario planning utilises another suite of methods that can be applied to climate change adaptation planning using different degrees of expert involvement and participation (Box 10).

Box 10: Scenario planning for climate change adaptation

Scenario planning is often used as part of climate change adaptation. Scenarios planning can be conducted using a range of different approaches, relying to different degrees on the input of experts. Three broad approaches can be singled out:

Off-the-Shelf: Applying pre-existing, down-scaled scenarios to specific locations, population groups and policy challenges

Tailored Exploration: Building and using context-specific scenarios to explore possible climate futures, impacts and adaptation policy options

Tailored Visioning: Building and using context-specific scenarios to envisage desirable futures and pathways.

Taking an Off-the-Shelf approach involves the adaptation practitioner or planner simply accessing scenarios (e.g. global climate change scenarios or global socio-economic scenarios) that have been developed by others, often using sophisticated quantitative methodologies that require scientific or modelling expertise. Tailored Exploration and Tailored Visioning approaches, on the other hand both encompass much wider variation in application, as they represent approaches through which context-specific scenarios (e.g. local climate impact scenarios or adaptation response scenarios) are developed (e.g. using participatory methods) and used as part of the adaptation planning process.

Source: Wiseman, J. et al. (2011). Scenarios for Climate Adaptation – Guidebook for Practitioners. http://www.vcccar.org.au/content/pages/scenarios-climate-adaptation (accessed 15 October 2012).

6.4 Types of adaptation interventions

There are many different ways of classifying adaptation activities. Typically, the policy and the adaptation literature classify adaptation interventions differently. Broadly speaking, they can be divided into the following categories:

- *Legislation and regulation* – laws and regulation designed to set standards that guide, restrain or reward actions of others
- *Capital works and infrastructure* – new infrastructural projects such as a sea wall, or modification of existing structures such as roads or railways
- *Economic instruments* – taxes, charges, subsidies, grants tradeable permits, government loans, fiscal sector changes

- *Governance* – reforming the way formal or informal organisations make decisions within themselves or with others
- *Research and innovation* – investment in research to develop new innovative solutions to emerging policy challenges and opportunities
- *Capacity development* – processes through which individuals, organizations, and societies obtain, strengthen, and maintain the capabilities to set and achieve their own objectives over time
- *Information and communications* – dissemination of targeted or large scale information or communication campaigns
- *Education* – using the formal education system for the delivery of particular policy objectives.

Like other policy and programs, adaptation goals can rarely be met by one type of intervention. It is important to think about how the interventions will meet the adaptation goal(s) with particular consideration of the factors discussed above:

- Will the adaptation intervention meet short, medium or long term adaptation goals or objectives?
- Is it a process or outcome-driven intervention?
- Does it align well with the conceptual foundations and methods used for the climate change assessment?
- Will it negatively or positively impact on other assets, systems or adaptation interventions?

6.5 Decision support tools for prioritising adaptation options

There are a number of decision support tools that can be used to help determine what adaptation policy, program or intervention are best suited to meet adaptation goals and objectives. Common to all prioritisation and decision support tools is that they use certain evaluation criteria for assessing different adaptation options.

Some tools rely more strongly on monetary information, which in the case of social and environmental impacts of climate change may not always be readily available. Other tools have the ability to factor in non-monetary information for evaluating adaptation options. In any case, decision support tools need to be tailored to the system under consideration (based on the definition of what adapts – see p.15) and to local context and needs. Decision support tools should be able to generate information on the strengths and weaknesses of alternative adaptation options, while also providing mechanisms for dealing with the uncertainties inherent in climate change.

Decision support tools come in many different guises, from simple checklists to complex software applications that can act as all-in-one, integrated decision-support systems. The United Nations Framework Convention on Climate Change (UNFCCC) *Compendium on Methods and Tools*[8], for example, lists 48 different adaptation decision support tools, some of which are sector-specific.

Among this growing list of decision support tools, some stand out as being most commonly used in the Australian context, namely: cost-benefit analysis (CBA), cost-effectiveness analysis (CEA) and multi-criteria analysis (MCA). These can be very useful in gaining a better understanding of the economic or other benefits of various adaptation options. However, in the context of place-based adaptation it needs to be emphasised that:

[8] See: UNFCCC Compendium on Methods and Tools, 2012, http://unfccc.int/adaptation/nairobi_workprogramme/knowledge_resources_and_publications/items/5457.php (accessed 15 October 2012).

- A detailed analysis using tools such as CBA, CEA and MCA is not always necessary, and more informal processes involving dialogue and deliberation at the local level can be more effective in leading to suitable adaptation decisions. This includes processes such as participatory ranking and evaluation, conceptual modelling, and citizens' juries.
- Economic decision support tools other than CBA, CEA and MCA may be equally or more useful for place-based climate change adaptation processes. This includes tools such as Net Present Value (NPV) Analysis, Real Options Analysis, and Contingent Valuation.

The following section explores the use of CBA, CEA and MCA in the context of climate change adaptation.

COST-BENEFIT ANALYSIS (CBA)

Cost-benefit analysis is an economic decision support tool that can be used to determine, in monetary terms, whether the total benefits of an adaptation option exceed its total costs. This involves calculating monetary values for all expected costs and benefits, for a defined range of stakeholders affected positively or negatively by the proposed adaptation option.

Using a discount rate, benefits and costs are adjusted for the time-bound value of an investment, so that all flows of benefits and costs over time can be expressed on a common basis as a 'present value'. Other than through the process of discounting, uncertainty is dealt with in CBA using probabilistic analyses, such as sensitivity analysis.

To different degrees, CBA calculations can include assigning monetary values to those costs and benefits that are not traded within a market (e.g. environmental and social goods and services). Based on a CBA, an adaptation option is considered viable if the aggregate benefits outweigh the costs. Different adaptation options that have been assessed using CBA can be compared and prioritised by their net benefit (i.e. by how much the benefits outweigh the costs).

CBA is most suited to decision-making vis-à-vis a single objective, where a substantial amount of quantitative, monetary information is available or can be generated with reasonable effort. This can be the case for large-scale policy interventions at the international and national level (e.g. taxes, financial incentives, etc.) or for specific interventions at the local and regional scale (e.g. investments in infrastructure).

In the context of climate change adaptation, multiple objectives are likely to co-exist, and many of the costs and benefits of adaptation options are likely to be social and/or environmental. Often, climate change risks and options to respond to these cannot readily be expressed in monetary terms. It is not straightforward, for example, to assign a monetary value to informal social networks and the community services they provide, or to quality-of-life factors.

Similarly, the value of irreversible yet avoidable changes (e.g. the loss of lives, the extinction of a species, or the permanent degradation of an ecosystem due to climate change) are difficult to assess in financial terms because it involves substantial value-based judgment[9]. The difficulty in costing adaptation efforts is well documented internationally, with the World Bank, Oxfam, the UNFCCC, and the United Nations Development Program (UNDP), all arriving at different annual total costs for adaptation (with a range of 9 billion US$ to 109 billion US$[10]).

[9] See the VCCCAR Framing Adaptation project Working Paper 2 for a summary of these challenges (Keating, A. and Handmer, J. (2011). Options for assessing the cost of climate change for adaptation policy in Victoria. Victorian Centre for Climate Change Adaptation Research, Melbourne. http://www.vcccar.org.au/files/vcccar/Framing_project_working-paper2_240511.pdf (accessed 15 October 2012)).

[10] See: Parry, M. et al. (2009). Assessing the Costs of Adaptation to Climate Change: A Review of the UNFCCC and Other Recent Estimates, International Institute for Environment and Development and Grantham Institute for Climate Change, London. Note that some of the estimates are for the total annual costs of adaptation to climate change for developing countries only, whereas others refer to the total global annual costs.

In many estimates, the cost of adaptation for sectors where information is not available, such as ecosystems, are not included. These costs are often referred to as 'intangibles' because they are difficult to estimate, rendering the process of economic modelling technically challenging and resource-intensive. However, these intangible costs are often distributed unequally across social groups or natural systems, and whether or not a CBA can pick up on such potential inequalities and nuances depends on the scale of the analysis and the availability and accuracy of data.

In addition to these methodological limitations, the financial net benefit, which is the result of a CBA, may not always be the key criteria for decision-making (e.g. preserving cultural values may be considered important despite significant associated financial costs).

For these reasons, the usefulness of CBA as a stand-alone decision support tool for place-based adaptation decision-making is limited. Where it is used, it is important that the quality of data and estimates and any inherent uncertainties are acknowledged and made transparent to all stakeholders, so that the likelihood of inaccuracies in the analysis results can be factored in as part of decision making processes.

COST-EFFECTIVENESS ANALYSIS (CEA)

Cost effectiveness analysis is a commonly used decision support tools that can help identify the least-cost option for achieving a defined, desired benefit (e.g. protecting properties from flooding). Traditionally, CEA has most commonly been applied in the health sector for identifying the least-cost option to achieve a specific non-monetary health outcome, such as increasing life expectancy in mothers. Probabilistic analyses can help address some of the uncertainty involved.

In its most basic form, CEA compares each alternative adaptation option with current practice, resulting in a cost-effectiveness ratio, where the expected benefit or effect of a policy measure is the denominator (e.g. years of expected protection from sea-level rise), and the numerator is the expected cost required to achieve that benefit with a given measure:

$$CE\ ratio_1 = \frac{cost_{adaptation\ option\ 1} - cost_{current\ practice}}{effect_{adaptation\ option\ 1} - effect_{current\ practice}}$$

$$CE\ ratio_2 = \frac{cost_{adaptation\ option\ 2} - cost_{current\ practice}}{effect_{adaptation\ option\ 2} - effect_{current\ practice}}$$

The CE ratio is a single-dimension unit that allows for a ranking and prioritisation of different adaptation options within a given amount of resources (e.g. an adaptation budget). Examples of commonly used units of measurement in CEA are *number of lives saved* and *number of live years gained.*

CEA is based on the principle of directly comparing the relative costs of alternative options for achieving the same or a very similar desired outcome. In the context of adaptation, CEA could be used to evaluate, for example, the cost effectiveness of different short-term measures to protect coastal properties from erosion and storm surges, where the different options may be: constructing structural barriers, sand replenishment and supportive technological measures to protect existing sand dunes.

A limitation of CEA is that the effect over time for each of the alternative options needs to be assessable with reasonable effort in order for the analysis to be possible. In the context of adaptation, it is often difficult to determine the exact effect an investment will have, since this will depend on a range of unpredictable future social, political and economic factors. For this reason many CEAs rely on existing published studies for effectiveness data, which may not accurately describe future effects of the intervention.

As mentioned above, adaption measures may also incur costs that are generally difficult to quantify (e.g. damage to ecosystems or lost future decision-making opportunities). Often, these costs can only be expressed using qualitative metrics that are highly dependent on value-based judgment.

Likewise, adaptation measures may result in benefits that are difficult to assess in standardised quantitative terms, and some effects may occur randomly after substantial investment. A good example of this is the value of social learning that occurs as a result of 'learning by doing' and making mistakes. If adaptation is primarily considered a process, where failure for the sake of education and learning is encouraged as part of an adaptive management approach, this cannot be effectively captured through either CBA or CEA. Learning from mistakes can be an irreplaceable driver for innovation and change, despite not appearing to be a cost-effective process.

MULTI-CRITERIA ANALYSIS (MCA)

Multi-criteria analysis (sometimes referred to as multi-criteria evaluation) represent a suite of decision support tools that are able to include assessing the benefits resulting from adaptation interventions that cannot be measured or costed in quantitative terms. There are many types of multi-criteria analysis (MCA) and no standard definition of what constitutes a MCA exists. Common to all MCAs is that they involve developing and applying a specific framework for integrating a range of quantitative and qualitative, monetary and non-monetary factors into the analysis, which are then weighted and scored against a set of criteria.

MCA is seen to be able to assist in making decisions by handling large amounts of complex qualitative and quantitative information in a consistent and transparent way. Economic and monetary analyses and MCA are not mutually exclusive. Monetary tools and evaluations such as CBA and CEA are frequently used as part of a MCA.

The centrepiece of the MCA is a matrix (Table 8) that is interchangeably called a performance matrix, impact matrix or preference matrix. The matrix contains the list of options, weighted criteria and scores. Different variations of MCA are generally based on how the basic information is processed in the performance matrix.

Table 8: Example of a MCA impact matrix

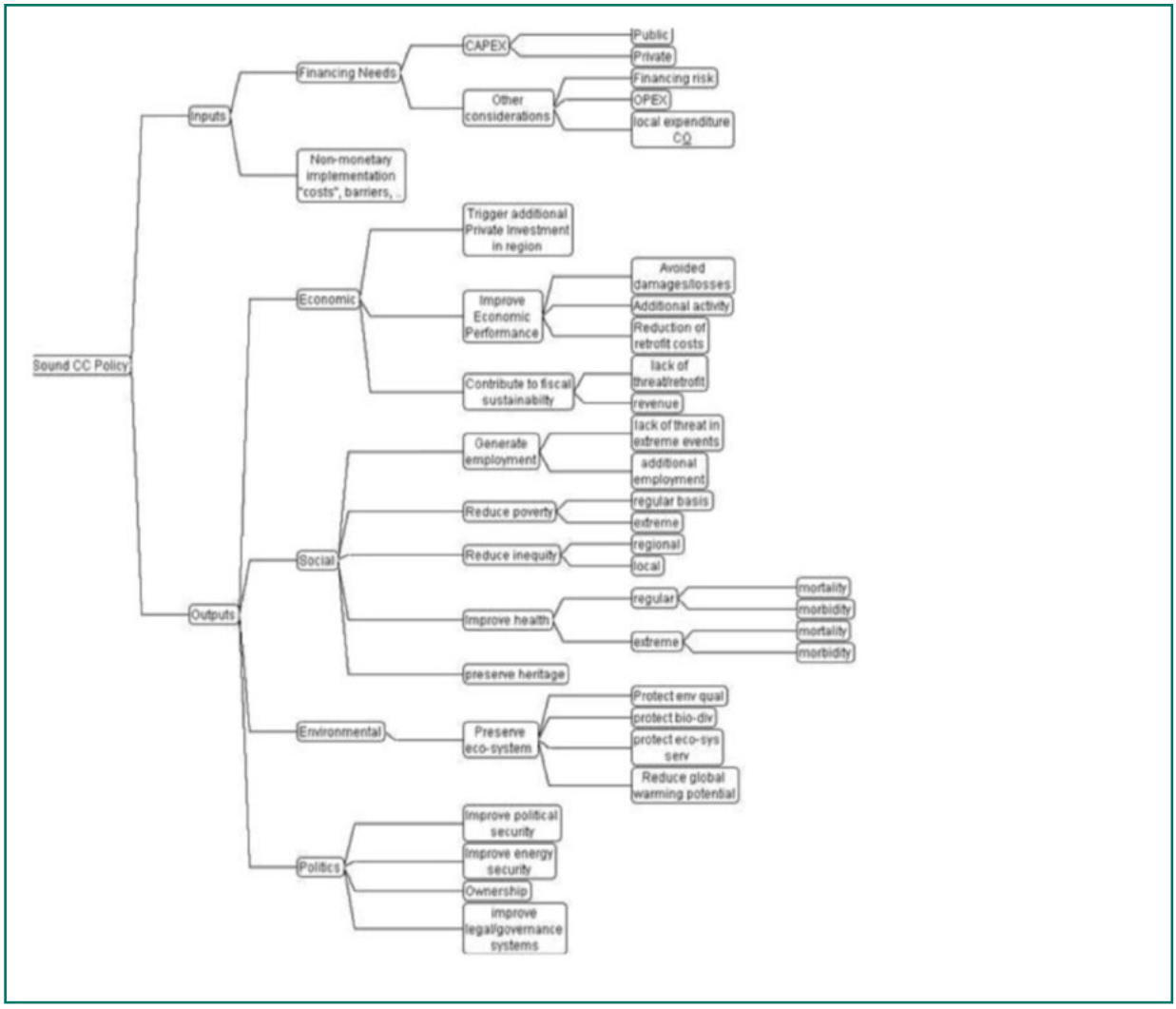
Criterion	Indicator	Ecosystem service scenario[a]				
		current	max ES	max S	max Ec	Mix
Ecosystem services						
Water quality	Mg/l P	0.02	0.005	0.05	0.1	0.01
Water quantity	discharge 10^3 ml	150	250	100	125	150
Biodiversity/native biota	10 = high 1 = low	6	10	3	5	10
Sediment filtration	10 = high 1 = low	3	8	6	8	8
Erosion control	10 = high 1 = low	7	10	7	4	7
Nutrient management/waste assimilation	10 = high 1 = low	3	8	7	3	8
Shading	10 = high 1 = low	5	10	6	2	8
Stream health, including instream and riparian zones	ISC[b] very poor: 0–19 poor: 20–25 moderate: 26–34 good: 35–41 very good: 42–50	35–41	42–50	35–41	26–34	35–41
Aesthetic/scenic views	10 = high 1 = low	5	8	6	2	7
Social/cultural						
Public access	10 = high 1 = low	5	1	7	10	5
Jobs	number (thousands)	15	18	20	25	18
Cultural and heritage[c]	0 = not maintained 1 = maintained	0	1	1	0	1
Education[c]	0 = not present 1 = present	0	0	1	0	1
Economic						
Costs	AUS$ million	2.5–3.5	0	2.5–3.5	0	18.3
Benefits	AUS$ million	5.5–6.5	0	6.4–49	4.3–40.1	9–57.3

[a] max ES—maximise ecosystem service outcomes, max S—maximise social outcomes, max Ec—maximise economic outcomes, mix—sustainable tourism/environment/society mix.
[b] ISC—index of stream condition (see http://www.vicwaterdata.net/isc/into.html).
[c] These were added after the initial ranking process at the request of one of the jurors.

Source: Proctor, W. and M. Drechsler (2006): Deliberative multicriteria evaluation. *Environment and Planning C: Government and Policy 24*(2) 169 – 190

The criteria to be included in the matrix can be established through a number of processes, including expert-driven or stakeholder-led methods (see above). They are often organised in a criteria tree, displaying several levels of criteria (see Figure 6). The criteria need to be meaningful indicators for whether the adaptation objective(s) will be effectively met.

Figure 6: Criteria tree for evaluating polices to increase infrastructure resilience



MCA can be considered a suitable decision support tool for a range of reasons, which relate to the character of the decision-making process and the complexity of adaptation goals and objectives.

MCA can be readily applied to adaptation decisions due to the method's ability to consider multiple objectives or goals. Adaptation planning processes are likely to have a number of goals, and these can be organised in MCA via a criteria tree and then evaluated systematically using an impact or performance matrix. For example, adaptation goals may include social objectives as diverse as ensuring local employment in the agricultural sector; preserving cultural heritage; improving community cohesion; and supporting low-income groups. The relative importance of these objectives can be weighted using MCA, and alternative adaptation options can be evaluated against these objectives.

Another common use of MCA is when quantitative information is either not available or not sufficient for making a well-informed decision. As discussed above, this is often the case when social and environmental concerns define adaptation goals. MCA provides a systematic process for accommodating a mix of quantitative (monetary and non-monetary) as well as qualitative information (e.g. information based on value judgement collected during participatory processes). Often, the outputs of CBA and other economic tools are incorporated into an MCA and balanced with qualitative information.

MCA can also be used as a support tool for systematic participatory decision making processes. Participatory elements of an MCA can include having stakeholders decide on the criteria to be used (e.g. via collaboratively developing a criteria tree). For example, deliberative MCA was used to assist a group of natural resource managers to decide on a suitable option for recreation and tourism activities in the upper Goulburn-Broken Catchment[11]. Here, MCA was effectively combined with deliberation and stakeholder interaction provided by a citizens' jury, which helped discover important aspects of the issue that required further assessment and understanding. A similar process could also be applied to climate change adaptation planning.

When undertaking a MCA for climate change adaptation, a number of issues should be considered. Firstly, the type of information that is required to effectively and equitably assess each option against the criteria. For example: Is the information readily available? Will it be resource-intensive to collect? Will it require particular types of expertise? Secondly, it is important to carefully consider the relationship between the different criteria. Are some of the criteria interrelated in any way? Are all criteria equally important or do they need to be weighted? Can low scores against one criterion be compensated by higher scores against another one?

Table 9 summarises the decision support tools described above, including their strengths, limitations and typical applications.

Table 9: Overview of decision support tools

Assessment	Cost-benefit analysis	Cost-effectiveness analysis	Multi-criteria analysis
Key concepts	Monetary costs and benefits Discount rate Economic efficiency	Cost-effectiveness Economic efficiency	Multiple criteria Weighting Scoring
Key assumptions	Benefits must exceed costs for any intervention to be viable Costs and benefits can be quantified in monetary terms	Benefit achieved per unit of cost is a key criteria for decision-making The least costly option for achieving a defined outcome is the option of choice	Cost is one of many criteria Decisions involve evaluating a complex set of known criteria
Purpose	To evaluate monetary costs and benefits of an intervention in order to assess whether or not it is economically efficient	To compare alternative options for achieving the same or a similar outcome and to determine the least costly option	To structuring complex decision-making problems explicitly consider multiple criteria
Number of objectives being considered	Best suited for single objectives	Best suited for single objective	Can accommodate multiple objectives
Level of participation	Expert driven	Expert driven	Expert driven or including participatory methods

[11] See Proctor, W. and M. Drechsler (2006). Deliberative multicriteria evaluation. Environment and Planning C: Government and Policy 24(2): 169-190.

Data requirements	Quantitative monetary data	Monetary and non-monetary quantitative data	Monetary and non-monetary quantitative and qualitative data
Uncertainty management	By selecting a particular discount rate (i.e. present time value of future costs and benefits) By using probabilistic analysis By conducting a sensitivity analysis for CBA parameters	As for CBA	As for CBA and by weighting criteria
Typical applications	Policy interventions with a single objective; local single-objective projects (e.g. infrastructure, service provision)	Policy interventions with a single, quantifiable well-being outcome (e.g. life expectancy, lives saved, etc.)	Policy interventions with multiple objectives
Strengths	Produces quantitative data Aligns well with quantitative climate change assessments Useful for engaging decision-makers with fiscal authority	Produces ranking for different options based on cost effectiveness ratio	Can integrate quantitative and qualitative data Factors in some of the complexity of decisions Transparency regarding the use inclusion of value judgement
Limitations	Depends on availability of quantitative monetary data Can only address a single objective	Depends on availability of quantitative data Can only address a single objective	Depends on availability of quantitative and qualitative data for all criteria Robustness of qualitative data can be difficult to ensure

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