



UNDERSTAND | ADAPT | TRANSITION

Queensland Climate Adaptation Strategy

Built Environment and Infrastructure Sector Adaptation Plan



This Sector Adaption Plan was developed by the built environment and infrastructure sector with the support of the Queensland Government. Sector Adaptation Plans are important components of the Queensland Climate Adaptation Strategy, outlining industry-led responses to the challenges presented by climate change.

More information on the Queensland Climate Adaptation Strategy is available from <https://www.qld.gov.au/environment/climate/adapting/>

Author

Ian Edwards, Climate Change Adaptation Specialist
ian.edwards68@gmail.com

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Foreword

In February this year, a group of us, mainly government ministers and mayors from around Australia, went diving on the Great Barrier Reef with the Minister for National Parks and the Great Barrier Reef, the Hon. Dr Steven Miles MP, to see first-hand the impact that rising water temperatures were having on the health of the Reef. What we witnessed was a highly distressed reef, all but covered in a chrisom of bleached-white staghorn coral.

Management of the impacts of climate change is a formidable task. Responses to these impacts have been slow, whether as a result of political conservatism or simple resistance to the major shifts that are required in systems and practices in order to respond to climate change. Coupled with this has been the expectation that the onus to respond falls on government. In reality, it is not an issue that government alone can resolve, and fortunately, it doesn't have to.

A number of key industry associations, universities, and representatives from the private sector, working with government, have taken the first step toward the development of a Built Environment & Industry Sector Adaptation Plan. The aim of this informal partnership is to work together with government to create an environment supportive of behaviour that safeguards the prosperity of the Built Environment and Infrastructure sector and Queensland as a whole from the impacts of climate change. Ian Edwards, a climate change adaptation consultant, along with Dr Miles' Department of Environment and Heritage Protection, represented by Catie Dunbar and David Putland, have worked with the sector over the last nine months to focus on identifying the operational, managerial, and financial impacts of climate change upon the sector. They are seeking to develop approaches, in the form of an adaptation plan, that will appropriately respond to the impacts affecting the sector and seeking to discover how the sector can work together, collaboratively, to adapt while balancing stakeholder interests and concerns. This Report is the first step towards development of that adaptation plan for the Sector.

It is apparent that there is a clear preference for members of the sector to engage with their business partners to reduce climate risk and in some circumstances, consideration is being given to management of traditional business relationships to reduce exposure to climate risk. The Report's findings and prioritised actions show a sector starting to come to terms with, and embrace, actions to reduce the risks that climate change presents. There is a clear indication that the sector no longer perceives climate change as a pure Corporate Social Responsibility issue. As such, this Report presents some significant findings. For example, there is recognition and concern within the sector of the impact that climate events could have on access to affordable funding for prospective customers. There is also recognition within the sector that if unmanaged, climate change represents a material risk to business operations in the short to medium term.

On our return from the Reef in February, one of the scientists on board said the only hope for a quick recovery of the coral was for a cyclone to occur and remove some of the heat from the water around the Reef. A month later Cyclone Debbie did hit, and although it may have caused some cooling it also caused widespread flooding in erosion hotspots causing sediment flows onto the Reef, which harm coral and sea grass by restricting light. Placing hope in one natural disaster to save us from another is not a plan. It is therefore encouraging to see collaboration between government, universities, and the private sector, working together in development of a Built Environment & Industry Sector Adaptation Plan, to look for the types of solutions that are needed to deal with climate change.

Mark Baker-Jones

Partner in the law firm DibbsBarker, Chair of the Queensland Adaptation Strategy Partners, and member of the Queensland Climate Advisory Council.

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Executive Summary

In October 2016, representatives of the Built Environment and Infrastructure Sector (BE&I) came together as a working group to develop a BE&I Sector Adaptation Plan (SAP). The process was guided by a draft Sector Adaptation Plan framework prepared by the University of Queensland's Global Change Institute, and included two workshops and a survey. To date, development of the SAP has involved the scoping of climate risk for the sector, identification of enablers and barriers to addressing these risks, and recognising gaps that hinder sector-specific adaptation action and practice. A set of priority adaptation actions has evolved from these findings. These outcomes form the basis of this report, the purpose of which is to inform the design of subsequent projects and processes that will address and implement the priority actions.

Key Findings

Eight key findings emerged from the SAP process. These are:

1. Climate change has already impacted, and continues to impact, the BE&I sector in Queensland.
2. There is recognition within the sector that if unmanaged, climate change represents a material risk to business operations in the short to medium term.
3. Practitioners, peak bodies and other institutions such as government agencies are currently undertaking a broad range of activity directed at managing climate risk and building organisational resilience in a broader sense.
4. There is a range of activities, initiatives and resources currently applied to sustainability and climate change adaptation, both within the sector and beyond, that can be leveraged and enhanced to prevent "recreating the wheel". In this regard, the current BE&I SAP working group represents a wealth of information and lessons for potential sharing amongst participants.
5. While challenges remain, organisations have already overcome a raft of barriers to adaptation activity, transforming them to enablers in the process.
6. There is recognition that engagement with other sectors and parties (e.g. finance, communities) is essential to motivate and enable the BE&I sector to adapt efficiently and successfully to climate change.
7. Most resource gaps identified represent those required to motivate support, via engagement and awareness, for BE&I sector climate change adaptation from within the sector itself and from external stakeholders.
8. There is an appetite amongst the BE&I sector to work collaboratively to address and minimise climate risk and maximise potential for adaptation action, i.e. there is an appetite for the BE&I SAP working group established under this project to continue in order to facilitate ongoing collaboration.

Priority Actions

Actions in response to the key findings in order of decreasing priority are:

1. Identify incentives to encourage and facilitate the BE&I sector to adapt to climate change and to design and build assets to go beyond minimum standard requirements.
2. Build climate risk awareness and capacity among BE&I sector practitioners, stakeholders and the wider community including:
 - develop and communicate a set of practitioner-informed climate change projection guidelines; and
 - develop and communicate climate projection data interpretive guidelines for broader communities.
3. Develop a report that explores and documents the intra- and inter- dependencies within and between the BE&I sector and other societal and economic sectors.
4. Work with the state government to aid them identify initiatives that demonstrate the benefits of effective climate change adaptation within their own operations and that motivates climate change adaptation amongst their suppliers.
5. Engage the financial sector on how to develop financial and insurance mechanisms that incentivise the provision of climate-resilient products and services from the BE&I sector and their demand from consumers.
6. Create an inventory of climate change adaptation information, tools and guidelines for the BE&I sector.
7. Create a community of practice within the BE&I SAP working group with a rotating chair.

Recommended Next Steps

It is recommended that the BE&I SAP working group reconvene in the near future to identify who is best placed to lead projects that address the above actions and to consider sustainable funding mechanisms for these projects. The working group should continue to operate as an open forum in order to identify and involve new participants.

Introduction

Background

In 2015, the Queensland Government initiated the development of a Queensland Climate Adaptation Strategy (Q-CAS). The Q-CAS is based on collaboration and partnerships across different levels of government, communities and industry. The Strategy was released in 2017 and identifies four clear implementation pathways for adaptation action, one of which is the Sectors and Systems pathway. This pathway is intended to assist sector leaders to collaborate with government agencies, local governments and other stakeholders to identify adaptation needs and to prioritise adaptation activities. Sector Adaptation Plans (SAPs) are a key tool designed to facilitate collaboration in adaptation planning within and across sectors.

At a workshop held in October 2016, representatives of organisations directly engaged in the Built Environment and Infrastructure Sector (BE&I) in Queensland expressed unanimous support for the development of a BE&I SAP. The SAP was based on a proposal from Mark Baker Jones, a Partner from legal firm DibbsBarker with extensive working experience of the environment planning and property sector. At that meeting, participants also considered a set of principles in support of climate change adaptation. The principles have and continue to provide a framework for development of the SAP. In addition, meeting participants agreed that development of the SAP would proceed as a collaborative process between BE&I sector representatives and the Queensland Government, under the broader direction of the Queensland Climate Adaptation Strategy (Q-CAS)¹.

DibbsBarker has worked with the Queensland Government over the past eight months to develop the SAP. This work has been based on national research about sector adaptation plan development undertaken by the Global Change Institute at The University of Queensland.

Document Purpose and Scope

This document details the outcomes of the BE&I SAP process to date, outlining key climate risks for the BE&I sector, barriers and enablers to respond to risks and key resource gaps. These components are reflected in eight key findings, in response to which seven priority actions have been developed. The document details a set of “Principles to support BE&I sector adaptation to climate change” and also provides an insight into how the SAP outcomes were derived. Development of the SAP to date has been limited to the identification and documentation of those outcomes noted above. The design of projects to deliver on the priority actions will involve a subsequent separate process.

Objective of the Built Environment and Infrastructure Sector Adaptation Plan

The objective of the BE&I SAP is for government and the sector to **work together** to create an **environment supportive of behaviour that safeguards the prosperity of the Built Environment and Infrastructure Sector and Queensland as a whole** from the **impacts of climate change**.

Key terms in the objective are defined below.

Working Together: Collaboration is integral to finding the solutions required to manage the pervasive nature of climate risk and the issues it creates. Effective collaboration rests upon identifying and engaging the most appropriate stakeholders.

Supportive Environment: It is broadly recognized that whilst private parties are responsible for managing risks to their own assets and incomes, it is the primary responsibility of government to create the right conditions that

¹ For more information about Q-CAS see <https://www.qld.gov.au/environment/climate/adapting/>

enable them to do so. This involves creating the institutional, market, and regulatory environment that provides the support and certainty the private sector needs to plan, implement, and invest in climate change related actions and behaviour.

In addition, the Council of Australian Governments (2013) states that:

Governments also need to ensure that risk is appropriately recognised and the responsibility for its management apportioned and communicated. Policy instruments, such as land-use planning, codes and standards or environmental or public health legislation, can play an important role in clarifying and strengthening incentives and private responsibility.

It is for the private sector to work with government to ensure that the private sector's needs are identified and clearly understood by government, and to visibly and actively support the government in its efforts to address those needs.

Behaviour that Safeguards: In this context, the term 'safeguard' broadly refers to a reduction in climate risk, with the expectation that both mitigation and adaptation measures will be required. Mitigation involves actions that target the primary causes of climate change, in contrast to adaptation, which involves actions aimed at enhancing tolerance and minimizing the impact of climate change hazards. Ultimately, the degree that society will need to adapt to climate change will be determined by the degree that society is effective in mitigating it.

Prosperity: In achieving prosperity, it is recognized that forward-thinking organisations stand to capitalise on climate-related products and new markets, whilst reducing climate-related risks to their own operations. Such pro-action can ensure economic sustainability, but may also give rise to a competitive advantage through: ensured business continuity, cost savings, and reputation enhancement.

Built Environment and Infrastructure Sector: The sector is broad incorporating builders, developers, planners, infrastructure and core network providers.

..and Queensland as a Whole: The interrelationship between the BE&I sector and Queensland as a whole links the prosperity of each to the other. As noted above, the nature of climate risk means that "we're all in this together".

Climate Change Impacts: Climate impacts represent a materialization of climate risk. As described below, climate risk extends beyond the potential for direct physical damage. It incorporates a range of indirect and cascading risks that can impact the financial integrity of an organisation in many ways.

Caveat

The BE&I sector encompasses a range of industry and other stakeholders. This SAP reflects the views of those stakeholders who have participated in the SAP's working group (see Appendix A) and as such does not necessarily represent the views of the whole sector.

Principles to Support Built Environment & Infrastructure Sector Adaptation to Climate Change

The Principles² developed to frame and support climate adaptation in the BE&I sector are:

1. The built environment and infrastructure sector will encourage cooperation across all communities and within all sectors of society to manage and, where possible, reduce climate risks.
2. To ensure ecologically sustainable development, the built environment and infrastructure sector will investigate, assess, and give account of, the impacts that its activities are likely to have upon the environment, and the impact the environment will have on its activities.
3. Successful development and operation of the assets is a product of effective planning, and effective planning requires informed and transparent decision-making.
4. The built environment and infrastructure sector supports decisions that address the cumulative effects and the

² See Appendix B for a detailed explanation of each principle.

subsequent risks associated with responding to climate change, including those at local, regional, national, and global levels, those that are short-term and long-term, those that are temporary and permanent, and those that are direct and indirect.

5. The built environment and infrastructure sector supports evidence based strategic resource planning decisions that integrate the best available information, analysis, and advice from all relevant expert practitioners.

The Built Environment and Infrastructure Sector and Climate Change

The BE&I sector’s relationship with climate change is complex, the implications of which extend well beyond the sector itself. This section explores that relationship through a brief discussion of the BE&I sector in the context of the financial implications of climate risk.

Climate Risk and Financial Impacts

Climate change is expected to increase the risk of interruption and financial loss to the private sector. Climate risk extends beyond direct physical damage. It incorporates a range of indirect and cascading risks and opportunities that appear as society moves to reduce climate risk, and reacts to the impacts and implications of climate change related extreme weather events.

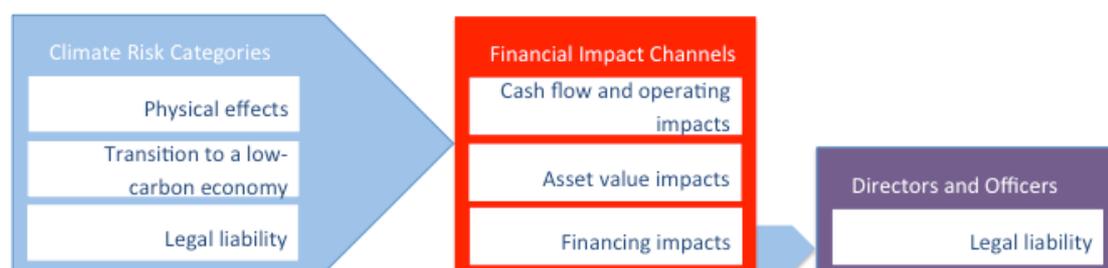


Figure 1 Climate risk categories and financial impacts (Based on frameworks presented by the Sustainability Accounting Standards Board (SASB, 2016, p. 6: Figure 1) and the Bank of England (Prudential Regulation Authority, 2015))

Categories of Climate Risk

Physical risk: these are first-order risks that arise from weather-related events, such as floods, storms and coastal inundation. They are the impacts that result directly from these events, and include such things as damage to property. The impacts also include those that come about indirectly through subsequent but related events, such as the disruption of global supply chains or resource scarcity.

Transition risk: this is the financial risk that arises as behaviour, consumption patterns, and societal expectations change as society transitions to a net zero emissions economy. This risk factor incorporates such things as potential re-pricing of carbon-intensive financial assets, consumer preference for climate friendly practice, a range of governmental policies, other binding and non-binding agreements, and regulatory mechanisms such as carbon-pricing.

Legal Risk: generally, this is a litigation risk that arises where parties who have suffered loss and damage from climate change seek to recover those losses. Such actions could be taken against an organisation itself, or slip in behind the corporate veil to the officers and boards responsible for the organisation’s governance.

Financial Impacts

Cash flow and operating impacts: may arise along both cost and revenue lines. They are due to climate-related impacts on the financial condition, operating performance, and expenses along an organisation’s full value chain.

Asset impacts: these impacts affect the value and use of core assets due to a carbon pricing mechanism and other regulatory outcomes; changes in asset value due to the physical effects of climate change; and/or devaluation of assets due the transition to a low-carbon, resilient economy. Current assets (e.g., inventory, crops, and livestock) and long-lived physical assets (e.g., coastal properties, infrastructure, and forestland) may be at risk of impairment or devaluation due to increased extreme weather events.

Financing impacts: access to and/or cost of debt and equity capital may be affected by how well entities manage

their climate risk exposure. Entities that have greater exposure to the physical effects of climate change demonstrate poor management of their transition risks and are subject to climate regulations, and may face debt and equity risk premiums as rating agencies, investors, and lenders factor in climate risks.

Directors and officer liability: this liability is closely aligned with all of the above but is differentiated due to its potential application beyond an organisation to those who are responsible and oversee its operation.

The Built Environment and Infrastructure Sector and Climate Risk

The myriad inter-relationships of participants involved in the BE&I sector means that actions and inactions of each has the potential for both positive and negative ramifications within the sector and beyond. Indeed, the scale and extent of the BE&I sector is such that it is exposed to, and exposes society to, both its own actions and that of society itself (Productivity Commission, 2014). Impacts, in particular to essential infrastructure, can have flow on effects that knock on from one category provider (e.g. electricity) to another (e.g. water supply) and cascade throughout the whole economy (The Climate Institute, 2012).

The expected lifetime and nature of the assets that the BE&I sector creates and manages, and the production process itself, exposes the sector to an environment of significant consumer preference and regulatory change. Regulatory approval and assessment processes can delay production, generating additional non-recoverable costs even before production begins (Shearer et al., 2016). Ill-conceived and redundant products can lock in additional overheads and expense for years with implications for asset valuations. Subsequent retrofitting and change may only come at significant additional cost (Norman et al., 2014).

Climate change adds more uncertainty to a BE&I operational landscape already characterised by risk complexity (Barnett et al., 2015). Often described as a risk multiplier, climate change exacerbates current risk and introduces new ones. Risks arise at the intersection between the sector and its direct and indirect exposure to climate change. In this regard, specific to the development industry but equally applicable to the broader sector, Shearer et al. (2016) identified three key relationships with climate change:

1. The production of the built environment contributes to climate change, for example by land clearing, the direct and indirect use of fossil fuels and other resources during construction, and the contribution of the design of buildings and development layout to total energy use;
2. The nature of the housing development products, such as material, location, scale and allied infrastructure, influence the degree to which consumers are exposed to climate hazards; and
3. Developers are vulnerable to climate change, either directly from weather impacts, or indirectly through more stringent regulation, financing or insurance requirements

While for Point 1, the relationship with climate risk appears *prima facie* more causal than effect, it is important to note that it creates exposure to elements of transitional and legal risk that are equally relevant to the more obvious direct and indirect climate risks implicit in Points 2 and 3.

Sector Adaptation Plan Process and Methodology

Overview

The development of this BE&I SAP involved desktop research, two workshops and a survey to collect information from BE&I representatives about their key climate risks, key resource gaps and develop priority actions in response to these gaps. The process was designed to minimise contact hours for BE&I sector participants. The first workshop introduced the BE&I SAP and the methodology that would be applied to complete it. Data was collected by way of a survey that was sent out after the first workshop, and at a second workshop where survey findings were distilled by the working group to a list of resource gaps and priority actions. For efficient use of respondents' time, a follow-up email was sent to BE&I working group members for them to rank priority actions in order of importance (Figure 2).



Figure 2 BE&I SAP data collection process

Framework and Governance

Given the importance of collaboration, the Collaborative Impact Model³ developed by Stanford University was applied to frame SAP development. The model is based on the premise that only through working together towards a common objective can solutions to complex problems be achieved and ultimately operationalized. A thin governance layer in the form of a Steering Committee oversaw the SAP process and framework. The Steering Committee consisted of Mark Baker-Jones, the initiator of the SAP project, Catie Dunbar, a representative of the Department of Environment and Heritage Protection, and Ian Edwards, the SAP facilitator and independent consultant.

Sector Adaptation Plan Themes

Five research themes (Table 1) formed the basis of the design and outcomes of the survey and Workshop 2 presented below. These themes were distilled from ten core components that had been identified by the University of Queensland’s Global Change Institute as integral to the development of an effective sector adaptation (see Appendix E).

Table 1 Survey research themes organised by SAP core components

Theme	Explanation
Hazards, risks and opportunities	Nature, timing, location and materiality of climate change hazards, risks and impacts relevant to the BE&I sector in Queensland.
Climate adaptation practice and risk management	The nature and extent of current and planned risk management and adaptation practice either designed specifically for climate change or as a by-product of other leading objectives.
Information and resources	Key information and communication resources and gaps both outright and specific to current resource.
Barriers and enablers	The nature and impact of factors that either aid BE&I organisations adapt to climate change or impede any action to do so.
Other initiatives	Current climate change adaptation activity undertaken by other associations and organisations.

³ See <http://www.collaborationforimpact.com/collective-impact/>

Data Collection

Desktop Review

A brief desktop review was undertaken to inform the design and content of the survey and second workshop discussed below. The review was limited to Australian-centric studies drawn from both academic and grey literature such as industry reports.

Survey

A BE&I SAP survey was distributed, by way of web-based platform ‘SurveyMonkey’, to inaugural BE&I workshop participants and other relevant parties who had expressed an interest in involvement in the BE&I SAP. The objective of the survey was to understand resource gaps with the view to compiling a list of ranked priority actions. The survey consisted of 34 questions specific to five themes (Table 1). Sixteen BE&I SAP participants completed the survey (Table 2).

Table 2 Survey respondent category by participant completion numbers

Respondent category	Number
Developer	4
Infrastructure provider	1
Peak body/association	5
Government agency	2
Consultancy	1
Details not provided	3
	16

Workshop 2 and Follow-Up

A workshop was held after the survey to review results and discuss in more detail issues that had arisen. In addition, key integration and linkages with other sectors, issues that had been raised during discussion at the first workshop, were also briefly explored. At workshop close, an inventory of priority actions had been agreed upon by participants but not ranked. A follow up email that contained priority actions and an explanation of each was subsequently distributed to BE&I SAP participants for them to rank.

Sector Adaptation Plan Working Group

BE&I sector stakeholders participated in the development of a SAP by way of a working group. A “snowballing” approach was taken to working group recruitment whereby participants engaged in the SAP as a result of identification from Q-CAS partners, were themselves requested to identify other potential interested stakeholders. This resulted in participation of a range of organisations including property developers, infrastructure providers, industry and sector peak bodies and associations, consultants and various stakeholders such as the Local Government Association of Queensland and Queensland State Government agencies. An inventory of organisations that contributed to the BE&I SAP working group is provided in Appendix A.

Survey Key Findings

This section presents the key findings of the survey. These are organised in accordance with the five themes noted in Table 1 above except for the two themes, “information and resources” and “other initiatives”, which are combined due to commonalities and synergies.

Key Climate Risks, Hazards and Opportunities

Hazards

While SAP participants reported exposure to all hazards, those of most concern are flooding, heatwaves and storms (Figure 3). The coastal nature of these hazards is not surprising given that the clear majority of Queensland’s infrastructure and development is located within 50 kilometres of the State’s shoreline (DCC, 2009; DERM, 2011).

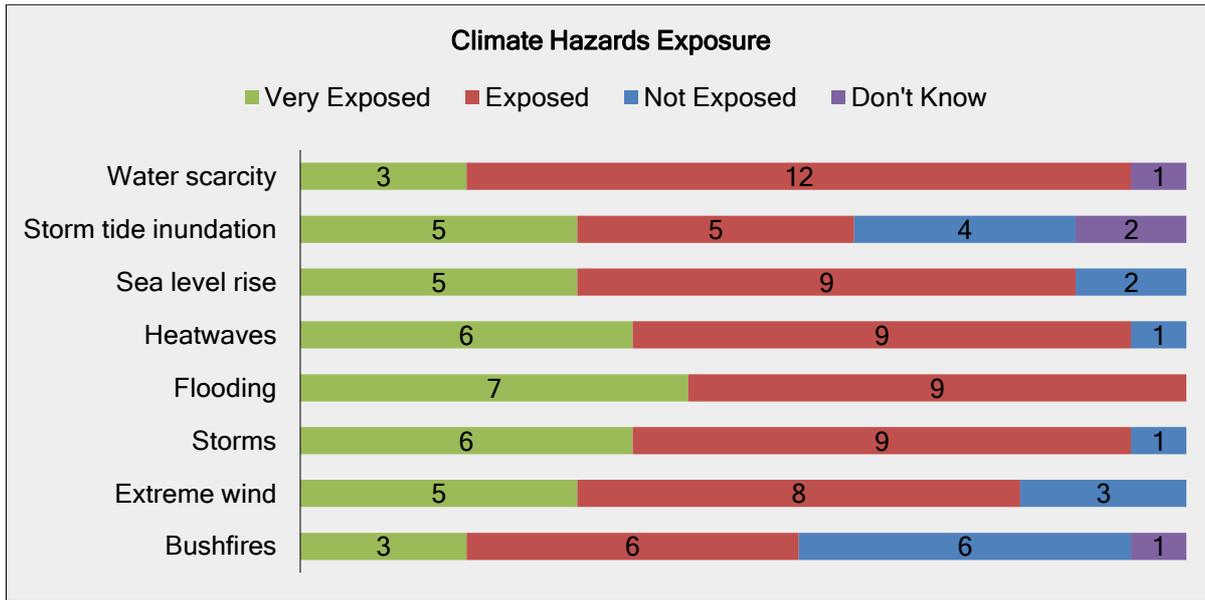


Figure 3 Degree of natural hazard exposure reported by survey participants

Most SAP participants reported that these hazards have already had a material impact on their organisation’s operations with a near consensus expecting material implications within the next twenty years (Figure 4).

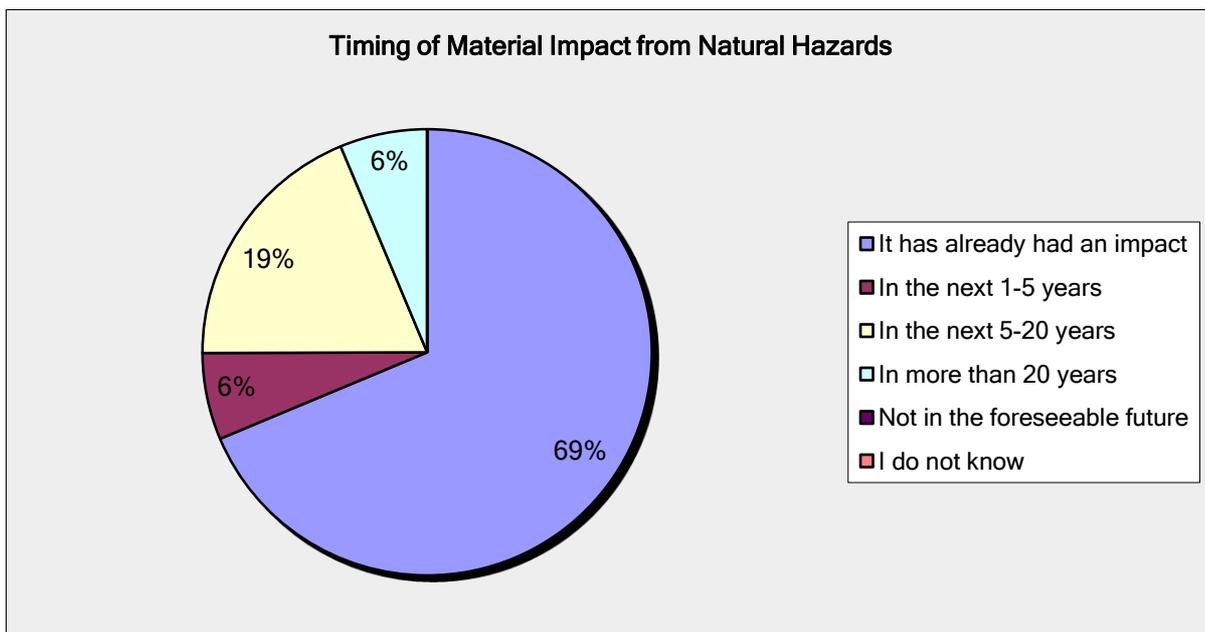


Figure 4 Timing of natural hazard impacts reported by survey respondents

Regionally, exposure is reported in all parts of Queensland, with greatest concern directed to North Queensland

and predominantly South-East Queensland. This is consistent with the Intergovernmental Panel on Climate Change’s characterisation of South-East Queensland as a “climate change hotspot” due to the region’s concentration of population and the built environment coupled with its proximity to the coast (Reisinger et al., 2014).

Climate Risks

The risks of greatest concern raised by SAP participants were: infrastructure, regulatory, insurance, and labour force (Figure 5 and Table 3).

Table 3 Explanation of climate risks (compiled from various sources including Shearer et al. (2016) and Productivity Commission (2012))

Risk	Explanation
Infrastructure risk	Physical damage to land and/or premises stock.
Supply chain risk	Disruption of access to production inputs that affect (sub) contractor productivity and/or ability to deliver as agreed.
Reputational risk	Damage due to actions taken or not taken to address climate change.
Financial risk	Limited access to finance as needed at a reasonable cost and terms.
Insurance risk	Loss of access to insurance due to reduction of insurance coverage at reasonable rates.
Market risk	Risk that final product is not bought, leased or operational at anticipated price or purpose.
Regulatory risk	Burdensome and/or unstable regulation targeted at climate change mitigation and adaptation.
Political risk	Instability due to climate change related disasters.
Labor force risk	Climate related impacts that affect staff productivity and ability to work.
Legal risk	Costs and resources dedicated to both remunerating and defending legal actions due to actions taken or not taken to address climate change.

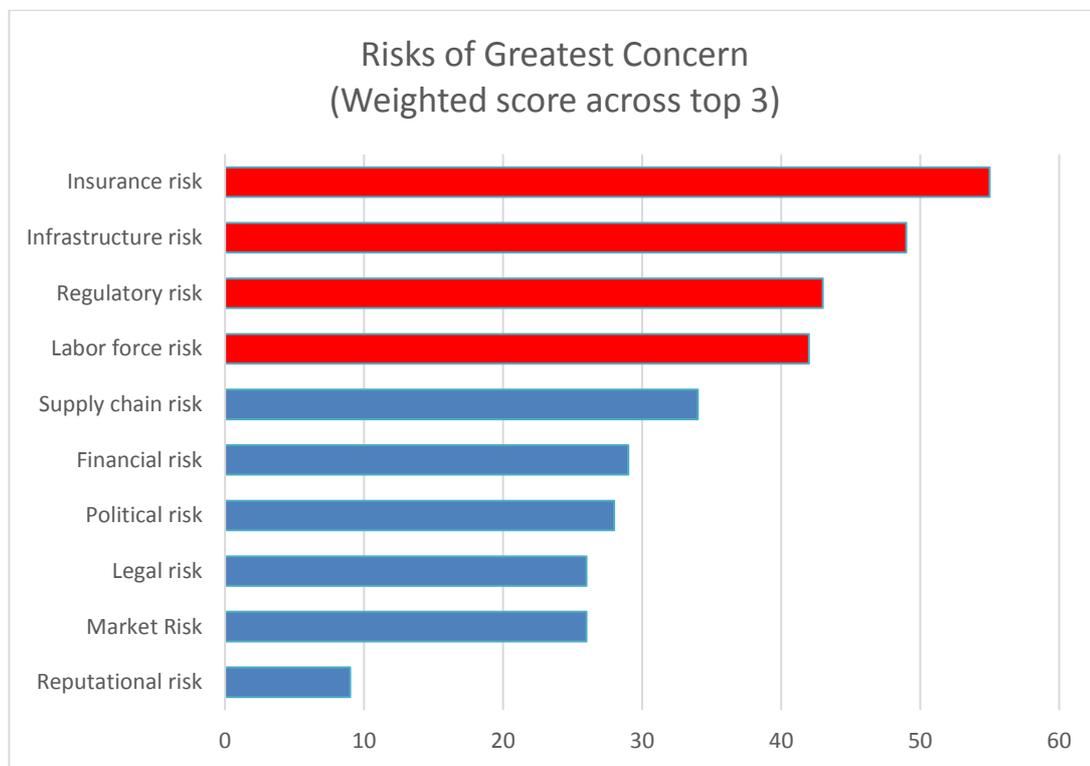


Figure 5 Weighted score of risk concern ranking (weighting calculated as major barrier by ranking)

While the risks of infrastructure and labour force are related to the direct physical impacts on capital and resource productivity due to climatic events, regulatory and insurance risk highlight an appreciation of the indirect risks involved with climate change. Concern about rapid regulatory change and the actual impact of regulatory, policy and legislative content on operations is well understood in current literature (e.g. see Biesbroek et al. (2013)). Concern about access to affordable insurance for both clientele and direct operators as the climate changes corresponds to a risk that is universally recognised and has been documented for quite some time (for an overview see Edwards (2016)). Insurance risk’s predominance probably also reflects recent cyclonic and flooding events in Queensland that have driven significant premium increases and governmental inquiries such as the Northern Australia Insurance Premiums Taskforce (Australian Government, 2015) to address. It also highlights an emergence of broader financial risk. Whilst not apparent in the survey, financial risk received some attention in the second workshop. Like insurance, there appears a recognition and concern of the impact that climate events could have on access to affordable funding for both prospective customers (e.g. mortgages for residential housing) and the industry itself (see The Climate Institute (2016) for a broader commentary of this risk). Interestingly recognition of climate change as a pure Corporate Social Responsibility issue appears to be a thing of the past with reputational risk of little concern.

Outcomes and Opportunities

Increased costs (e.g. capital, risk management, operational) are the predominant expected outcomes of climate change. Some participants noted that these costs have already increased in response to dealing with climate risk. There was an indication that not all expected outcomes are negative, however, with an expectation of the potential for new products and markets to emerge. Opportunities noted extend beyond market and product extension to cost and efficiency gains and the potential for climate-savvy operators to access greater funding due to emerging trends such as climate-focused finance.

Key Finding 1. Climate change has already impacted, and continues to impact the BE&I sector in Queensland.

Key Finding 2. There is recognition within the sector that if unmanaged, climate change represents a material risk to business operations in the short to medium term.

Current Adaptation and Risk Management Practice

Current Practice

Recognition of climate risk within the BE&I sector is implicit in the extent of actual and planned adaptation and risk management activity. There is evidence that this has resulted in climate change being mainstreamed into the enterprise risk management systems of some organisations. There was also an indication that for some organisations, climate change has been incorporated into broader strategies that look to enhance organisational resilience. A resilience approach is consistent with frameworks that have evolved of late such as the “National Land Use Planning Guidelines for Disaster Resilient Communities” (noted in table 5 below) in which climate change is only one of many facets of consideration.

SAP participants represented a range of points along the path of climate change adaptation. The most common next steps in this regard involved accessing and analysing data and engaging internal and external stakeholders and interested parties to support climate-related activities.

The survey and workshop exposed a broad range of measures implemented by the BE&I sector to address climate change. These include research, design and retrofitting to reduce climate risk, staff training, insurance coverage, business continuity planning, and asset relocation. There is evidence of respondent engagement with their business partners to reduce climate risk and in some circumstances consideration of existing business relationship discontinuation to reduce their exposure to climate risk. It would appear that the BE&I sector has or is developing an appreciation of the impact of business partners' climate risk on their own operations.

Table 4 Examples of exemplary practice provided by survey participants

Example	Details
Developers	
Barrangaroo South Development – Sydney	High profile urban renewal project being developed with a strong focus on climate change adaptation. The redevelopment process includes a detailed analysis of climate risks which help to inform design. For further details see: https://coastadapt.com.au/sites/default/files/case_studies/SS27_Barangaroo_urban_renewal.pdf
Coolmax roofing	Collaborative research of mitigation and adaptation benefits for materials and modelling 2nd order benefits.
Life Cycle Assessments & Embodied Energy evaluations	For large scale developments including commercial, health, residential, retail etc.
Emergency Infrastructure adaptation	Assessment of retail centres in terms of suitability to provide emergency infrastructure for the community, as well as a central meeting point for emergency services during local disasters, such as storms, floods and bushfire.
Physical asset portfolio risk assessment and mitigation program	Undertaken to inform asset management decisions.
Peak Bodies and Associations	
National Land Use Planning Guidelines for Disaster Resilient Communities	Provides relevant guidance material for the preparation of climate-related policy, strategy and development controls relating to the built environment, for member reference. Presents best-practice planning principles land use planning activities relating to natural hazards and climate impacts. Leading reference in Australia on risk-based land use planning.
ecoBiz	Provides Queensland businesses and organisations access to complimentary tools and events including one-to-one coaching, site survey, online benchmarking, workshops and webinars. Helps businesses save thousands of dollars across their power, water and waste bills.

Example	Details
Envirodevelopment	Scientifically-based assessment scheme that independently reviews development projects and awards certification to those that achieve outstanding performance across four or more of the provided elements - Ecosystems, Waste, Energy, Materials, Water and Community.
Infrastructure Providers	
Mt Crosby East Bank Pumping Station Risk Assessment	Undertaken to inform asset management decisions. Quantified reliance on other utility providers, e.g. electricity.
Queensland Government Agencies	
Betterment program	Provides funds to local government to build existing assets back better after a damaging event, thus minimise damage from future disasters.

Two exemplary activities are presented in the case studies below. These case studies and the details provided in Table 4 depict practice that extends to research collaboration to design adaptive construction materials, generation of frameworks and “green” rating schemes, application of risk assessment processes and betterment programs. Links to identified tools, frameworks, standards and codes of practice can be accessed in Appendix C.

Case Study: Seqwater’s Climate Resilience Framework

Seqwater is one of Australia’s largest water businesses, with the most geographically spread and diverse asset base of any capital city water authority.

The Mt Crosby water treatment plants are significant assets for the South East Queensland drinking water supply system, supplying approximately 40% of the water to the region. These plants are part of an extremely complex system with dependencies on external networks and service providers. For example, the power supply on which the plants are dependent are also vulnerable to a range of off-site hazards, including flooding, storm damage, bushfires or extreme heat.

Extreme rainfall events in 2011 and 2013 exposed some operational weaknesses, including risks to the central Brisbane water supply. It is expected that these kinds of events will increase in frequency under a changing climate.

Seqwater has developed a Climate Resilience Framework to ensure climate risks are adequately understood and managed through business-as-usual asset planning, management and operations. Over 300 unique risks have been identified that may have pervasive impacts on the cost: income ratio, service reliability and stability, water quality, ecological properties of the catchment, and reputational damage to the organisation. Priority actions include quantifying the changing level of risk to assets, considering future climate in catchment planning, and addressing the critical cross dependencies with external assets and services.

This Climate Resilience Framework has enabled Seqwater to take a structured approach to assessing risks and priority actions to ensure a climate resilient bulk water supply for South East Queensland.

Case Study: Hervey Bay Cool Roof Study

A multiparty business/research collaboration, initiated by BlueScope and Stockland with involvement from Lendlease and the University of Wollongong, has calibrated measurable financial and environmental benefits of cool roof retrofitting on a shopping centre. The work intended to further the widely understood benefits of high reflectance high emissivity roof surfaces.

The research involved a study that sought to account for the micro climate found directly above the roof surface (hotter than ambient air) using Stockland’s Harvey Bay shopping centre’s 15,000 square-metre roof as a reference case. These “second order effects” are typically not recognised by conventional thermal modelling. The focus of the study compared the thermal performance of roofing made from conventional ZINCALUME® steel with COLORBOND® Coolmax® steel developed by BlueScope.

The results of the study, carried out in part by Lendlease and the University of Wollongong, revealed that for larger roofs (like those common for industrial facilities, shopping centres and airports) a failure of industry simulation tools to account for second order effects can result in an under-valuation of up to 75% of the full energy benefit of cool roofs. These findings are ground-breaking insofar as they prove second order financial benefits that in turn provide additional impetus and justification for further adoption of energy-efficient and climate resilient outcomes.

Key Finding 3. Practitioners, peak bodies and other institutions such as government agencies are currently undertaking a broad range of activity directed at managing climate risk and building organisational resilience in a broader sense.

Key information resources and communication channels

Resources

The BE&I sector sources climate related information from a broad range of institutions including research centres, peak bodies, government agencies, universities and private sector consultancies (Figure 6).

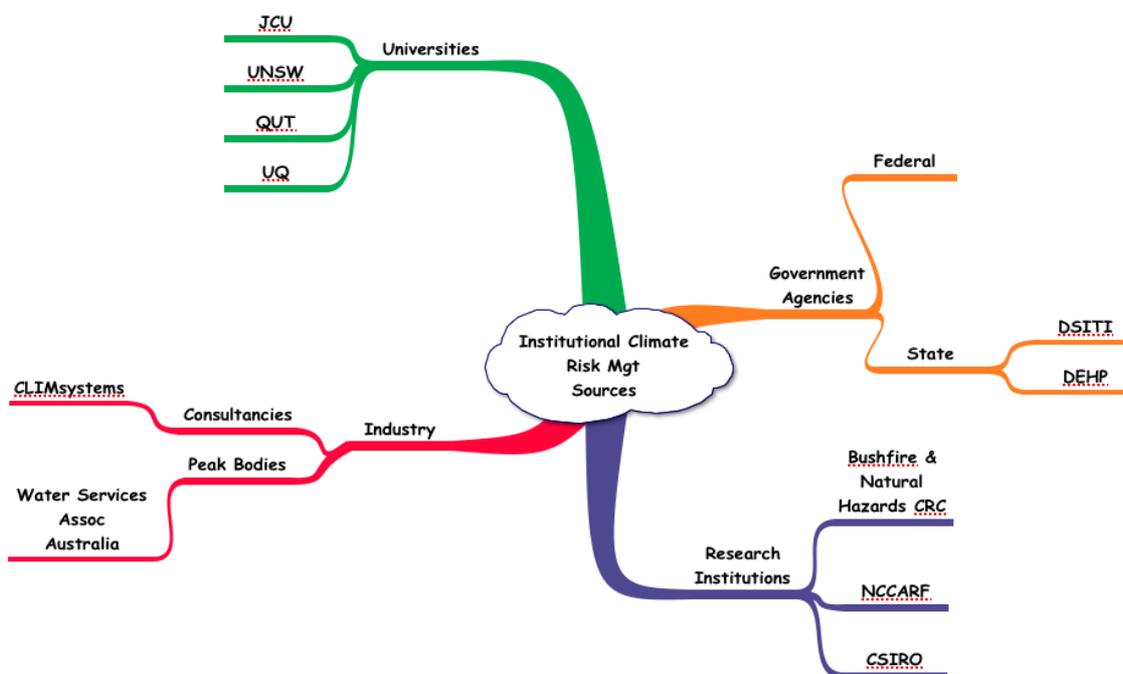


Figure 6 Institutions noted by survey participants as sourced for climate related information

Results of the survey indicate that consultancies, publicly available tools, reports and planning guides are the most common resources applied to adaptation practice. In this regard, the survey also highlighted a range of tools, frameworks and guidance that are used to aid adaptation activity (see Appendix C).

Communication

SAP participants advised a preference for meetings and workshops to communicate climate predictions and recommended adaptation actions. They also reported that relevance, clarity and simplicity are important elements of communication as complexity undermines all forms of communication media. Given this assertion, meetings and workshops would appear a natural choice given that they enable the multi-directional communication required to delve into what is essentially a complex field.

Initiatives

There is a range of initiatives instigated by both industry and government in Australia to address climate change either directly or under the broader umbrella of resilience and/or sustainability (see Appendix C). These current initiatives represent networks, experience and knowledge that the BE&I SAP could tap into. All industry representatives engaged as part of this Phase 1 process displayed enthusiasm about working with a Queensland BE&I SAP. A number of representatives are currently actively engaged as members of the BE&I SAP (see participant list in Appendix A).

Key Finding 4. There is a range of activities, initiatives and resources currently applied to sustainability and climate change adaptation, both within the sector and beyond, that can be leveraged and enhanced to prevent “recreating the wheel”. In this regard, the current BE&I SAP working group represents a wealth of information and learnings for potential sharing amongst participants.

Barriers and Enablers

Results of the survey (Figure 7) show that organisations have already overcome some commonly cited barriers to adaptation activity (e.g. for an extensive literary review of common climate change adaptation barriers, see Biesbroek et al. (2013)). These elements are now major enablers, the three most commonly cited and highest ranked of which are: organisational culture, access to hazard information and access to expertise.

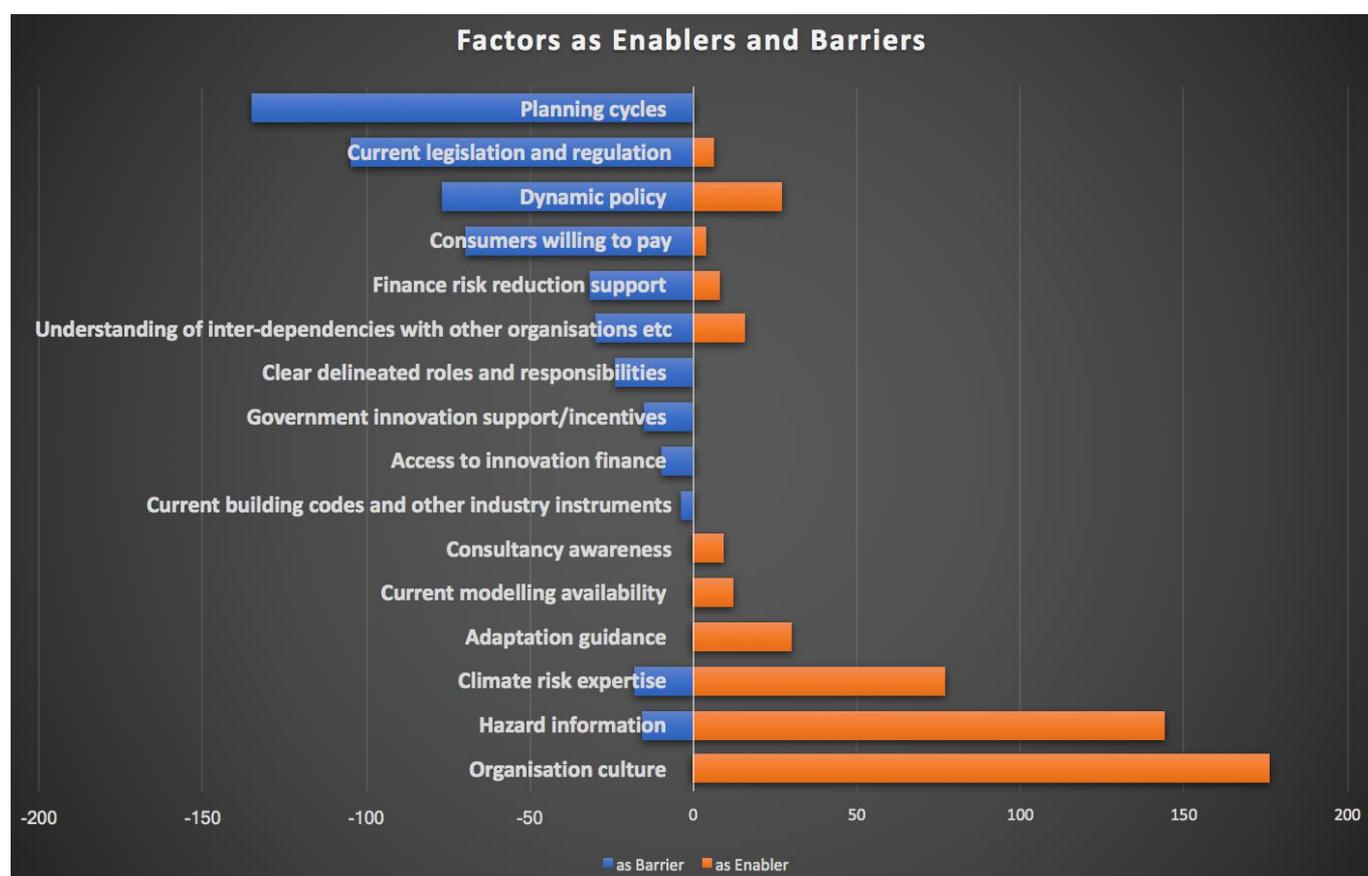


Figure 7 Barriers and enablers ranked by impact by survey participants

Despite advancements, improvements are still sought in the timeliness, granularity and applicability of hazard information and sector specificity of guidance. These were not however the main barriers raised. Whilst a broad range of factors were cited as barriers to adaptation activity, the following emerged from the survey as of highest concern:

- tension caused by short versus long term planning cycles,
- the dynamic nature and state of current legislation and policy, and
- consumers not willing to pay for additional adaptive features.

Beyond these three factors, an additional barrier that drew significant attention in the workshops was the ability to understand and integrate inter-dependencies within and beyond the BE&I sector. In other words, an ability to ensure that all economic and social actors are working in the same direction and not impeding the success of each other’s activities. Given the pervasive nature of the BE&I sector, this represents a particularly challenge going forward. This is a change that for the same reason, however, is critical to the holistic solutions required to address

both the specific and systemic risk⁴ that climate change presents.

Key Finding 5. While challenges remain, organisations have already overcome a raft of barriers to adaptation, activity transforming them to enablers in the process.

Key Finding 6. There is recognition that engagement with other sectors and parties (e.g. finance, communities) is essential to motivate and enable the BE&I sector to adapt efficiently and successfully to climate change.

Resource Gaps

At the second workshop, participants working in groups applied survey findings to generate a list of resource gaps that if filled would aid their organisations adapt to climate change. The gaps identified are presented in Table 5.

Table 5 Resource gaps identified by participants of Workshop 2

ID	Resource Gap	Explanation
A	Out-of-date interdependencies report	A report prepared by the Climate Institute in 2012 provides insight into inter-relationships within the infrastructure sector. This report is now out of date and needs to be revisited. It could also be enhanced to include a wider scope with a Queensland specific focus. Such a report could inform holistic adaptation action within and beyond the BE&I sector. It would form the basis of action to address integration barriers.
B	No layman's guide to understanding risk	To enable community understanding of risks such as climate change and how their actions and those of the BE&I sector can increase or reduce risk.
C	No asset management insurance guide	To enable asset owners and managers to maintain and build assets to a standard that reduces the risk of natural hazard impacts thus minimising insurance premiums.
D	Incomplete risk quantification guidance	To provide risk assessors and financiers with the tools, frameworks and guidance they need to incorporate climate risk into financial and risk analysis. It was considered that incorporation of climate risk within pricing would motivate climate change adaptation. Such pricing could extend to the residential mortgage market for example and would enable consumers to better understand any exposure to longer term risks.
E	No lifecycle costing framework	To enable an up-front appreciation the financial benefits of building beyond minimum standards. It was considered that such a view would motivate more risk-relevant and resilient assets.
F	No adaptive feature certification	It was considered that easily accessible recognition of asset adaptive features would enable consumers to demand and reward those features.
G	Inadequate funding to maintain and install critical infrastructure	To ensure local government and state infrastructure is built and maintained at levels to minimise climate risk.
H	Lack of guidance that integrates catchment management into BE&I related decision making	To enable a more holistic understanding of the inter-relationship between environmental management and the built environment. It was considered that such a failure prevents decisions that both enhance natural and built capital to the detriment of each.

⁴ Specific risk only affects an industry or organisation whilst systemic risk refers to risk that could trigger the collapse of an entire market or the financial system (SASB, 2016).

ID	Resource Gap	Explanation
I	No comprehensive break down of insurance premiums	It was considered that this would provide insurance consumers with a better understanding of how natural hazards are impacting their insurance premiums and provide an incentive to adopt risk reduction behaviour.
J	Lack of climate change visual tools	It was considered that helping the community visualise potential climate-related impacts would enable them to gain a greater understanding of climate risk hence motivating them to address it.
K	Understanding of adaptation requirements	To address lack of understanding, a document should detail what the BE&I sector requires from Government to motivate and enable adaptation activity within the sector. Not inconsistent with the overriding objective of the BE&I SAP this could include requirements specific to legislation and government procurement policy.
L	No Statement of Obligation	As part of the Victorian's Climate Change Framework water corporations will pledge a pathway for net-zero emissions. These pledges not only provide a corporate target but will also be incorporated in an industry Statement of Obligations under Victoria's Water Industry Act 1994 ⁵ . Participants considered such an approach could also be applied to adaptation action in Queensland and that this would provide both a regulatory and targeted focus for the BE&I sector. Importantly it also ensures that climate change is incorporated in the decision-making process implicitly reducing any decision hurdles.

A synthesis of Table 5 reveals that most resource gaps identified represent work required to motivate both the BE&I sector and stakeholders to adapt to climate change. Even gaps in technical resources such as risk quantification guidance form an integral part for building a case to adapt to climate change.

Key Finding 7. Most resource gaps identified represent those required to motivate support, via engagement and awareness, for BE&I sector climate change adaptation from within the sector itself and from external stakeholders.

Prioritised Actions

The resource gaps identified in Table 5 formed a basis from which a list of seven priority actions was distilled. During this process, workshop participants adopted two additional actions and in the main, grouped the resource gaps into high level action items. Table 6 provides the results of this exercise ranked by participants in order of priority. Action items are cross-referenced, where applicable, back to the originating resource gap inventory (column "Ref").

Table 6 Priority actions identified by participants of Workshop 2

Rank	Action	Details and Comments	Ref
1	Identify incentives to encourage and facilitate the BE&I sector to adapt to climate change and to design and build assets to go beyond minimum standard requirements	There was recognition within the workshop that the current BE&I sector contains little incentive and many barriers to incorporate adaptation consideration into activities and products. For example, workshop participants noted that even though current regulatory standards are inadequate to safeguard BE&I assets against projected climate change, most assets are developed to meet minimum standard	C, D, E, F, I, L

⁵ For further details see <http://www.depi.vic.gov.au/water/governing-water-resources/water-corporations/water-corporations-statements-of-obligations>

		requirements only. For this example (and there are many others) consideration is required to determine what is needed to motivate the sector to build beyond minimum requirements to safeguard assets from projected climate hazards. In addition, consideration should extend to how policy instruments such as land-use planning, codes and standards can be strengthened to drive climate-resilient practice.	
2	Build climate risk awareness and capacity among BE&I sector practitioners, stakeholders and the wider community	This action is broad and incorporates creating community and stakeholder awareness about the value that climate-resilient features add to BE&I assets and products. This could involve, for example, the inclusion of climate change in professional qualifications and courses to ensure that practitioners such as engineers and architects mainstream climate change considerations into their daily work, and developing easy to understand material to help community members understand key technical climate related aspects, for example what a 1 in 100 year event means. Note that some of this material has already been developed by organisations such as the National Climate Change Adaptation Research Facility (NCCARF), but is hard to find and not that accessible to the community.	B, C, D, H, I, J
3	Develop a report that explores and documents the intra- and inter- dependencies within and between the BE&I sector and other societal and economic sectors	Understanding how the actions and inactions of other economic and societal actors impacts the BE&I sector and vice versa is integral to the holistic solutions and approaches required to ensure effective climate change adaptation. A report was prepared by The Climate Institute in 2012 but this is now out of date and needs to be revisited. Such a report would enable informed engagement amongst relevant stakeholders going forward.	A
4	Work with the state government to aid them identify initiatives that demonstrate the benefits of effective climate change adaptation within their own operations and that motivates climate change adaptation amongst their suppliers	Government as a service provider can set a tangible example of the benefits of adapting to climate change. As a significant consumer, they can also drive demand for climate-resilient products. There was a feeling in the workshop that governments in both these regards could do a lot more and that the BE&I SAP group could work with them to enable this to happen.	G, K
5	Engage the financial sector on how to develop financial and insurance mechanisms that incentivise the provision of climate-resilient products and services from the BE&I sector and their demand from consumers	The current disconnect between developer finance, owner insurance and BE&I products creates a significant barrier to both the BE&I sector providing climate ready products and the generation of consumer appetite for same. As such, how the financial sector prices its products (e.g. insurance and loans) and the degree that climate risk is incorporated in this pricing is a significant element of climate change adaptation activity. Part of this action may incorporate working with relevant parties to ensure that climate related data (e.g. projections) is provided in a format that is fit for purpose.	D, E
6	Create an inventory of climate change adaptation information, tools and guidelines for the BE&I sector	The sustainability/climate change landscape is broad and dynamic with a range of initiatives, either specifically designed to address sustainability themes or doing so as part of a broader agenda. A list of tools, frameworks, guidelines and networks engaged in climate change adaptation prevents 'recreating the wheel' and enables the BE&I SAP working group to support and learn from other initiatives whilst capitalising on the work that they have done.	
7	Create a community of practice within the BE&I SAP working group with a rotating Chair	Consideration is required to determine the most effective and efficient form for the SAP to continue and lead to real change in practice.	

Conclusion

Seven key findings have emerged from the survey and resource gap analysis presented above. These are enhanced with an eighth that is included to reflect the support engagement and positive feedback that the BE&I SAP has experienced to date. The key findings of BE&I SAP are:

1. Climate change has already impacted, and continues to impact the BE&I sector in Queensland.
2. There is recognition within the sector that if unmanaged, climate change represents a material risk to business operations in the short to medium term.
3. Practitioners, peak bodies and other institutions such as government agencies are currently undertaking a broad range of activity directed at managing climate risk and building organisational resilience in a broader sense.
4. There is a range of activities, initiatives and resources currently applied to sustainability and climate change adaptation, both within the sector and beyond, that can be leveraged and enhanced to prevent “recreating the wheel”. In this regard, the current BE&I SAP working group represents a wealth of information and lessons for potential sharing amongst participants.
5. While challenges remain, organisations have already overcome a raft of barriers to adaptation activity, transforming them to enablers in the process.
6. There is recognition that engagement with other sectors and parties (e.g. finance, communities) is essential to motivate and enable the BE&I sector to adapt efficiently and successfully to climate change.
7. Most resource gaps identified represent those required to motivate support, via engagement and awareness, for BE&I sector climate change adaptation from within the sector itself and from external stakeholders.
8. There is an appetite amongst the BE&I sector to work collaboratively to address and minimise climate risk and maximise potential for adaptation action, i.e. there is an appetite for the BE&I SAP working group established under this project to continue in order to facilitate ongoing collaboration.

Next steps

The key findings and prioritised actions of the BE&I SAP indicate a sector starting to come to terms with and embrace action to reduce the risks that climate change presents. Current government and industry initiatives both exemplify this advancement and represent sources of knowledge and network potential going forward. In many respects, there is no requirement to recreate the wheel. Additionally, many of the priorities listed above are orientated towards broad stakeholder engagement and education. They represent system challenges that it is arguable will only be solved with holistic solutions based on collaborative and congruent effort. As it has been to date, collaboration and support from all stakeholders, including industry and government, will be integral to the transformation of actions identified in this SAP to implementation, and the significant benefits that this represents for the Sector and Queensland as a whole.

It is recommended that the BE&I SAP working group meet in the near future to identify who will lead and undertake the above actions and to consider how these will be funded. It is also recommended that the working group continue to operate as an open forum in order to incorporate the views of additional industry participants and stakeholders as they are identified and engaged.

Appendix A: Organisation Participant List

Participation of events by Built Environment & Infrastructure Sector Adaptation Plan organisations.

Organisation	Category	WorkShop 1	Survey	WorkShop 2
Beaumont Care	Aged care	Y	Y	
Chamber of Commerce Industry Queensland	Industry Association	Y	Y	Y
Department of Environment and Heritage Protection (EHP)	Qld State Agency	Y		Y
Department of Infrastructure, Local Government and Planning	Qld State Agency	Y	Y	Y
Dexus	Developer		Y	
DibbsBarker	Legal	Y		Y
Energy Queensland	Infrastructure provider	Y		
Green Building Council of Australia	Industry Association		Y	Y
Independent Consultant	Consultancy	Y	Y	Y
Lendlease	Developer	Y	Y	Y
Local Government Association of Queensland	Peak body	Y	Y	Y
NRM Regional Groups Collective	Peak body	Y	Y	Y
Planning Institute of Australia	Industry Association	Y	Y	Y
Property Council of Australia	Industry Association	Y	Y	Y
QIC Limited	Investor	Y	Y	Y
Queensland Reconstruction Authority (QRA)	Qld State Agency	Y	Y	
Queensland Tourism Industry Council	Industry Association	Y		
Green Cross Australia	Industry Association	Y	Y	Y
Seqwater	Infrastructure provider	Y	Y	Y
Stockland	Developer	Y	Y	Y
Urban Development Industry of Australia	Industry Association	Y	Y	Y

Appendix B: Principles to Support Built Environment & Infrastructure Sector Adaptation to Climate Change

A set of Principles to Support BE&I Sector Adaptation to Climate Change (the principles) was adopted at a gathering of BE&I sector representatives in October 2016. The principles have been developed by legal expert Mark Baker-Jones with the kind assistance of Emeritus Professor Douglas Fisher who provided suggestions about the context of the principles. They deliberately apply wording and terminology drawn from relevant legislation to ensure consistency, and hence, potential integration with Queensland's statutory planning framework. The purpose of the principles is to enable and support the BE&I sector to adapt to climate change. In this regard, their objective is to promote safe, efficient and adaptive development that addresses risks to the people and communities that will use the development, or be affected by the environment, infrastructure, and economy arising from the development. They complement existing development standards such as relevant ISO International Standards (e.g. ISO 14000) and development tools such as the Infrastructure Sustainability Council of Australia's rating scheme. The principles have also provided an informed basis and focus for the BE&I SAP.

No.	Principle	Explanation
1.	The built environment and infrastructure sector will encourage cooperation across all communities and within all sectors of society to manage and, where possible, reduce climate risks.	<p>A global response to climate change is inevitable. It is already underway in Queensland. The built environment and infrastructure sector has a crucial role to play in this regard. The development and operation of assets has an effect on the relationship between all components of the built and natural environment. The effect from the development and operation of assets includes, in particular, the influences of population growth, urbanisation, industrial expansion, use of resources, and new and expanding technological advances. As such, in order to contend with the global response to climate change and to be an effective part of that response, development must:</p> <ul style="list-style-type: none"> ▪ be economically, socially and, in most cases, technically sustainable ▪ not compromise the values of heritage conservation ▪ be ecologically sustainable. <p>The <i>Environmental Protection Act 1994</i> provides that ecologically sustainable development is essential to improving the total quality of life, both now and in the future, of all individuals and communities within the State of Queensland. Government at all levels, private organisations, communities, and individuals should therefore seek to achieve ecologically sustainable development across all sectors. Consequently, in the course of responding to climate change and achieving ecologically sustainable development, the built environment and infrastructure sector will support the following objectives:</p> <ul style="list-style-type: none"> ▪ Cooperation with private organisations, Government at all levels, and with individuals and communities ▪ The use of all practicable means and measures, including those that are financial and technical, in a manner calculated to foster and promote general welfare ▪ The creation and maintenance of conditions in which the built and natural environment can exist in productive harmony ▪ Economic growth, environmental protection, social wellbeing, and other sustainable outcomes, for the benefit of present and future generations.

No.	Principle	Explanation
2.	<p>To ensure ecologically sustainable development, the built environment and infrastructure sector will investigate, assess, and give account of, the impacts that its activities are likely to have upon the environment, and the impact the environment will have on its activities.</p>	<p>The built environment and infrastructure sector recognises, in the course of responding to climate change, the critical importance of maintaining and restoring the quality of the environment. The sector recognises that this is achieved by allowing ecologically sustainable development and applying this principle through the development and operation of its assets. To ensure development and operation of assets is ecologically sustainable, and as a matter of professional best practice, decision makers must be made fully aware of all relevant facts and circumstances. This will in turn ensure that the decisions made in any particular set of circumstances are valid in accordance with legal requirements. Consideration must therefore be given to:</p> <ul style="list-style-type: none"> ▪ the availability and quality of information explaining the activity to be considered ▪ the adequacy of this information in terms of quantity and quality to enable it to be given consideration ▪ an understanding of the activity so far as it is based on this information ▪ an understanding of the function of the activity in the context of the decision as a whole ▪ an evaluation of the activity in the context of the decision as a whole ▪ the incorporation of the activity in the overall decision making process in a way that reflects these criteria.
3.	<p>Successful development and operation of the assets is a product of effective planning, and effective planning requires informed and transparent decision-making.</p>	<p>In order to achieve sustainable development and operation of assets, decisions about the management of all resources must be made in an open and transparent manner. This includes decisions about the use or development of natural resources.</p> <p>Access to information must be provided to both the prospective user of the resource and the decision maker. Accordingly, the statutory arrangements designed to achieve sustainable development and operation of assets must be transparent, comprehensible, and implementable.</p>
4.	<p>The built environment and infrastructure sector supports decisions that address the cumulative effects and the subsequent risks associated with responding to climate change, including those at local, regional, national, and global levels, those that are short-term and long-term, those that are temporary and permanent, and those that are direct and indirect.</p>	<p>A detailed understanding of the cumulative impacts associated with responding to climate change is essential for the achievement of ecologically sustainable development and operation of assets. Assessment of these impacts is essential at the outset when the very first steps are taken to plan for the management of resources. This enables decision makers in both the public and private sectors to identify not only the risks associated with these impacts but also the opportunities presented in managing these risks. It also enables decision makers to make decisions that are substantively robust and legally compliant. Knowledge of the risks, therefore, can assist resource managers in prioritizing responses to climate change. In particular, knowledge of:</p> <ul style="list-style-type: none"> ▪ what are the risks ▪ how and where the risks are spatially located ▪ how to reduce the risks.

No.	Principle	Explanation
5.	<p>The built environment and infrastructure sector supports evidence based strategic resource planning decisions that integrate the best available information, analysis, and advice from all relevant expert practitioners.</p>	<p>The use of a scientific approach to investigate all available evidence of impact and risk will lead to decisions that are more effective in responding to climate change: simply because, these decisions will be based on accurate and meaningful information.</p> <p>Evidence based decision making requires a systematic and rational approach to researching and analysing the available evidence. It helps in the making of well- informed decisions about projects, policies, and programmes, by putting the best available evidence from research at the heart of development and implementation.</p>

Appendix C: Tools, Frameworks, Standards and Codes of Practice

Tools, frameworks, standards and codes of practice noted as used by survey respondents.

Name	Type (Process/Tool/Information portal)	Developer	Description	Information
Building Resilience Rating Tool	Analysis tool	Australian Resilience Taskforce in collaboration with Insurance Council of Australia (ICA)	The Building Resilience Rating Tool (BRRT) is intended to rate the resilience of a given home in Australia to common extreme weather hazards (Flood, Bushfire, Cyclone and Hail). The Exposure Rating shows a low-to-high scale for how exposed a particular house is to each natural hazard. The Vulnerability Rating shows a low-to-high scale for how vulnerable the building materials of a house are to each natural hazard.	https://www.resilient.property
Infrastructure Sustainability (IS) Rating Tool	Analysis tool	Infrastructure Sustainability Council of Australia	The IS rating scheme allows users to assess the sustainability of their infrastructure projects over all phases (design, construction and maintenance). It also has a standardised sustainability rating tool. Among other sustainability factors, the tool includes adaptation of infrastructure as one of the components of the rating system.	http://isca.org.au/is-rating-scheme/about-is/item/68-is-rating-tool
AdaptWater	Analysis tool	Water Service Association of Australia (WASAA) in collaboration with Sydney water	AdaptWater is a climate change adaptation and asset planning tool developed for urban water utilities. It allows water utility providers to assess the risk asset failures or damage associated with extreme weather and climate impacts and then analyse cost-benefits of proposed adaptation options	http://www.climaterisk.com.au/projects.html
Green Star	Analysis tool	Green Building Council of Australia (GBCA)	Facilitates assessment of sustainability outcomes across a four categories: communities, building design, interiors and building performance.	http://new.gbca.org.au
Climate Change in Australia	Data & Information portal	CSIRO and Bureau of Meteorology (BOM)	The web application allows users to generate regional climate change projections (per state) and has a range of parameters to choose from (see below). The tool utilises emission scenarios generated by the IPCC	http://www.climatechangeinaustralia.gov.au/en/
EnviroDevelopment	Process Guidance	Urban Development Institute of Australia	EnviroDevelopment is a scientifically-based assessment scheme that independently reviews development projects and awards certification to those that achieve outstanding performance across four or more of the provided elements - Ecosystems, Waste, Energy, Materials, Water and Community.	http://www.envirodevelopment.com.au

Name	Type (Process/Tool/Information portal)	Developer	Description	Information
Climate Adaptation Manual for Local Government	Process Guidance	Australian Centre of Excellence for Local Government (ACELG)	While there exists a number of useful resources for undertaking climate risk assessment and adaptation planning, to date there has been a gap in practical guidance for embedding, mainstreaming or systematising (referred to collectively as 'embedding') climate risk planning into council business. In recognition of this gap, ACELG in consultation with key stakeholders determined that a guidance manual that includes real-life practical examples of embedding activities would enable a 'step change' in how climate risk is being addressed within local government.	http://www.uts.edu.au/research-and-teaching/our-research/centre-local-government/news/national-climate-adaption-resource
SimCLIM	Data & Information portal	CLIMSystems	SimCLIM is a software tool designed to facilitate the assessment of risks from climate change for sustainability officers, consultants, policy makers, academics, non-governmental and governmental organisations and students	http://www.climsystems.com/products/
National Land Use Planning Guidelines for Disaster Resilient Communities	Process Guidance	Planning Institute of Australia	Provide the context, process frameworks and tools for how to integrate natural hazard risk reduction and resilience into land use planning practice	https://www.planning.org.au/policy/national-land-use-planning-guidelines-for-disaster-resilient-communities-2
WSAA Climate Change Adaptation Guidelines	Process Guidance	Water Service Association of Australia (WASAA)	These guidelines are designed to assist water utilities with all stages of the adaptation process, from initial appreciation of the issues, through to the implementation and monitoring of response actions. Importantly, they also consider inter-dependencies with other utility sectors, such as energy and telecommunications providers.	https://www.wsa.asn.au/news-now-available-wsaa-climate-change-adaptation-guidelines
Community Resilience Guideline for Developers	Process Guidance	Green Cross Australia	This guideline is designed to assist developers increase the resilience of master planned communities against severe weather. It can be used as a resource for applying for the Green Building Council of Australia's (GBCA) Green Star - Communities rating tool credit - GOV- 6 Adaptation and Resilience.	https://www.greencrossaustralia.org/media/9921293/community%20resilience%20guideline%20v7.pdf
Model Code of Practice: Principles of Climate Change Adaptation for Engineers	Process Guidance	World Federation of Engineering Organizations	Provides further amplification and explanation to engineers and national engineering organisations to interpret and implement principles of climate change adaptation at a practical level. It is intended for practicing engineers who are members of one or more of the national organisations who are members of the World	http://www.wfeo.org/climatechangeadaptation/

Built Environment and Industry Sector Adaptation Plan

Name	Type (Process/Tool/Information portal)	Developer	Description	Information
			Federation of Engineering Organizations (WFEO). The Model Code of Practice has been prepared as a complement to the WFEO Model Code of Ethics for Engineers and the Model Code of Practice for Sustainable Development and Environmental Stewardship.	
AS 5334: 2013 Climate Change Adaptation for settlements and infrastructure - a risk based approach	Standard	Standards Australia	Provides principles and generic guidelines on the management of the risks that settlements and infrastructure face from the impacts of climate change. In particular, it describes a systematic approach to planning the adaptation of settlements and infrastructure based on the risk management process given in AS/NZS ISO 31000:2009.	http://infostore.saiglobal.com/store/details.aspx?ProductID=1631218
ISO 14001:2015 Environmental Management Systems (EMS)	Standard	International Organization for Standardization	Maps out a framework that a company or organisation can follow to set up an effective environmental management system.	https://www.iso.org/iso-14001-environmental-management.html
ISO 31000:2009 Risk Management - Principles and Guidelines	Standard	International Organization for Standardization	Provides principles, framework and a process for managing risk.	https://www.iso.org/iso-31000-risk-management.html

Appendix D: Industry and Government Initiatives

Industry and government initiatives identified by survey participants.

Initiative	Description	Information Link
100 Resilient Cities Program	100RC supports the adoption and incorporation of a view of resilience that includes not just the shocks—earthquakes, fires, floods, etc.—but also the stresses that weaken the fabric of a city on a day to day or cyclical basis	http://www.100resilientcities.org
Green Cross Australia	A business community of practice that works with Green Cross Australia to support learning, build capacity and promote and recognise best practice in climate change adaptation across industry sectors. BAN creates value that transcends business boundaries, working with a practical, non-advocacy model able to engage government and research stakeholders with aligned aims.	https://www.greencrossaustralia.org
Australian Sustainable Built Environment Council	Peak body of key organisations committed to a sustainable, productive, resilient built environment in Australia.	http://www.asbec.asn.au
South Australia Climate Change Strategy	South Australian State Government initiative to introduce, and drive, the adoption of sustainable practices in the Australian property industry. In 2003 they launched their Green Star environmental rating system for buildings.	https://www.environment.sa.gov.au/Science/Science_research/climate-change/climate-change-initiatives-in-south-australia/sa-climate-change-strategy
Victoria's Climate Change Framework	Victorian State Government initiative that includes Adaptation Plan 2017-2020 that, amongst other things, incorporates preparation of sector adaptation plans.	http://www.delwp.vic.gov.au/_data/assets/pdf_file/0011/369929/Victoria-Climate-Change-Adaptation-Plan-2017-2020.pdf
Green Building Council of Australia	Not-for-profit member based organisation promoting green building programs, technologies, design practice and operations.	http://new.gbca.org.au
Adapt NSW	New South Wales Government initiative that includes an adaptation component.	http://climatechange.environment.nsw.gov.au/About-climate-change-in-NSW/NSW-Government-action-on-climate-change
CoastAdapt	CoastAdapt is a decision support system tailored to those with an interest in Australia's coast, the risks it faces from climate change and sea-level rise, and what can be done to respond to those risks. It is administered by the National Climate Change Adaptation Research Facility (NCCARF).	https://coastadapt.com.au/
QCoast2100	QCoast ₂₁₀₀ will provide the funding, tools and technical support to enable all Queensland coastal local governments to progress the preparation of plans and strategies to address climate change related coastal hazard risks over the long-term.	http://www.qcoast2100.com.au

Appendix E: Sector Adaptation Plan Core Concepts

Based on a detailed review of sector-based adaptation plans and programs, the University of Queensland’s Global Change Institute identified ten core components integral to the development of an effective sector adaptation plan (Figure below).

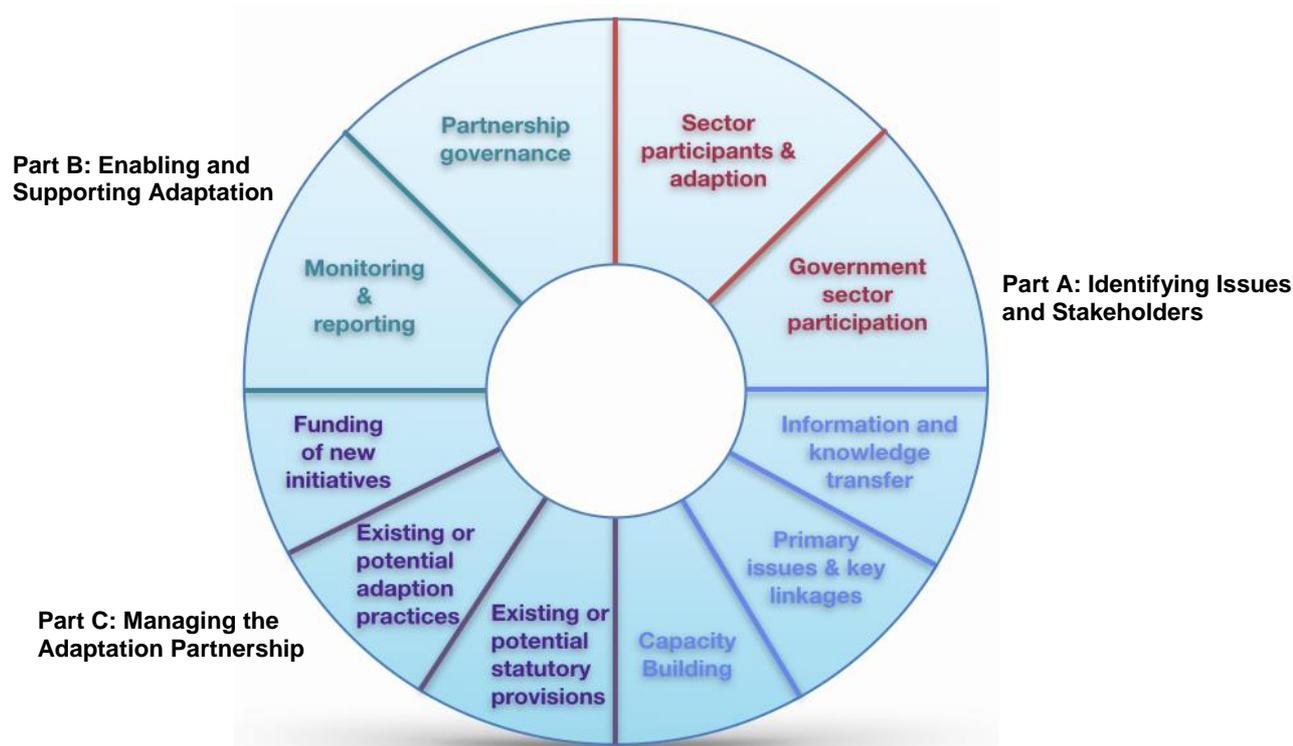


Figure. Sector adaptation plan core components identified by the Global Change Institute

The composition of each component is provided in the below table.

Core Component	Requirements
Sector participants & adaptation	<p>Specify which industry sectors, organisations and individuals will be actively involved, and which others might be consulted.</p> <p>Define the objectives of this industry – government ‘sector adaptation plan’</p> <p>For the defined industry sectors included in this plan, define what constitutes successful ‘adaptation’ and the key desired outcomes.</p>
Government Agency Participation	<p>Identify which state government agencies (and key contacts) are, or need to be, engaged in planning and implementing adaptation responses with the industry sectors included in this plan.</p> <p>Highlight how their resources can be used effectively to maximise their positive contribution</p>
Information availability and knowledge transfer	<p>Identify the specific climate change information that is available to the sector (e.g. likely climate risks, vulnerabilities and impacts according to region and industry sub-sector).</p> <p>What additional data, information and tools are required to facilitate successful adaptation?</p> <p>Define how this information will be developed into a usable form, by whom, and what methods are most appropriate for dissemination to industry stakeholders.</p>
Primary adaptation issues (and key linkages)	<p>Define the principal issues and management practices in the sector that have been / are likely to be affected by climate change.</p> <p>Identify and prioritise the key points of integration and linkages with other sectors that</p>

Core Component	Requirements
	<p>will be important to develop or maintain.</p> <p>How will integration be achieved? For example, will cross-sectoral working committees be required or will an iterative evaluation and review process be sufficient?</p>
Sector & government capacity building (creating acceptance)	<p>Develop methods to define the sector's capacity to respond to the challenge of adaptation (including existing levels of understanding and acceptance for adaptation planning and responses).</p> <p>Prioritise the development of sector-specific information and engagement programs.</p>
Existing & proposed adaptation practices	<p>Identify what, where or who represents 'best adaptation practice' in the sector (which knowledge and insights can be used).</p> <p>Identify and prioritise which existing industry guidelines or codes of practice could be modified to incorporate this 'best adaptation practice' knowledge.</p>
Existing or potential statutory provisions	<p>Identify the most relevant statutory, regulatory or policy provisions that guide or govern adaptation responses in the sector. Are these currently being used and to what effect (enabling or hindering)?</p> <p>Do any of these need to be amended to remove potential barriers or to facilitate more effective adaptation?</p>
Funding for new adaptation initiatives	<p>Develop the principles for funding adaptation initiatives in this sector, outlining the potential roles of industry, government, research bodies and other organisations.</p> <p>What specific funding would be required for implementing new measures defined in the partnership plan?</p> <p>Identify potential funding sources and develop options for what a sustainable funding model in this sector would look like.</p> <p>Seek out innovative funding mechanisms that involve community, industry and government collaborating to achieve funding for specific outcomes.</p>
Monitoring and reporting	<p>Define a simple, regular and transparent monitoring and reporting program, including qualitative and quantitative metrics and specific reporting on sector-specific adaptation responses.</p>
Partnership governance (of the industry sector – government partnership arrangement)	<p>Clearly identify how this industry – government partnership will be managed (e.g. structure, formality of partnership meetings, frequency, resolution processes, review period for the strategy / plan etc.).</p> <p>Consider whether an independent, industry-specific, scientific advisory committee would be useful.</p>

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