



INVESTING IN RESILIENCE

Tools and
frameworks for
managing physical
climate risk



Investor Group on
Climate Change



The Investor Group on Climate Change (IGCC) is a collaboration of Australian and New Zealand institutional investors and advisors, managing over \$2 trillion in assets under management and focusing on the impact that climate change has on the financial value of investments. IGCC aims to encourage government policies and investment practices that address the risks and opportunities of climate change. www.igcc.org.au

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FOREWORD

The effects of climate change are already being felt in Australia. Science tells us that, even if all of the commitments currently set under the Paris Agreement are implemented, the world is still on track for average global warming of over 2.6 degrees Celsius. This means more extreme weather, heat waves, flooding and increased certainty around the need to understand and manage for the future.

This guide provides a snapshot of the tools and frameworks emerging to help investors assess and manage physical climate risk at both the portfolio and the asset level. It lays out some of the key concepts, issues and challenges associated with adaptation and provides a snapshot of emerging resources to help manage for resilience.

It forms part of a series of guides that the Investor Group on Climate Change has developed in recent years to assess key climate risks across major industry sectors and identify means of investing in adaptation. It has been shaped and framed by investors and the finance community to accelerate the management of resilience across the Australian economy.

Climate change is increasingly recognised as a financial risk for investors, requiring the same levels of governance, oversight and active management as any other dimension of material financial performance. These risks include both the financial costs and opportunities presented by transitioning to a net zero carbon economy, and the physical effects of climate change itself.

The emergence of frameworks such as the Taskforce on Climate-related Financial Disclosures (TCFD) provide a means of measuring and understanding climate change in accounting and market disclosure. While financial and corporate regulators in all jurisdictions are increasingly assessing companies and investors on their strategic management of climate change risks. Climate risk as litigation risk is now a clear and present danger for those companies who fail to act and invest in the resilience of their business.

Climate science is undoubtedly complex, but sophisticated tools are rapidly emerging. This guide aims to accelerate progress to strengthen the resilience of our infrastructure, our economy and our community to the physical effects of climate change.

Emma Herd
CEO, IGCC

INTRODUCTION

There is increasing demand from investors and prudential and corporate regulators for companies and other financial entities within Australia to disclose their level of financial exposure to physical risks related to climate change. Directors and those charged with governance can be in no doubt that prudent investors will be seeking to understand how they will manage and minimise the impact to their investment, as well as seeking new opportunities. The ability of a company and its overall business system (e.g. capital base, assets, market, employees and supply chain) to withstand impacts and to recover is defined as its climate resilience.

For an investor, the challenge of understanding the nature and extent of climate resilience is not confined to just individual companies or specific physical assets but the measure of resilience across their entire portfolio. This brings advantages (diversification of risks) but also disadvantages (analytical complexity). It should be noted that despite decades of scientific endeavours and global policy development focused on climate change, in many ways for investors, Australian companies and asset owners, their journey has only just begun.

The purpose of this document is to provide a short and handy reference for investors on the basic concepts of climate resilience and to signpost a number of tools and resources relating to its management.

Section 1 outlines the core concepts of climate resilience; Section 2 describes the two different views of climate resilience that investors require: the first an overall / portfolio wide view and the second a location / asset specific view. Both views are important and provide investors with different options to manage climate resilience. Section 3 presents a table of tools and resources that can assist investors to manage climate resilience. Section 4 concludes with a short discussion on the challenges for investors and suggested next steps.

This work grew out of a stream of work that IGCC has had underway for a number of years, looking at physical risks for key industry sectors and approaches for increasing the deployment of capital into adaptation solutions.¹ Mapping the landscape of emerging tools and resources for managing climate resilience was a logical next step in the investor journey. This was undertaken in a workshop, co-hosted with NAB in June 2018, that forms the basis of many insights gathered together in this guide.

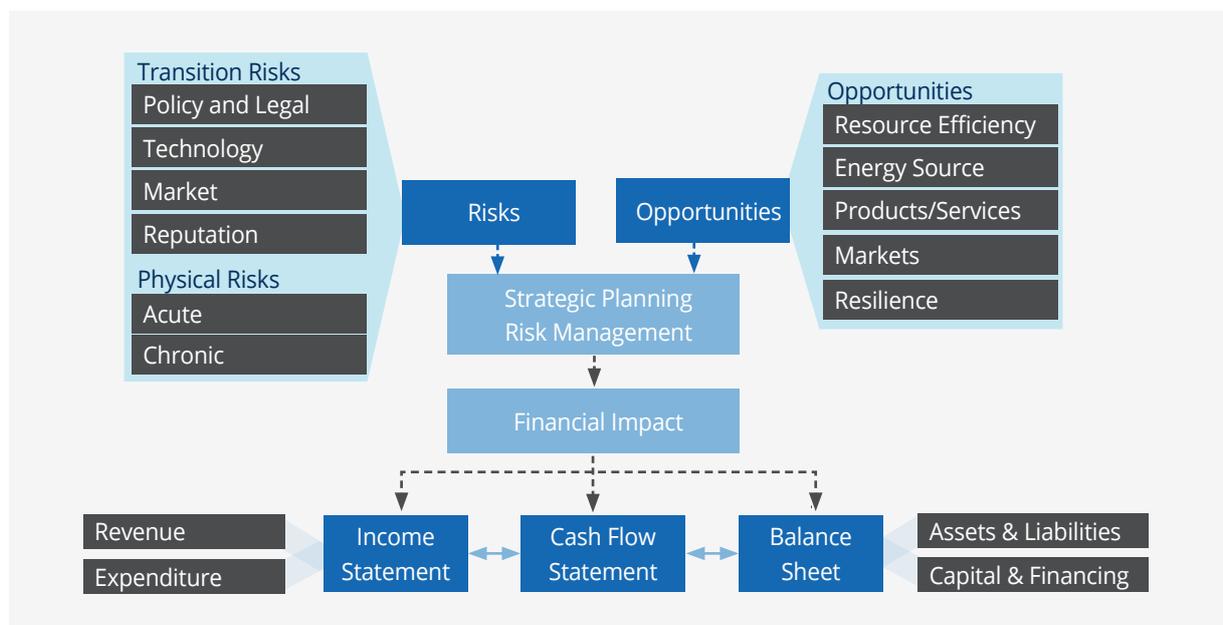
A key theme that runs throughout this document is that all practitioners should know their data in detail and ensure that they are comfortable with its relevance, quality, consistency and transparency. Climate science is a very complex discipline and provides detailed probabilistic data. There needs to be a clear and demonstrable link between the decisions investors make to manage climate resilience (including taking no action) and the underlying data and information that supports that decision.

Task Force on Climate-related Financial Disclosures – TCFD

In June 2017 the Task Force on Climate-related Financial Disclosures released a set of recommendations with accompanying guidance on how companies could prepare climate related financial disclosures. Specific guidance was also released for a number of sectors, including for asset owners and asset managers, and on the use of scenario analysis in the disclosure process. This covers both *transition* and *physical risks* (defined as both *acute* (extreme events) and *chronic* (trends)).

The recommendations act as a key driver for investors to manage climate resilience and to incorporate scenario analysis into that process. It provides key context for the financial materiality of climate change and the need for investors to manage resilience.

The overall TCFD framework is shown below.



Source: Task Force on Climate-related Financial Disclosures. www.ssb-tcfd.org

1. MANAGING CLIMATE RESILIENCE - KEY CONCEPTS AND ISSUES

1.1. Adaptation is what you do, resilient is what you are

Climate resilience describes the nature and extent of an overall system's ability to withstand the physical impacts from a changing climate. The system-based concept is important as it differentiates resilience from the more action centred notion of climate adaptation, which encompasses the decisions, process changes and actions that are taken to manage the physical impacts of climate change.

1.2. Climate is what you expect, weather is what you get

The term "climate change" is often misused in everyday discussion. Climate and weather are not the same thing; they are differentiated by timescale. Climate refers to the behaviour of the atmosphere (coupled with oceans, ice, and land) over relatively long periods of time (usually decades). Weather is the behaviour of the atmosphere in the short term (minutes to months).² Climate change refers to the way that the daily weather (rainfall, air temperature etc.) or rather its statistical distribution (minimum, mean, maximum etc.) change over time. Climate change is a science or probability and "statistical uncertainty" is part of its makeup. This is not a problem to be avoided; it is part of the challenge of managing climate resilience.

1.3. Climate change impacts – here, there and everywhere (and now)

The climate for any given location on Earth is the fundamental determinant of the physical environment (geomorphology and hydrology) and ecosystem that will be found there. Change the climate a bit and you will change the ecosystem; change the climate a lot (particularly the intensity, frequency and duration of extreme weather events) and you will change the geomorphology / hydrology (rivers, flood plains, coastal processes etc.). These impacts are highly location and system specific. Consequently, the management of resilience has to be done on the same basis.

A location based point of failure for a system of 15 coal mines could be a single railway bridge that was not designed for future (or even current) levels of repeated flooding. A time based point of failure for a large retail or warehouse facility could be a single hail event within a heavy rainstorm that blocks roof drainage causing the building to collapse. A portfolio wide point of failure for an investor could occur due to the low level of climate resilience of an entire nation state or multi-state region. This would be characterised by a lack of belief and investment in underlying climate science and a weak approach to embedding climate adaptation into regulation and planning.

1.4. Extreme climate events – super storms, heatwaves and system breakers

The current practice of managing climate resilience significantly underrepresents the impact of extreme climate events. The large-scale changes in global atmospheric and ocean circulation patterns could create local climates that will be very different to today's. These locations could experience patterns of extremes that are significantly different to anything in the historical record. Recent heatwaves in NSW are thought to fall into this category: the changes observed were too large to be attributed to the historic climate. They were something new.

This “knowledge/ skill gap” is a critical issue and, if not adequately addressed, could leave investors with an incomplete view of the level of risks at both an asset and portfolio level. This situation has come about for a number of reasons.

Firstly, much of the easily accessible information on climate change available to practitioners from the corporate sector comes from sources originally designed to tackle global level policy questions. The 40+ Global Climate Models (GCMs) designed by leading climate research organisations around the world, were never designed to provide location specific, granular information on the intensity, duration and frequency of extreme climate events, or the “application ready” data sets of future weather predictions required by the land and agriculture models needed to manage climate resilience. The climate change projections associated with four emission scenarios known as Representative Concentration Pathways (RCPs) from the 2013 IPCC Fifth Assessment Report (AR5) are based on GCMs that run on a spatial grids of around 200 x 200 km. This is too coarse a scale to model many location specific, extreme climate events, and results in data sets where up to 90% of the information on “true” population of extremes is absent. Using these data sets for risk assessments would result in a suboptimal assessment of risk and an incomplete level of disclosure.

The latest generation of climate change information includes such things as detailed reanalysis of recent weather records, complex simulations of “future extreme weather” and regional and local scale downscaling. However, it should be noted that a rough estimate indicates that even these data sets only express about 50% of the true population of future extreme climate events.

Secondly, the information that could provide a significantly better (but by no means complete) understanding of extreme climate events is detailed and complicated. And accessing it requires a skill set that does not generally sit in the mainstream finance and corporate sector. The finance sector has not (yet) invested anything close to the time, budget and resources required to appropriately manage climate resilience.

1.5. Attribution – climate science goes to court

Increasingly, a key issue for investors who may suffer financial loss due to the impact of climate change on a specific asset or across a broader portfolio, is likely to be judgements concerning whether the event was foreseeable and whether asset managers could have taken action to prevent the loss.

Both a leading legal opinion³, and the enforcement positions of regulators including Australian Prudential Regulatory Authority (APRA) and Australian Securities and Investment Commission (ASIC), have made clear that the physical and economic transition risks associated with climate change present foreseeable financial risks that should be governed by Directors in the same way as any other financial risk issue. A robust process of due care and diligence must be applied – one that requires Directors to proactively ensure that they have current, adequate information on potential impacts (including reports from qualified management or experts where warranted), which must be critically evaluated.

A cursory or presumptive approach to physical risk management is unlikely to provide a robust defence – particularly in those industries with significant exposures.

A key development in the last few years that may support a future legal challenge is the emergence of a branch of climate research called “climate change attribution”. We are observing weather records being broken all across the globe, heaviest rainfall, longest, hottest heatwaves and everything in between. The science of attribution is more reliably able to prove that human induced climate change has significantly contributed to these events. For investors the key point here is that the climate is already changing at an increased rate and that risk management models based upon historical records (as almost all are) are becoming less relevant with each passing year.



2. CLIMATE RESILIENCE - TWO POINTS OF VIEW

The tools and resources discussed in this guide are in use by investors today. Some are only accessible on a commercial basis or through direct contact with the research team, others are open source. They are being applied through both a top down / portfolio wide perspective and/or at the asset level.

2.1 A market view - top down - portfolio wide

A “market view” of climate resilience for an investment portfolio is a measure of the level of aggregated exposure across a range of different asset classes. The scope of this assessment includes aspects such as where and to what degree climate related risks sit in sector supply chains, the level of diversification of assets in the investment portfolio and a consideration of the asset’s adaptation capability when compared to high level climate risks and impacts (e.g. water availability, coastal flooding or the degradation of eco-systems).

This approach is efficient in dealing with large amounts of data and useful in its ability to encompass interdependencies across sectors and supply chains. It is capable of providing investors with a high level view of portfolio risks and qualitative information that allows relative comparisons of climate resilience. It greatly reduces the need for investors to engage with complex underlying science. This approach to managing climate resilience would not be suitable for providing understanding of the specific types of impacts (trends + tipping points vs extreme events) or for assessing and managing adaptation options at an asset level.

2.2 An operational view – bottom up – location specific

An operational view of climate resilience would apply to a specific asset such as an airport, harbour, or mineral / fossil-fuel resource cluster. It is a measure of the vulnerability to the physical climate impacts, both acute and chronic, and the ability of asset operators to identify and mitigate those impacts. A key feature of climate related physical risks is that they are highly location specific and the mechanism by which impacts occur can only be fully understood through detailed asset specific assessments. The strength of this approach is that it can provide investors with a detailed understanding of resilience at a quantitative level and if required, information on adaptation costs and opportunities for climate investment. It also allows investors to understand the resilience of the asset under various climate scenarios. This asset level view is of particular relevance to investors with a significant portfolio of unlisted real assets (i.e. Infrastructure).

Delegates at the IGCC / NAB *Investing in Resilience Workshop* held in Sydney on the 6th June 2018 were provided with a number of examples of both open source and commercial tools. Some of the tools presented in section 3 deliver aggregate and asset level information for asset classes such as infrastructure, commercial property and large corporate entities. Other tools deliver data such as climate projections, scenario projections and detailed geospatial tools and information appropriate for managing resilience at an asset level.

3. TOOLS AND RESOURCES

This section provides an overview of a number of tools and resources that can assist investors to manage the challenges of climate resilience within mainland Australia. There is already a very large and rapidly expanding cannon of reference material and this document can only provide a snapshot of current tools and resources most relevant to investors and their needs, given the level of skills, budgets and resources available to them (at present). These tools and resources provide investors with a number of options, ranging from published guides such as AECOM's ⁴ *Becoming Climate Resilient* and *The Future of Infrastructure*, through to tools based upon self-reporting and ranking such as GRESB ⁵ and ISCA's ⁶ rating, to the capabilities on asset and portfolio level cost analysis seen in the tools developed by ClimateRisk and DWS.

The tools and resources listed in the table below are very versatile and can be selected to provide investors with both a top down - portfolio wide view or a bottom up - location specific view of climate resilience including where relevant, data on vulnerability (exposure, sensitivity and adaptive capacity), emission scenarios and climate projections.

A number of useful decision making frameworks and portfolio level analysis tools have also been developed by commercial providers, such as Deloitte or AECOM for example. While not specifically detailed here, it should be acknowledged that they are also being adopted by investors and by property and infrastructure companies for managing resilience.



TABLE1: TOOLS AND RESOURCES TO MANAGE CLIMATE RESILIENCE

KEY:					
ASSESSMENT LEVEL:	Portfolio 	Asset 			
ACCESS:	Open source 	Propriety 			
TYPE:	Climate data focus 	Impact data focus 	Rating based 		
	Geo-spatial focus 	Finance focus 			

	Name and details	Suggested application area and example	A/Level	Access	Type
AGRI - LAND USE	<p>Australian Bureau of Agricultural and Resource Economics and Sciences⁷</p> <p>The ABARES tool provides access to detailed land use data at a catchment scale. The classifications cover the major agriculture and forestry uses based upon satellite imagery and other land use information (last update Sept 2017).</p>	<p><i>Due diligence and equity</i></p> <p>The extensive datasets on land use are a powerful resource that can be utilised to conduct assessments of the vulnerability of areas and sectors dependent upon agricultural production. The land use data can be used in conjunction with data on climate change and future water availability and biophysical models for specific crops to assess the future vulnerability of food supply and specific commodities in the supply chain.</p>	 		 

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">AREA WIDE FLOODING</p>	<p>Australian Rainfall and Runoff (ARR), Engineers Australia⁸</p> <p>The ARR is a national guideline document, data and software suite that can be used for the estimation of design flood characteristics in Australia. Geoscience Australia supports ARR as part of its role to provide authoritative, independent information and advice to the Australian Government and other stakeholders to support risk mitigation and community resilience.</p>	<p><i>Property, infrastructure, due diligence</i></p> <p>The ARR information portal is a good resource for assessing the vulnerability of areas to flooding. The user is able to input latitude and longitude and obtain Intensity, Frequency and Duration (IFD) design rainfall depth (mm) for durations ranging from 1 minute to 168 hours, and Annual Exceedance Probability (AEP) ranging from 1% to 63.2%. Datasets are derived for the selected location from values at the nearest grid point on the 0.025° grid. Climate change is addressed through the use of simple uplift values for increased rainfall for RCP4.5, RCP6.0, and RCP8.5 for 10-year intervals from 2030 to 2090 inclusive.</p>			  
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">AUSTRALIA WIDE – HISTORICAL DATA</p>	<p>The Bureau of Meteorology (BoM) Observational Data</p> <p>The BoM web portal is Australia’s top tier information system on historical data and most types of extreme weather events. The two specific areas of the web portal are:</p> <p>Australian Climate and Weather Extremes Monitoring System⁹ and Climate Change Tracker¹⁰</p> <p>The BoM web portal provides access to extensive historical data for any location in Australia. Users can access maps and trends in extremes, including 18 temperature-related extremes (e.g. trend in number of very hot days) and 11 rainfall-related extremes (e.g. trend in number of heavy rain days).</p>	<p><i>Property, infrastructure, due diligence</i></p> <p>Many users will find the historical data accessible on the BoM web portal a good starting point for building up their understanding of asset’s vulnerability before progressing to the probabilistically based climate projections. The extensive data allows for practitioners to understand how systems have responded to recent events and changes. This type of information forms the baseline and provides a useful framework upon which to base scenario analysis. The users need to understand that historical data will become increasingly unrepresentative of future conditions the further it is extrapolated and that there could be future extreme events for which there is no incident in the historical record.</p>	 		

<p>COASTS / WAVES</p>	<p>CANUTE - The Sea Level Calculator¹¹</p> <p>The CANUTE tool includes the functionality for a wave setup and run up and a shoreline recession calculator. The web portal also provides links to case studies and relevant publications. It was originally developed using data from the GCMs associated with AR4 but was upgraded to work with AR5 RCP scenarios in Aug 2014.</p>	<p><i>Property, infrastructure, due diligence</i></p> <p>CANUTE takes the assessment of vulnerability one step further than CoastAdapt by allowing for the effects of waves. It also provides data on sea level rise expressed as exceedance probabilities. This has been shown to be particularly useful to sectors such as insurance and shoreline infrastructure.</p>			 
<p>GREEN INVESTING</p>	<p>Climate Bonds Initiative (CBI)¹²</p> <p>The Climate Bonds Initiative (CBI) is an important development in the overall global policy to direct capital towards climate adaptation in a focused and effective manner. The CBI, through its suite of standards and certification of debt instruments, provides investors with confidence that the funds invested are used in climate resilient projects.</p>	<p><i>Debt, due diligence</i></p> <p>The CBI standards address physical climate resilience within components of certain sector guidance (for example, Water Infrastructure). The standards do not have a separate sector or category itself on physical climate resilience.</p>			

<p>AUSTRALIA WIDE PROJECTIONS AND HISTORICAL DATA</p>	<p>Climate Change in Australia (CCIA)¹³</p> <p>CCIA is Australia’s top tier information system on climate change and most types of extreme climate events. It includes both projections on the four emission scenarios (RCPs) from the 2013 IPCC Fifth Assessment Report (AR5) out to 2100 and historical re-analysis.</p> <p>It is free to access and specific to the Australian mainland and Tasmania.</p> <p>It has deep and extensive read-only content (50+ pages), encompassing training and guidance.</p> <p>The underlying datasets are built upon a suite of 8 GCMs used in the IPCC AR5 report that have been selected for their “skill” on the Australian climate. One of the key features of CCIA is that it was designed to provide “application ready” synthetic future data that can be input directly in a number of important agricultural productivity tools such as Agricultural Production Systems sIMulator (APSIM).</p>	<p><i>Property, infrastructure, equity, debt, due diligence</i></p> <p>CCIA is arguably the most accessible and functional data portal currently in Australia. It allows users to scope and build bespoke datasets of the future climate variables for any location in Australia out to 2100.</p> <p>It provides functionality to build the best/ worst-case climate futures based upon knowledge of the vulnerabilities of the asset / system in question.</p> <p>The projections builder tool prevents users mixing up climate models and creating datasets that do not actually represent reality.</p> <p>Users can set up climate trigger levels such as maximum temperature - the annual number of days over 40°C can be calculated for over 400 sites for different combinations of years, emissions and GCMs.</p> <p>Other features include the ability to visualise and download datasets using the Extremes Data Explorer, Thresholds Calculator, Map Explorer Tool Gridded Data and Station Data Download Tools (require registration through CCIA website), and the Marine Explorer Tool.</p>	<p>✦ ▲</p>	<p>📖</p>	<p>☀️ 📍</p>
<p>ORGANISATION WIDE RISK MANAGEMENT</p>	<p>Climate Risk Information and Services Platform (CRISP)¹⁴</p> <p>CRISP is a web-based platform that integrates open source, public geospatial, economic and climate data with a decision / management project methodology. CRISP is already in use by a number of Commonwealth Government entities.</p>	<p><i>Property, infrastructure, due diligence</i></p> <p>CRISP is designed to be a customisable platform and could be adopted by investors wanting to develop a detailed approach to managing climate resilience across their entire portfolio. The CRISP approach was integrated into the Infrastructure Australia Assessment Framework released in March 2018 ¹⁵.</p>	<p>✦ ▲</p>	<p>🔒</p>	<p>⚙️ 💰</p>

<p>AN ADAPTATION COST TOOL FOR INFRASTRUCTURE</p>	<p>Climate Risk – XDI¹⁶</p> <p>The company Climate Risk provide investors with two tools, AdaptInfrastructure and XDIGlobe, on a commercial basis. The tools are able to provide detailed physical and financial risk projections (out as far as 100 years) including the cost benefit analysis of adaptation pathways.</p>	<p><i>Property, infrastructure, equity, due diligence</i></p> <p>Climate Risk’s suite of tools is based upon detailed climate projections and the possible impact of the changes such as sea level rise on infrastructure systems. The fact that the tools deal directly with financial aspects makes it a useful application for linking climate resilience to investors’ existing financial analysis.</p>			
<p>COASTS</p>	<p>Coast Adapt¹⁷</p> <p>Specifically designed with end users in mind Coast Adapt provides extensive and detailed information on the assessment of climate related coastal risks and examples of adaptation pathways.</p>	<p><i>Property, infrastructure, due diligence</i></p> <p>Coast Adapt is a key resource for any consideration of vulnerability of physical assets in coastal and estuarine locations. The shoreline explorer and sea level rise tools facilitate the initial assessment for climate impacts based upon the four IPCC RCP scenarios. The portal provides a link to a more powerful climate scenario tool “Coastal Risk Australia”¹⁸. It should be noted that Coast Adapt does not provide functionality for future changes in shoreline erosion caused by changes in wave direction.</p>			
<p>PHYSICAL RISK SCORING FOR COMPANIES</p>	<p>DWS and FourTwentySeven¹⁹</p> <p>DWS/427 provide a climate resilience rating service for investor organisations on a commercial basis. This service includes climate risk scores for listed securities and site-specific risk assessments.</p>	<p><i>Equity, debt, due diligence</i></p> <p>The DWS/427 approach is based upon the integration of economics, market analysis and geospatial data to provide a score of relative levels of climate resilience and transition risk exposure. The key feature of the approach is that it can deliver information at the level of an individual company and across the supply chain of vulnerable assets.</p>			

PROPERTY RATING	<p>Green Building Council of Australia (GBCA)²⁰</p> <p>Climate change resilience and adaptation was introduced for new buildings and precincts in Green Star – Design & As Built and Green Star – Communities in 2014.</p> <p>GBCA is in the process of testing a holistic resilience credit for existing buildings in the Green Star – Performance category.</p>	<p><i>Property, due diligence</i></p> <p>The aim of the ‘Asset Resilience’ Innovation Challenge is to encourage a holistic approach to improving the response of the asset to shocks and stresses as they affect the asset’s value, the business operations of organisations using it, the people occupying it, and provide opportunities to improve the community’s resilience.</p>	▲	🔒	 
PROPERTY & INFRASTRUCTURE RATING	<p>The Global ESG Benchmark for Real Assets, (GRESB)²¹</p> <p>GRESB are a commercially based global provider of Environmental, Social and Governance (ESG) ratings focused on property and infrastructure assets and portfolios. The first snapshot of global resilience practice and performance is scheduled for launch in September 2018.</p>	<p><i>Property, infrastructure, due diligence</i></p> <p>The ESG assessment is one of a number of self-reporting, best practice systems found in sustainability. It is applicable to investors seeking to understand the physical, economic and social resilience of portfolios and assets across the world.</p>	 ▲	🔒	 
INFRASTRUCTURE	<p>Infrastructure Sustainability Council of Australia (ISCA)²²</p> <p>ISCA are a non-profit organisation that run the IS Rating Scheme in Australia and New Zealand. The IS ratings are designed to evaluate aspect of sustainability across all stages of infrastructure projects. The ISV2.0 tool includes a category “resilience” in the “governance” section of the assessment framework.</p>	<p><i>Infrastructure, due diligence</i></p> <p>The IS Rating Scheme is applicable to investors seeking to understand the climate resilience of new infrastructure assets. The efficacy of this as a tool for managing climate resilience is driven by the fact that the “resilience” assessment category includes multiple climate related risks such as water availability and failure of critical infrastructure.</p>	▲	🔒	 

<p>MULTI HAZARD EXPOSURE</p>	<p>National Exposure Information System, (NEXIS), Geoscience Australia²³</p> <p>A comprehensive and nationally consistent information system on exposure to risk, produced by sourcing the best publicly available information, statistics, spatial and survey data about buildings, demographics, community infrastructure and agricultural commodities.</p>	<p><i>Property, infrastructure, due diligence</i></p> <p>This resource provides the starting point for any assessment of vulnerability of the built environment (domestic and commercial), of populations, institutions and agriculture. Covers bushfire, flooding, high winds and other natural disasters. Links to disaster resilience assessment tools and information.</p>	 		 
<p>ENERGY DEMAND</p>	<p>Nationwide House Energy Rating Scheme (NatHERS)²⁴ and</p> <p>Energy Made Easy – Energy Price comparison site²⁵</p> <p>These two web portals are part of Federal Government initiatives to provide price information to domestic energy consumers.</p>	<p><i>Property, due diligence</i></p> <p>The datasets on the web portals can be combined with data on future extreme heat events to assess the vulnerability of areas and population cohorts to the combined impacts of the increased intensity, frequency and duration of extreme heat events and high electricity prices. The reduced spending power of vulnerable households is an important factor in the local economy.</p>			 

<p>NWS AND ACT - AUSTRALIA EAST COAST</p>	<p>The NSW and ACT Regional Climate Modelling (NARcliM) Project ²⁶</p> <p>NARcliM is a detailed and sophisticated resource. It provides dynamically downscaled climate projections for southeast Australia at a horizontal resolution of ~10 km. This means that it has more useful local applicability than non-downscaled data. The domain includes NSW, ACT, Victoria, and parts of Queensland and South Australia. The downscaling provides for a much higher level of resolution than available from GCMs. The climate projections were developed using the GCMs available at the time of the IPCC 4th Assessment report (AR4) (2007) and use a single mid range emission scenario A2. This scenario has been superseded by the AR5 Relative Concentration Pathway (RCP) approach.</p>	<p><i>Property, infrastructure, equity, debt, due diligence</i></p> <p>A very useful feature of NARcliM is the ability to access multi-model, mean regional maps for the whole of NSW as well as separately for 10 regional areas, in JPEG and ASCII formats. The interactive maps enable the user to select the variables “temperature, hot days and cold nights, rainfall and severe Forest Fire Danger Index (FFDI)” in future time periods, and to select regions within NSW.</p> <p>NARcliM’s design is suited to more sophisticated end-users. A key feature is the ability to specify metadata and then download the data (file size range from Kb to Gb), both site-specific and gridded, for a wide range of variables of direct relevance to the downstream data tools used in agriculture, water catchment management. The relatively high resolution of the downscaled data (10 km) makes NARcliM very useful from a climate impacts perspective.</p>	 		 
<p>NATURAL HAZARD RISK AND PLANNING SPATIAL TOOL</p>	<p>UNHaRMED - University of Adelaide / BNHCRC ²⁷</p> <p>UNHaRMED is a sophisticated spatial mapping tool that can map changes in hazards through planning and economic development, developed as part of the Bushfire and Natural Hazard Cooperative Research Centre (BNHCRC).</p>	<p><i>Property, infrastructure, due diligence</i></p> <p>The UNHaRMED tool was designed for state planning and is used to model spatial maps of various climate risk indicators (e.g. average annual loss, people / floor space impacted, property damage) change over time in response to different climate scenarios on hazards (i.e. extreme heat, precipitation and coastal flood) and the impact of different economic and population change scenarios on exposure (i.e. land use and building stock). Adaptation measures can be modelled to allow a cost-benefit-assessment.</p>	 		  

4. THE CHALLENGES - NEXT STEPS

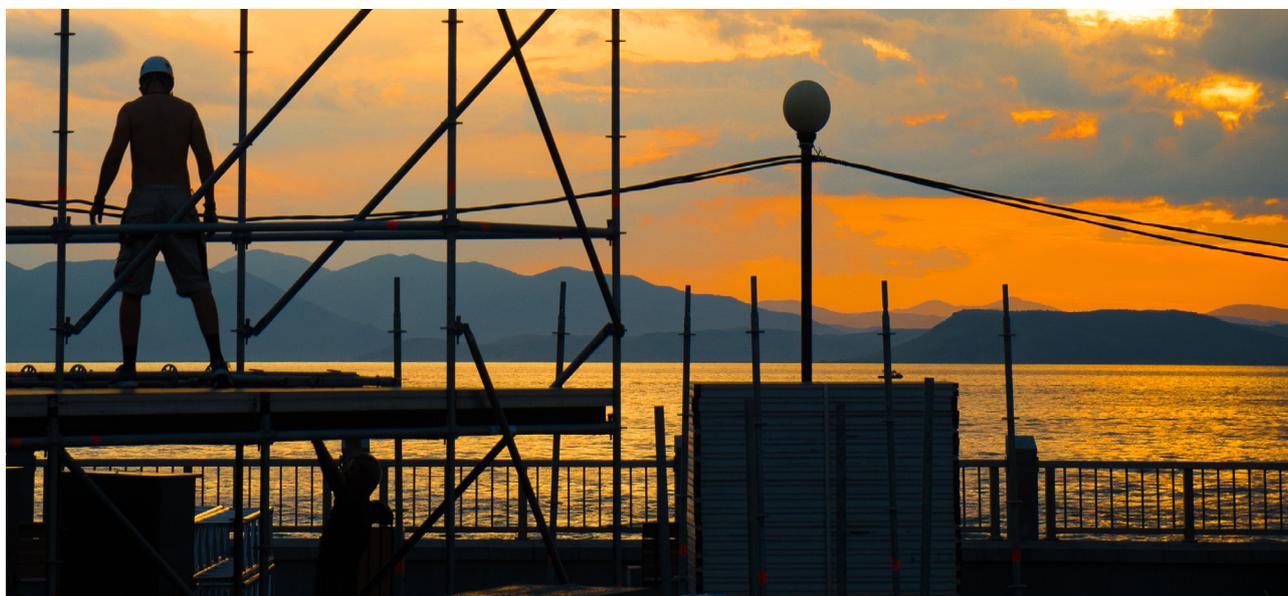
There is no doubt that this is a rapidly evolving area of commercial focus, while the development of new tools and resources to assist investors in managing resilience is accelerating.

The IGCC / NAB *Investing in Resilience Workshop* demonstrated a number of useful tools and resources that can assist investors in their engagement with climate resilience. However, the current situation also presents a number of challenges which investors must be alive to when managing resilience.

The first challenge is that the tools are very diverse and have very different levels of transparency when it comes to the origins of the underlying climate change data. In some cases the tools do not encompass climate data but leave it up to the user to disclose what they use. The level of investor expectation and regulatory oversight on climate related issues is increasing and issues of governance and transparency are key aspects. Investors who want to make use of these tools and resources should be cognisant of some of their current limitations. Scenarios used need to be informed by science and stress tests should encompass extreme events, including the likelihood of events on a scale that is greater than ever observed in the historical record.

The second challenge is ensuring that sufficient resources are being applied to manage climate resilience. These resources are not just budgetary, they also include the involvement of senior management and decision makers, the understanding of the skills and capabilities needed to work with complex and probabilistic data sets and, most importantly, permission. Investors should resource the management of climate resilience in a strategic, long term and effective way.

The final challenge is understanding the imperative for taking action now. The management of the financial risks associated with climate change has been identified as a critical issue in many areas of the global financial system. A number of different actors such as prudential regulators, credit rating agencies and market analysts are building up capabilities to integrate their understanding of the risks into their own operations. The ability to differentiate investment opportunities by climate risks will be a key financial metric within the next 3 - 5 years.





REFERENCES

1. Investor Group on Climate Change. *From Risk to Return: Investing in Climate Change Adaptation*. https://igcc.org.au/wp-content/uploads/2017/03/Adaptation_FINAL.pdf
2. NASA – *What's the Difference Between Weather and Climate*, https://www.nasa.gov/mission_pages/noaa-n/climate/climate_weather.html
3. Centre for Policy Development, *Directors duties and climate risk*, <https://cpd.org.au/2016/10/directorsduties/>
4. AECOM. <https://www.aecom.com/climate-resilience-framework-2/>
5. GRESB. <https://gresb.com>
6. Infrastructure Sustainability Council of Australia. <http://www.isca.org.au>
7. Australian Bureau of Agricultural and Resource Economics and Sciences. <http://www.agriculture.gov.au/abares/aclump/land-use/land-use-mapping>
8. Engineers Australia. *Australian Rainfall and Runoff (ARR)*, <http://arr.ga.gov.au>
9. Australian Climate and Weather Extremes Monitoring Service. <http://www.bom.gov.au/climate/extremes/>
10. Climate Change and Variability. <http://www.bom.gov.au/climate/change/#tabs=Tracker&tracker=timeseries>
11. CANUTE – The Sea Level Calculator. <http://www.sealevelrise.info/About%20Canute.php>
12. Climate Bonds Initiative. <https://www.climatebonds.net>
13. Climate Change in Australia. <https://www.climatechangeinaustralia.gov.au/en/>
14. Climate Risk Information and Services Platform. <http://www.crisp.csiro.au>
15. Infrastructure Australia, Assessment Framework. March 2018 <http://infrastructureaustralia.gov.au/policy-publications/publications/assessment-framework-ipl-inclusion.aspx>.
16. Climate Risk. <https://www.climaterisk.com.au>
17. Coast Adapt. <https://coastadapt.com.au/assess-risks-and-impacts>
18. Coastal Risk Australia. <http://coastalrisk.com.au>
19. DWS. <http://www.dws.com.au> and FourTwentySeven. <http://427mt.com>
20. Green Building Council of Australia. <https://new.gbca.org.au>
21. GRESB. <https://gresb.com>
22. Infrastructure Sustainability Council of Australia. <http://www.isca.org.au>
23. Geoscience Australia. *National Exposure Information System, (NEXIS)*, <http://www.ga.gov.au/scientific-topics/hazards/risk-and-impact/nexis>
24. Nationwide House Energy Rating Scheme, <http://www.nathers.gov.au/>
25. Energy Made Easy, Australian Government energy price comparison site. <https://www.energymadeeasy.gov.au/benchmark>
26. The NSW and ACT Regional Climate Modelling (NARClIM) Project. <http://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/About-NARClIM>
27. Bushfire and Natural Hazards Cooperative Research Centre. <https://www.bnhcrc.com.au>

