Climate Resilience Principles

A framework for assessing climate resilience investments

September 2019

With support from

The ROCKEFELLER FOUNDATION

Table of Contents

Acronyms

AREG	Adaptation and Resilience Expert Group
CBA	Cost Benefit Analysis
CBI	Climate Bonds Initiative
GCF	Green Climate Fund
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
LDC	Least Developed Countries
NAP	National Adaptation Plans
NDC	Nationally Determined Contributions
RCP	Representative Concentration Pathway
SDG	Sustainable Development Goals
TCFD	Task Force on Climate-related Financial Disclosures
TEG	European Union Technical Expert Group on Sustainable Finance
TWG	Climate Bonds Initiative's Sectoral Technical Working Groups
UNFCCC	United Nations Framework Convention on Climate Change

1 Authors and Contributors

This paper was prepared by the Climate Bonds Initiative, Climate Resilience Consulting (CRC) and World Resources Institute (WRI), based on input and advice from the Adaptation and Resilience Working Group (AREG).

- The Climate Bonds Initiative is an investor-focused, not-for-profit organisation working to mobilise debt capital markets for climate change solutions, to accelerate a global transition to a low-carbon and climate-resilient economy.
- CRC is a consulting firm that works with clients to provide practical strategies to enhance markets and communities through adaptation to climate change. CRC is an LLC with Women Owned Small Business, WBE, and B Corp certifications.
- WRI is a global research organisation working to move human society to live in ways that protect Earth's environment and its capacity to provide for the needs and aspirations of current and future generations. WRI's Finance Centre and Climate Resilience Practice work to strengthen investments in adaptation and resilience.
- The AREG is a group of experts convened by the Climate Bonds Initiative to develop the climate resilience principles.

The Climate Bonds Initiative wishes to thank all members of the Adaptation and Resilience Expert Group (AREG) for their contributions to this work. These members are listed overleaf. Particular thanks are given to Joyce Coffee and Sarah Dobie of Climate Resilience Consulting and June Choi of Climate Bonds Initiative for leading this work. Thanks are also given to Niranjali Amerasinghe for leading the engagement and contribution on behalf of WRI, and to those who reviewed drafts of this paper. These reviewers are also listed below.

Reviewers

Sergio Collaco de Carvalho	University of Oxford
Eric Glass	Alliance Bernstein
David Jenkins	National Australia Bank
Jacob Michaelsen	Nordea
Kevin Ranney	Sustainalytics
Puja Sawhney	EU SWITCH Asia SCP Facility
Robert White	Natixis

Further review was provided by the following WRI professionals: Nisha Krishnan, Giulia Christianson, Lauren Sidner, Leonardo Martinez-Diaz, Carlos Muñoz Piña, Andrew Wu, Nambi Appadurai, Todd Gartner, Michael Westphal, Gerard Pozzi, Arya Harson and Indira Masullo.

Climate Bonds Initiative Staff

Anna Creed	Head of Standards
Ujala Qadir	Climate Science Programme Manager
June Choi	Policy & Standards Advisor

AREG members

John Firth	Acclimatise
Xianfu Lu	Asian Development Bank
Christine Lafon	BNP Paribas
Neuni Farhad	C40 Cities Climate Leadership Group
Stacy Swann	Climate Finance Advisors
Federico Mazza	Climate Policy Initiative
Joyce Coffee with Sarah Dobie	Climate Resilience Consulting (Technical Lead)
Kevin Bush	District of Columbia
Carel Cronenberg	European Bank for Reconstruction and Development
Craig Davies	European Bank for Reconstruction and Development
Cinzia Losenno	European Investment Bank
Emilie Mazzacurati	Four Twenty Seven
Josh Sawislak	Four Twenty Seven
Yoon Kim	Four Twenty Seven
Nathanial Matthews	Global Resilience Partnership
Kevin Smith	Goldman Sachs
Swenja Surminski	Grantham Research Institute
Carmen Lacambra	Grupo Laera
Celeste Connors	Hawaii Green Growth
Vladimir Stenek	International Finance Corporation
Karoline Hallmeyer	KPMG
Jay Koh	Lightsmith Group
Brooks Preston	Macquarie
John Thieroff	Moody's
Aris Papadopoulos	Resilience Action Fund, UNDRR
Miroslav Petkov	S&P Global
Richard J.T. Klein	Stockholm Environment Institute
Peter Wheeler	The Nature Conservancy
Jenty Kirsh-Wood	UNDP
Carlos Sanchez	Willis Towers Watson
Michael Cote	Winrock International
Stephane Hallegatte	World Bank Group
Niranjali Amerasinghe	World Resources Institute
Karl Mallon	XDI

Executive Summary

Losses due to weather-related events have increased nearly ten-fold over the last 40 years, from a ten-year global average of USD 12 billion in 1980 to USD 119 billion today.1 To combat spiralling losses from climate impacts, an estimated USD 200 billion globally will be required annually within twenty years.2 The accelerated deployment of various sources of finance, including green bonds, is urgently needed.

To this end, in October 2018, the Climate Bonds Initiative (CBI) convened the Adaptation and Resilience Expert Group (AREG) to design a set of principles that would guide the integration of criteria for climate adaptation and resilience into the Climate Bonds Standard. The Climate Bonds Standard & Certification Scheme for green bonds was established in 2015 to provide guidance to issuers and provide assurance to investors on green bond credentials in a voluntary market. To date, 15% of all green bonds issued globally (by value) have been certified under the Climate Bonds Standard & Certification Scheme.

Until now, the Standard & Certification Scheme has focused primarily on greenhouse mitigation, and to be eligible for certification, a green bond's use of proceeds needs to meet the sector-specific greenhouse gas Mitigation Criteria. These Criteria screen for assets and projects compatible with a low-carbon trajectory necessary to meet the goals of the Paris Agreement. While the Standard includes Climate Resilience Criteria for some sectors, these have been developed by different groups of experts and therefore lack consistency across sectors.

Therefore, the AREG was tasked with advising on the types of climate adaptation and resilience investments that are needed. These are defined as investments that improve the ability of assets and systems to persist, adapt and/or transform in the face of climate-related stresses and shocks in a timely, efficient and fair manner that reduces risk, avoids maladaptation, unlocks development and creates benefits. And then, with a focus on resilience investments that might be financed via green bonds, the AREG was tasked with determining how any such proceeds might be screened to ensure that the underlying assets and activities are 'fit for purpose' in terms of addressing climate resilience and therefore could be considered eligible for certification under the Climate Bonds Standard & Certification Scheme. The Climate Resilience Principles ("the Principles") described in this document provide an overarching framework for this screening.

Subsequently, the Technical Working Groups convened by the Climate Bonds Initiative will develop sector-specific Climate Resilience Criteria in line with these Principles. Such sector-specific Criteria will be the primary reference for issuers of green bonds seeking certification.

Together, the Principles and sector-specific Criteria will support the mainstreaming of climate resilience considerations across all green bonds as well as improve transparency in the market for green bonds that aim to enhance resilience. It is also hoped that these Principles and the sector-specific Criteria can serve as a model for other identification and assessment schemes for climate resilient investments.

This document is therefore intended for a wide audience, including but not limited to bond issuers, investors and other stakeholders seeking guidance on:

- The potential range and type of climate resilience investments
- How to define and assess physical climate risks
- How to credibly demonstrate climate resilience outcomes

For these Principles, the focus has been on investments that address physical climate risks. This enables us to put a firmer boundary around the climate resilience risks that might be addressed and benefits that might be delivered through these investments for the purposes of providing guidance for bonds seeking certification under the Climate Bonds Standard. It is noted that addressing these physical climate risks will require not just investments in hard infrastructure, but also increased investment in 'soft' areas such as technologies, services, supply chain management, operations etc. that have a key role to play in enabling climate resilience in ecosystems, economies and societies.

In terms of the range of climate resilience investments, two types are identified, both of which are encouraged for inclusion in green bonds:

- **Asset-focused**: Where the intention is to maintain or enhance the resilience of an asset or activity to climate change, specifically to ensure that the asset or activity's performance is fit-for-purpose over its design lifespan.

1 SwissRe

2 Mott McDonald and Global Sustainability Institute, "Climate Change and Business Survival: The Need for Innovation in Delivering Climate Resilience," June 2015

In many cases, this will also contribute climate resilience benefits to the system in which the asset or activity is a part, depending on the type of product or service the asset or activity provides.
Examples of asset-focused investments include upgrading, replacing, or relocating infrastructure to reduce vulnerability to floods etc, use of drought resistant crops or training on and implementation of sustainable farming practices at individual farm level to maintain and enhance productive capability and incomes.

- **System-focused**: Where the intention is to deliver climate resilience benefits to the broader system (i.e. going beyond merely ensuring an asset's or activity's performance over its design lifespan). To be effective, such an asset or activity will also need to have a sufficient degree of resilience to climate change.
Examples of system-focused investments include the construction and operation of desalination plants, research into drought resistant crops, wild-brush clearing at landscape level, climate monitoring and data management technologies and services, and provision of healthcare services for the treatment of diseases that might increase due to climate change.

In layman's terms, the Principles provide a framework for Climate Resilience Criteria requiring Certified Climate Bond issuers to go beyond just assessing climate risks. Specifically, issuers must demonstrate that for the assets and activities (re)financed via the bond they:

- Understand the climate risks faced by the asset, activity or system in question;
- Have addressed those risks by undertaking risk-reduction measures and adopting flexible management plans that take account of inherent uncertainties around climate change, ensuring that the asset, activity or system is robust, flexible and fit-for-purpose in the face of that uncertainty;
- Can deliver resilience benefits over and above addressing identified risks (for system-focused investments); and
- Are undertaking regular (re)evaluation of the asset and/or system's climate resilience performance, adjusting to risk reduction measures over time as needed.

It is worth highlighting that the Principles, therefore, go beyond a requirement for robust analysis of climate risks, requiring that any residual risk remains at a tolerable level that ensures the underlying assets and/or activities are 'fit for purpose' in the face of the uncertainties associated with a changing climate. Guidance on how 'fit for purpose' might be interpreted is given in this document and will be further addressed by the Technical Working Groups through sector-specific Climate Resilience Criteria.

In the case of assets or activities that deliver substantial resilience benefits, the AREG has explored the possibility of a trade-off assessment that may justify a relaxation of the Mitigation Criteria. This may be warranted for assets or activities that address an exceptional climate risk—such as a desalination plant that helps avert a water shortage crisis but has an energy-intensive operation. Initial proposals for undertaking trade-off assessment between climate mitigation and climate resilience criteria are presented in this document. The Climate Bonds Initiative will consider further if and how such an assessment might be incorporated into the Climate Bonds Standard & Certification Scheme.

In the absence of agreed trade-off assessment methodology, it will be required that the underlying assets or activities being financed via a Certified Climate Bond will need to meet both the Climate Mitigation Criteria for assets and activities in that sector and are also robust, flexible and fit-for-purpose in the face of climate change uncertainty, per the Climate Resilience Criteria to be developed in accordance with these Principles.

The Climate Resilience Principles are divided into three parts, illustrated in Figure 1 and briefly summarized in Table 1.

Figure 1: Overview of the Climate Resilience Principles

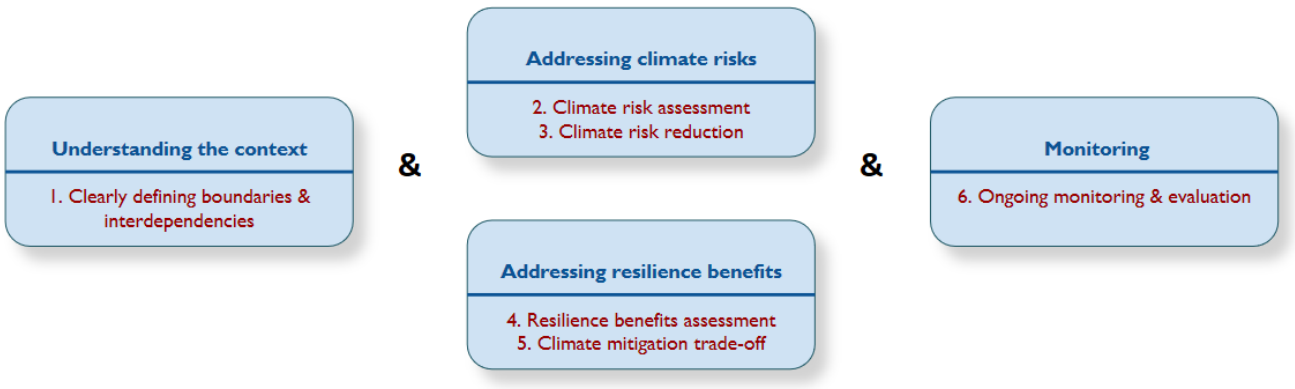


Table 1: CBI Climate Resilience Principles in brief

Principle	Brief Description
1. Boundaries and interdependencies for assessing climate risks and resilience impacts are clearly defined	Issuers must define the boundaries of the climate resilient investment and associated assets and activities, as well as the internal and external interdependencies between the broader system affected by those assets and activities. These boundaries and interdependencies are important for scoping risk and benefits assessments, and ensuring the asset or activity being invested in is fit-for-purpose and does no harm to the system of which it is part, per the further principles defined below.
2. Physical climate risk assessment undertaken	Issuers must perform an assessment of the physical climate hazards to which the subject asset or activity will be exposed and vulnerable over its operating life . Issuers should use both top down risk assessment methods using a broad range of climate models and observed data. RCP 4.5 and 8.5 emissions scenarios should guide these top down assessments. Bottom up risk assessment methods that look at inherent system vulnerabilities in local context should also be used.
3. Risk reduction measures undertaken	Issuers must demonstrate that the risks identified have been mitigated to a level such that the subject asset or activity is 'fit for purpose' in the face of coming climate change over its operational life, and does no significant harm to the resilience of the system of which it is a part. It is recognised that that there will be uncertainty about future climate change impacts, which influences on what it means to be 'fit for purpose'. Therefore, flexible solutions that are robust in a variety of scenarios are encouraged.
4. Climate resilience benefit assessment undertaken	Issuers are to assess the climate resilience benefits of system-focussed assets and activities and demonstrate that they are 'fit for purpose' in the sense that they significantly contribute to enhancing climate resilience at a systemic level, again with flexibility to take into account the inherent uncertainty around future climate change impacts.
5. Mitigation trade-offs	Climate mitigation requirements may be lowered for climate resilience focused assets or activities whose resilience benefits considerably outweigh associated emissions or serve to avoid GHG emissions in the event of a disaster. In these instances, a trade-off analysis is required. Discussion is ongoing as to a rule set to determine under what circumstances such a trade-off might be permitted and the nature of the trade-off analysis in the circumstance. In every case, the asset or activity must not lock in fossil fuels or undermine any international or national commitments.
6. Ongoing monitoring and evaluation	Issuers are required to undertake ongoing monitoring of climate risks and benefits to determine whether the subject assets and activities continue to be fit for purpose and maintain any climate resilience benefits as climate risks evolve. In its reporting to the Climate Bonds Initiative, the issuer must annually verify this ongoing monitoring and evaluation of the climate resilience performance.

Like all Criteria under the Climate Bonds Standard, these Climate Resilience Principles and the resulting Criteria will be reviewed and updated on a regular basis. It is expected that they will continue to be refined as tools and modelling technologies for assessing climate risks as they evolve, and as we gain access to better data and methodologies for evaluating resilience performance and examples of best practices.

2 Introduction

There is an urgent need to increase finance for climate adaptation and resilience. Doing so requires the deployment of a variety of different sources of finance, including green bonds. This paper presents the key aspects relevant to describing and assessing the broad range of potential climate resilience investments, and from that, a set of Climate Resilience Principles ("the Principles") for evaluating the appropriateness and effectiveness of climate resilience investments.

The Climate Resilience Principles will inform the development of sector-specific Climate Resilience Criteria for the Climate Bond Standard & Certification Scheme ("the Standard"). These Criteria will be applied alongside existing Climate Mitigation Criteria under the Standard. It is hoped that this will incentivise bond issuers to mainstream climate resilience into climate investments. It is also hoped that these Principles and the sector-specific Climate Resilience Criteria can serve as a model for other certification and assessment schemes for climate resilient investments.

The paper is structured as follows:

- Chapter 1 provides background and context for developing the Principles. This includes outlining the opportunities for and barriers to investment in climate resilience.
- Chapter 2 explores the definition of 'climate resilience,' climate resilience investments, and key factors influencing the formation of the Principles.
- Chapter 3 describes the proposed Principles.
- Chapter 4 addresses the next steps for this work, specifically guidance to the Technical Working Groups that will use these Principles as the framework for the development of sector-specific adaptation and resilience Criteria for the Climate Bonds Standard.

2.1 A pressing urgency to systematically address climate resilience

The current trajectory of greenhouse gas (GHG) emissions is expected to lead to global warming of 4.1-4.8°C above pre-industrial levels by 21003, posing an enormous threat to the future of the world's nations and economies. The risks associated with a greater than 2ºC rise in global temperatures by the end of the century are significant, and growing in prominence both in terms of likelihood and impact.4 The 2018 International Panel on Climate Change (IPCC) Special Report finds that there are significant impacts associated with 1.5 ºC warming, a threshold that is likely to be exceeded between 2030 and 2052 at the current rate of global warming.[5]

Losses due to weather-related events have increased nearly ten-fold, from a ten-year global average of USD 12 billion in 1980 to USD 119 billion today.[6] In the worst case scenario, costs from extreme weather alone could reach 1% of global GDP per annum by 2050, reaching up to 20% of GDP in 2100 if a wider range of risks and impacts are considered.[7] Negative effects include rising sea levels, increased frequency and severity of hurricanes, droughts, wildfires and typhoons, and drastic changes in agricultural patterns and yields, with disadvantaged and vulnerable populations facing disproportionately higher risk. Addressing climate change risk is an urgent priority, given continued population growth, current and future concentration of development along coastlines, and aging and increasing demand for infrastructure.

Across various sectors, climate change related risks are already evident or beginning to emerge, particularly among the industries that are exposed to water stress. For instance, under a business as usual scenario, 49% of global grain

[3] Climate Action Tracker, "Temperatures: Addressing Global Warming," Climate Action Tracker, 2018, https://climateactiontracker.org/global/temperatures/.

[4] WEF, "The Global Risks Report 2018: 13th Edition" (Geneva, Switzerland: WEF, 2018), http://www3.weforum.org/docs/WEF_GRR18_Report.pdf.

[5] IPCC, 2018: Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global GHG emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, Maycock, M. Tignor, and T. Waterfield (eds.)]. World Meteorological Organisation, Geneva, Switzerland, 32 pp.

[6] Swiss Re Institute, "Sigma" (Zurich, Switzerland: Swiss Re Institute, 2017)

https://www.swissre.com/dam/jcr:1f198386-eab9-408e-a970-1b0f7fe20bf8/4sigma3_2017_en.pdf.

[7] IPCC AR5 and Stern (2005), cited in: Schroders 2016. The impact of climate change on the global economy. https://www.schroders.com/en/sysglobalassets/digital/us/pdfs/the-impact-of-climate-change.pdf

production areas today are expected to be at risk due to water stress by 2050.8 The damage is disproportionately high in developing countries, undermining efforts to meet the Sustainable Development Goals (SDG).

Additionally, failure of assets or systems in one sector can often lead to a "failure chain", or a cascade of failures, resulting in wide-ranging consequences for a community. For instance, an extreme flood event that submerges an electricity substation may cause hospitals and water treatment plants to shut down some of their functions. Such shutdowns may result in the loss of a city's ability to provide healthcare services and drinking water. This is a failure chain that spans energy, water, and healthcare systems.

Avoiding such catastrophic climate change requires a dramatic reduction in global GHG emissions and unprecedented transformation in all sectors of society. But despite increasing awareness of climate risks, action falls behind—according to an analysis by the Global Adaptation and Resilience Initiative (GARI), 72% of suppliers believe climate change related risks can significantly impact their business operations, revenue, and expenditure, yet only half are managing this risk.[9]

2.2 Investing in Climate Resilience

The increasing recognition of the urgency to build climate change resilience in all assets and systems, whether publicly or privately owned and managed, presents new opportunities for investors. Box 1 describes several potential investments that can enhance the resilience of key assets to climate change effects and/or to enhance the resilience of the broader system of which that asset is a part.

Investments that aim to increase the resilience of the broader system may often be considered as more relevant for the public sector, partly due to the idea that the public sector has greater ownership or influence over the system, and/or due to challenges for the private sector in monetising system-focused investment. However, the examples given in part 2 of Box 1 illustrate many opportunities for private asset owners and managers to make contributions to system resilience and all asset owners and managers are encouraged to consider at a minimum ensuring that their assets and projects are doing no harm to the resilience of the system, and ideally are maximizing all opportunities to enhance the resilience of the system. The private sector can gain multiple benefits by investing in climate resilience, including indirect financial benefits, such as enhanced liability management, increased reputation among local communities, trust among suppliers and customers, and employee protection.[10,11]

Key takeaway

The changing climate creates new needs for system-level climate resilience investments and thus a new opportunity for bond investors, with bonds proceeds that link to projects seeking to enhance the resilience of a system or community

Section 2.2 provides further detailed description of the different types of resilience investments.

[8] IFPRI, "Water Futures Project," IFPRI, n.d., https://www.ifpri.org/project/water-futures.

[9] J. Koh, E. Mazzacurati, and S. Swann, "Bridging the Adaptation Gap: Approaches to Measurement of Physical Climate Risk and Examples of Investment in Climate Adaptation and Resilience" (11/2016: Global Adaptation & Resilience Investment Working Group, n.d.),http://427mt.com/wp-content/uploads/2016/11/GARI-2016-Bridging-the-Adaptation-Gap.pdf.

[10] UNCG, UNEP, UNFCCC, CDP, Oxfam, ND GAIN, and WRI, "The Business Case for Responsible Corporate Adaptation: Strengthening Private Sector and Community Resilience" (United Nations Global Compact (UN Global Compact), the secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) and the United Nations Environment Programme (UNEP), 2015), https://www.unglobalcompact.org/docs/issues_doc/Environment/climate/Adaptation-2015.pdf.

[11] T. Tanner et al., "The Triple Dividend of Resilience: Realising Development Goals through Multiple Benefits of Disaster Risk Management" (London: Overseas Development Institute (ODI), International Bank for Reconstruction and Development / International Development Association or The World Bank, 2015), https://www.gfdrr.org/sites/default/files/publication/The_Triple_Dividend_of_Resilience.pdf.

Box 1: Illustrative examples of investments in climate resilience (Q13)

Investments that enhance the climate resilience of assets over their design lifespan	
✓	Resilient features in new infrastructure (e.g. building to meet/exceed minimum requirements that relate to addressing climate change impacts)
✓	Upgrading and modifying existing infrastructure to be climate resilient
✓	Adding spare capacity and thereby pre-positioning resilient infrastructure to prepare for the climate future
✓	Relocation of at-risk infrastructure
✓	Multi asset, multi-action adaptation projects, that may include a series of timed or triggered upgrades
✓	Use of climate resilient crops (e.g. drought resistant seeds) and drip irrigation for agricultural production systems, stormwater storage, grain storage, soil rehabilitation, conservation agriculture, climate resilient livestock infrastructure (e.g. cooling sheds, emergency shelters), novel fodder species and enriched feed for livestock etc at the farm level
Investments by sector that aim to increase the climate resilience of the broader system	
✓	Water (Extreme Precipitation, Drought): Flood defence, wetland protection, stormwater management, rainwater harvesting, waste-water treatment relocation, strengthened water distribution systems, desalinisation plants, etc.
✓	Buildings (Extreme Precipitation, Extreme Temperatures): Green roofs and walls, water retention gardens, porous pavements, etc.
✓	Forestry (Extreme Temperatures, Fire Weather): Wild brush clearing, species diversification, transmigration of species more capable of survival, afforestation and reforestation, mangrove conservation and replanting, etc.
✓	Energy (Hurricanes/Typhoons/Cyclones): Grid resilience, back-up generation and storage, etc.
✓	ICT (Extreme Precipitation, Extreme Temperatures, Hurricanes/Typhoons/Cyclones): Strengthened data distributions systems, climate monitoring and data collection that is applied to inform and build community resilience such as early warning systems, relocation or social networks, etc.
✓	Health (Extreme Temperatures): Treatment and monitoring for diseases that might increase due to climate change (e.g. vector-borne diseases), treatment of respiratory conditions from wildfires.

Combating climate impacts will require significant resources. To combat increasing losses from climate impacts, an estimated USD 200 billion globally will be required annually within twenty years.[12] While the scale of future adaptation needs will depend on the success of current mitigation efforts, there already exists a huge investment gap to address the climate impacts that are already locked-in today. Failure to make investments that incorporate climate resilience considerations into new and existing infrastructure will necessarily result in higher costs and loss of lives and livelihoods.

Insurance is one mechanism that can increase financial resilience, but it remains underused in many parts of the world. On a global scale, approximately 70% of losses due to climate events remain uninsured, with the burden of recovery and liabilities falling on governments, in the form of disaster relief, welfare payments, and hasty reconstruction.[13] Furthermore, relying on insurance alone will not be enough as it merely allows for the ex-post transfer of climate risk, which does not necessarily involve the proactive reduction of climate risks upfront.[14,15] This is important as the insurance

[12] Mott MacDonald & Global Sustainability Institute 2015. Climate Change and Business Survival: The Need for Innovation in Delivering Climate Resilience.

[13] Marsh & McLennan Companies, Inc., "Financing for Climate Resilience," 2017.

[14] Further, in some cases, insurance may not have the intended effect of helping poorer communities. Crop insurance, for example, can sometimes favour larger, wealthier farmers and leave smaller farmers without sufficient protection against crop loss. https://niskanencenter.org/blog/the-strange-economics-of-crop-insurance/

[15] Swenja Surminski, Laurens M. Bouwer, and Joanne Linnerooth-Bayer, "How Insurance Can Support Climate Resilience," Nature Climate Change 6 (March 24, 2016): 333–34, https://doi.org/10.1038/nclimate2979.

industry's viability rests on the probability and costs of losses being low enough to provide affordable premiums - thus as the risks increase, so must premiums, unless vulnerability is reduced through adaptation. In this sense, insurance premiums are a useful market signal for the need for climate resilience investment on the part of both governments and private entities, and higher insurance costs may incentivise proactive reduction of risks to reduce insurance costs as stakeholders react to those signals. However, without bold action now it is possible that entire communities vulnerable to climate change may be declared "uninsurable" in the future as risk premiums become too high and investors develop risk appetites that are averse to climate change impacts.[16]

Despite recognition that both mitigation and adaptation efforts are essential, adaptation funding remains a small fraction of climate finance for mitigation and falls far short of meeting estimated needs, which are estimated at USD 280–500 billion per annum by 2050 under a 2ºC warming scenario in developing countries (N.B. in the literature, funding needs are described in terms of mitigation and adaptation, not climate resilience).[17] In contrast, historically less than a fifth of public climate finance has been dedicated to adaptation (USD 23-27 billion)[18] and cumulative funding from developed countries in dedicated adaptation funds remains at around USD 3.2 billion.[19]

This persistent imbalance is reflected in Decision 1/CP.21 of the Paris Agreement, which "*strongly urges* developed country Parties to scale up their level of financial support, with a concrete roadmap to achieve the commitment of jointly providing USD 100 billion annually by 2020 for mitigation and adaptation while significantly increasing adaptation finance from current levels." The Green Climate Fund's (GCF) aim to allocate 50% of funds to adaptation is an indication of the increasing awareness around financing needs for adaptation, yet cumulative funding pledged currently stands at just USD 10.3 billion.[20] With a reversal of trends, it is estimated that bold climate action could potentially deliver up to USD26trillion in cumulative economic benefits by 2030.[21]

Table 2 summarises some of the key barriers that have been identified as holding back investment in climate resilience. It is intended that the development and application of the Climate Resilience Principles for the green bond market will address a number of these challenges by providing clear guidance on how to assess and address climate risks and how to define, measure, monitor, and report on climate resilience benefits. In turn, this will help to mainstream climate resilience across all green bonds and reduce friction in the market for green bonds that focus on or incorporating resilience outcomes.

Table 2: Identified barriers to investment in climate resilience

Lack of awareness of climate resilience benefits	Despite recognition of the need for more finance for climate resilience, there is still insufficient understanding of the broad benefits of climate resilience and how they may be measured. For instance, some finance institutions currently use the metric "number of beneficiaries" as a measure of progress on adaptation, which is vastly insufficient for measuring resilience benefits.
Mismatch in Investor Time Horizons	For some investments, there is a mismatch between investor and issuer climate resilience time-horizons since impacts from risks that a physical asset is designed to address may be projected beyond a shorter-term investor or analyst's pricing scenario[227]
Nature of Chronic and Acute Climate Risks	Chronic climate hazards may cause financial impacts to accumulate incrementally over the long-term in the form of increasing operating or capital expenditures, while acute disaster-related disruptions may be considered force majeure, removing liability from otherwise responsible parties, though liability expectations are changing.
Lack of Common Definition and Taxonomy	Currently, organisations and governments employ different climate resilience definitions and screening criteria. For most development finance institutions, adaptation finance is tracked according to three process-based principles: identifying the context of climate risks, a stated intent to address the risks, and a demonstrated link between proposed activities

[16] Ange Lavoipierre and Stephen Smiley for The Signal, "Climate Researcher Fears Australia Could Become Too Disaster-Prone to Insure," ABC News, February 6, 2019, https://www.abc.net.au/news/2019-02-06/could-climate-change-make-australia-uninsurable/10783490.

[17] UNEP, "The Adaptation Gap Finance Report" (Nairobi, 2016), https://climateanalytics.org/media/agr2016.pdf.

[18] B. K. Buchner et al., "Global Landscape of Climate Finance 2017" (Climate Policy Initiative, October 2017), https://climatepolicyinitiative.org/wp-content/uploads/2017/10/2017-Global-Landscape-of-Climate-Finance.pdf.

[19] A. Caravani et al., "Climate Finance Thematic Briefing: Adaptation Finance," in Climate Finance Fundamentals (London: Overseas Development Institute, 2014).

[20] Green Climate Fund, "Portfolio Dashboard," Text, accessed April 13, 2019, https://www.greenclimate.fund/what-we-do/portfolio-dashboard.

[21] The New Climate Economy. The 2018 Report of the Global Commission on the Economy and Climate.

[22] 2 Degrees Investing Initiative. The Long-Term Risk Signal Valley of Death: Exploring the Tragedy of the Horizon. November 2015.

	and the risks. Most recently, the EU Taxonomy defines "substantial contribution to adaptation objectives" as an economic activity that reduces physical risks on a "best effort basis" and/or reduces material physical climate risk in other economic activities. How an entity defines adaptation and resilience may influence the range of climate risks considered, the type of resilience action taken and the project objectives.
Lack of Common Methodologies for Climate Risk Assessment	Climate resilience related assessments may have difficulty determining the acceptability of climate hazard response, resilience benefit magnitude, and ensuring the investment will Do No Significant Harm (see explanation below). Thresholds and common measures do not exist across resilience as a field or even within many sectors. Furthermore, geographic and other investment specificity and case history for comparative purposes, is lacking.
Lack of Recognition of Multiple Resilience Dividends	A narrow view of resilience as a pure loss-avoidance tool often makes it unattractive to decision-makers, as loss avoidance may not recognise wider collateral benefits that resilience can bring even in the absence of any loss event. For instance, investing in sustainable agricultural practices and switching crop varieties may help economies realize new opportunities and undergo transformative change needed to thrive with a changing climate.
Complex Quantification	There is a need for greater market experience with the quantification and monetization of climate resilience outcomes, given the dynamic, iterative, and context-specific nature of climate resilience targets (unlike mitigation targets that can be more easily defined and quantified in terms of GHG emission reductions).
Unattractive Risk-Return Profiles	The lack of market experience with measuring resilience benefits, including calculating avoided losses, as well as the overall lack of clarity on commercial climate resilience financial returns[23], may create vague or unattractive risk-return profiles for resilience projects. This clarity should improve over time if the market learns to quantify and capture the financial benefits of climate resilience investments.
Investability	Some resilience projects do not have a clear source of cash flow (historic or prospective) or clearly defined contribution in monetary terms, making them less bankable and thus less attractive to investor.
Misaligned Political Incentives	Public sector timeframes and processes (e.g. election cycles) may not be aligned with long-term planning, thus dampening efforts to identify location-specific climate change risks, create regulation for incentivizing asset-focused or system- focused investments, or prioritize long-term projects and returns.
Lack of Capacity	Certain government and private institutions lack the capacity to 1) identify climate hazards, exposures, vulnerabilities, and risks which would indicate climate resilience opportunities and risks, and 2) develop an appropriate action plan. This challenge is decreasing rapidly as this hazard information is more readily available in most parts of the world at an increasingly granular level.
Lack of Clarity	Uncertainty about the rate, scale, and cumulative impact[24] of climate change risks can slow down analysis of the financial impact of physical climate risks that would drive market uptake.[25] Thus, since losses due to climate change may not yet appear on balance sheets, businesses may not be incentivised to actively reduce those losses.
Cross Dependency	Many organisations are unaware of the extent to which they are dependent upon, and thus vulnerable to the climate driven loss of, critical services such as power, water, data, and access. They also have neither agency in requiring critical service risk disclosure, nor the ability to require greater supply resilience from their suppliers.

[23] Global Investor Coalition on Climate Change, "Global Investor Groups Publish Guidance on Investing in Solutions to Address Climate Change: Solutions Guide Supports Implementation of Investors' Actions and Commitments on Climate Change," 2015,

https://globalinvestorcoalition.org/wp-content/uploads/2015/04/Solutions-guide-FINAL_AUS_sponsors.pdf.

[24] UNEP identifies three key knowledge gaps in adaptation as: 1) gaps in knowledge production, 2) inadequate integration of knowledge, and 3) limited transfer and uptake. In particular, developing countries lack the capacity to systematically identify, assess, and prioritize adaptation needs.

[25] V. Stenek et al., "Climate Risk and Business: Practical Methods for Assessing Risk" (Washington, D.C.: International Finance Corporation, September 2010), https://www.ifc.org/wps/wcm/connect/09deed804a830d0f85e6ff551f5e606b/ClimateRisk_Business.pdf?MOD=AJPERES.

Language differences	Language differences between public and private sector and hard and soft infrastructure prevents the communication of adaptation or climate resilience as a common priority. For the public sector, climate resilience is a matter of ensuring the safety of populations and guaranteeing the reliable functioning of infrastructure in the face of climate risks. On the other hand, the GARI Working Group's report found that private investors were less aware of "adaptation" as an investment category, but understood the need for business continuity, reliability, disaster recovery, business continuity, and maintenance and the security of supply chains. There may also be issues related to differences in the ways soft and hard infrastructures are discussed e.g. resilience through supply chain diversification (soft) versus physical infrastructure protecting a manufacturing facility (hard).

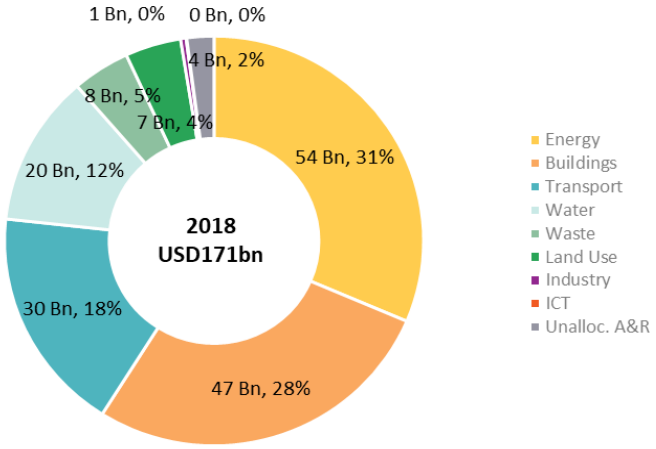
2.3 Green bonds to finance climate resilience

Bonds are a type of debt instrument that offer relatively stable and predictable returns and long-term maturities, making them a good fit with institutional investors' as well as physical asset owners' needs. Typically, 50-75% of infrastructure is financed through debt and bonds as they are especially well-suited for infrastructure financing due to the stable cash flow and asset-backed nature of infrastructure.

Labelled green bonds are regular bonds with the distinguishing feature that proceeds are earmarked for projects with environmental benefits. To date, they have been primarily associated with climate change mitigation, although climate adaptation or resilience and/or other environmental factors such as water management, pollution control, circular economy etc. have also been a focus. Green labels serve as a discovery mechanism for investors, enabling the identification of climate change-related (and/or other environmentally beneficial) investments for investors with limited resources for due diligence. By doing so, a green bond label (especially when combined with third party certification) can reduce friction in the markets and facilitate growth in climate-aligned investments.

Green bonds are commonly issued by governments, companies, municipalities, and commercial and development banks to finance or refinance assets, projects, technologies, activities, services, tools etc. with environmental benefits. Energy, transport and buildings are the three most common use of proceeds. See Figure 2.

Figure 2: Use of green bond proceeds – 2018 issuances

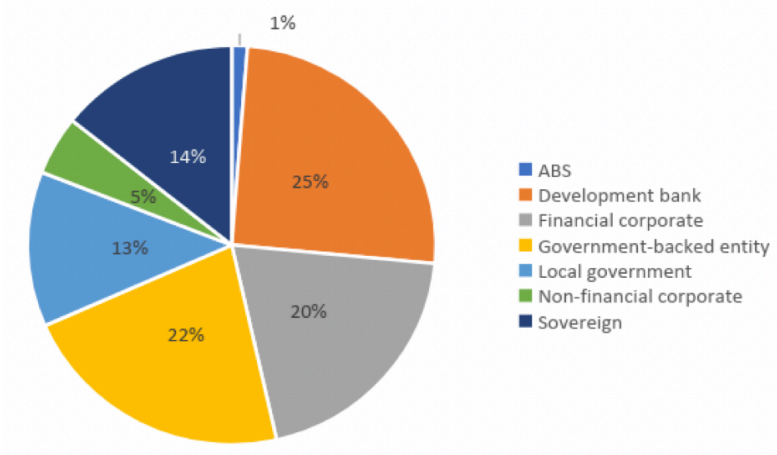


The green bond market has grown rapidly since the issuance of the first green bond in 2007, with USD 175 billion of green bonds issued in 2018. But with a global bond market totalling USD 90 trillion in 2018, green bonds still accounted for less than 0.2% of all bonds issued. The potential for scaling up is tremendous since traditional sources of capital for infrastructure investment are insufficient to meet investment needs for addressing climate change. As green bonds may be used for refinancing, they are not necessarily bringing additional resilience interventions into the market. However, drawing new issuers into the green bond market should enable greater capital flows overall to climate resilience investments, and provides important visibility to climate resilience investment opportunities, thereby spurring on additional investment. A useful future exercise would be to analyse the impact of these principles in terms of both the degree of consistency and robustness of assessment and reporting on resilience investments, and on impacts on financial flows to such investments.

According to analysis by the Climate Bonds Initiative in 2018, only 3-5% of green bond proceeds can be traced to climate resilience related efforts (~USD 12 billion) to date. Leading green bond issuers of climate resilience related activities are

development banks and government-backed entities, followed by financial corporates, primarily commercial banks in China. See Figure 3. Non-financial corporates are underrepresented in allocating proceeds to climate resilience, accounting for 19% of overall green bond issuance but only 5% of climate resilience proceeds. Climate resilience-linked issuance spans 23 countries, led by China, France, the Netherlands, and the US. There may be additional bond financing going towards climate resilience that is not captured in the Climate Bonds Initiative's database, either because the bond is not labelled green, or because climate resilience aspects are not made explicit. However, increasing awareness of climate risks is driving improved transparency and disclosure mechanisms to track climate resilience-related efforts and finance.

Figure 3: Issuance of climate resilience related green bonds in 2018, by issuer type



Currently, the water sector accounts for the highest share of proceeds allocated to climate resilience in the green bond market. Examples of issuers include the City of Cape Town[26], New York State Environmental Facilities Corporation[27], and utilities such as DC Water[28] in the US and K-Water[29] in Korea, with proceeds allocated to securing drinking water supply, installing water meters, reducing combined sewage water overflow, and stormwater management. In the Netherlands, NWB Bank[30] has issued green bonds to provide loans to local water authorities to fund projects related to flood protection, water management, and water quality.

Forestry and land-use sectors also have a relatively high share of proceeds going towards climate resilience measures. A leading issuer in this sector is the State of California[31], with proceeds going towards coastal protection and restoration of rivers and watersheds. Another example is China's Chouzhou Commercial Bank, with over 50% of its proceeds from a bond issued in June 2018 financing ecological protection and adaptation, including land rehabilitation[32].

In the energy, building and transport sectors, allocation of proceeds to climate resilience is less explicit. One example of an issuer in the energy sector that did highlight allocation to climate resilience is Latvian power utility Latvenergo[33], which had flood protection measures explicitly included in their green bond framework issued for renewable energy and grid efficiency. In the buildings space, most proceeds remain focused on energy efficiency. Sweden's Östersund municipality bond provides an example of how adaptation for buildings can be explicitly prioritised alongside emissions

[26] Issued a Certified Climate Bond for ZAR 1bn in July 2017 https://www.climatebonds.net/certification/city-of-cape-town

[27] Issued a USD 213m green bond in June 2014 https://www.climatebonds.net/2014/06/ny-state-enviro-facilities-corp-issues-213m-2530yrs-aaa-water-bond-opens-big-question-clean

[28] E.g Issued a USD 350m green bond in July 2016 https://www.climatebonds.net/2014/07/dc-water-issues-aa-350m-'green-century-bond'-—-yes-that's-right-very-first-100-year-green

[29] Issued a USD 300m green bond in May 2018 https://www.climatebonds.net/2018/05/market-blog-5-may-2018-lithuania-sovereign-lebanon-spanish-and-swiss-corporates-rising-em

[30] E.g Issued a EUR 1bn green bond in Sept 2015 https://www.climatebonds.net/2015/09/nwb-bank-eur1bn-water-—-bravo-swedish-corps-uppsala-hem-stångåstaden-sek500m-59m-gbs-eib

[31] E.g Issued a USD 300m green bond in Oct 2014 https://www.treasurer.ca.gov/publications/2014green.pdf

[32] E.g Issued a CNY 1.5bn green bond in Jun 2018 https://www.climatebonds.net/2018/06/market-blog-june-2018-icbc-boc-certified-bonds-record-month-certifications-1st-gb-pension

[33] In their EUR 25m green bond in April 2016 https://www.climatebonds.net/2016/04/gb-market-rpt-alliander-€300m-3396m-10yrs-1st-china-onshore-corporate-concord-wind-rmb200m

reductions requirements.[34] In the transport sector, Hong Kong MTR includes adaptation in its green bond framework, but eligible adaptation investments do not appear to be limited to transport infrastructure.[35]

Looking beyond physical assets, scaling up climate resilience also requires investments in research and development for new technologies and future assets, in financial products, and service offerings such as training and information management.

Several financial sector innovations may enable greater uptake of climate resilience investments in the green bond market. Three are described briefly by way of illustration in Table 3 below.

Box 2 describes how the term 'resilience bonds' is used in the insurance industry to capture the latest developments in terms of combining a debt instrument with a risk transfer element, by dedicating proceeds to an ex-ante resilience intervention.

Table 3: Financial sector innovations for climate resilience

Innovations	Description
Aggregation Mechanisms	Green finance firms may use aggregation mechanisms to identify and combine small-scale projects into a larger investment vehicle, thus reducing private investors' time spent on performing due diligence for small projects. While the Paris Climate Bond concept pioneered by Climate Mundial uses this approach to aggregate mitigation projects aligned with the UNFCCC's Clean Development Mechanism, there is not yet such an aggregation mechanism for climate resilience. Once clear standards are established for defining climate resilience investments, there is potential for such aggregation mechanisms to attract investors to smaller-scale climate resilience projects as well.
Pay for Success	Green bonds may utilise a "pay-for-success" structure that allows investors to share the performance risk of climate resilience projects. For example, DC Water's Environmental Impact Bond raised funds to build green infrastructure that could help reduce stormwater runoff. Based on predetermined performance tiers, if the project successfully reduces runoff (>41%), investors receive an additional payment of USD3.3m. If the project is not successful (<18%), the utility receives a risk share payment of USD3.3m from the investors.[36] The downside of such mechanisms is that they generally require long project preparation times and a bespoke investor/issuer relationship, which can be time consuming and complicate bond rating reviews.
Blended Finance	Green bonds enable blended finance, mixing development finance or other public capital with private capital, thereby helping to improve the risk-reward profile of climate resilience green bond projects. For instance, multilateral development banks and public-sector entities may take a first loss-tranche, limit certain risks (such as liquidity or sovereign risk), provide technical assistance during the project design phase, and/or offer co-financing options with donors.

[34] Östersund Kommun, "Green Bonds Framework," November 9, 2017, https://www.ostersund.se/download/18.7a53b42715fa021ababb9884/1511291849714/Green-Bonds-Framework.pdf.

35 MTR 2016. MTR Green Bond Framework. https://www.mtr.com.hk/archive/corporate/en/mtr_green_bond_framework2016.pdf

36 J. North and G. Gong, "DC Water Environmental Impact Bond" (Harvard Kennedy School Government Performance Lab, 2017), https://govlab.hks.harvard.edu/files/dc_water_environmental_impact_bond.pdf.

Box 2: A note on "Resilience Bonds" in the insurance sector

Over the last 10 years, the rapid advancement in risk analytics, coupled with rising exposure levels, has facilitated the emergence of Insurance-linked Securities (ILS), such as catastrophe bonds and parametric solutions. A brief summary of these terms is provided in Appendix 1. More recently, several definitions have emerged in the market competing for the label "resilience bonds" in the insurance sector specifically.

According to Willis Tower Watson, "resilience bonds" are expected to be a financial instrument that can be applied to a range of resilience projects. At their heart, "resilience bonds" are an evolution of catastrophe bonds, combining a debt instrument with a risk transfer element, with proceeds dedicated to an ex-ante resilience intervention. This definition places a particular emphasis on exposure to, climate hazards, and the potential impact that such hazards may have on a projects' finances.

"Resilience bonds" as a category used in the insurance sector are different from "resilience bonds" as a category used in the green bond market, as the latter does not include a contingent component and is only defined by the use of proceeds being directed to assets and projects addressing climate resilience. Even then, most resilience-focused bonds in the green bond market are often simply labelled as green or climate bonds as this nomenclature is broad enough to capture climate mitigation, climate adaptation & resilience and other specific environmental benefits related use of proceeds, thereby avoiding fragmentation and supporting growth in a single, coherent green bonds market.

2.4 The Climate Bonds Standard & Certification Scheme

Activating the mainstream debt capital markets to finance and refinance climate-aligned assets is critical to achieving international climate goals, and the robust labelling of green bonds is a key requirement for that mainstream participation. Confidence in climate objectives and impacts is fundamental to the credibility of green bonds and the ability of this market to reach scale while investor capacity to assess green credentials may be limited, especially in the fast-paced bond market.

For this reason, the Climate Bonds Initiative, an investor-focused not-for-profit organisation, created and runs the Climate Bonds Standard & Certification Scheme. This is the only certification scheme for green bonds and aims to provide the green bond market with the trust and assurance that it needs to achieve scale.

The Climate Bonds Standard & Certification Scheme is a tool that assists investors and issuers in prioritising investments that truly contribute to addressing climate change, both from a GHG mitigation and climate change adaptation/resilience perspective. It is made up of the overarching Climate Bonds Standard detailing management and reporting processes, and a set of sector criteria detailing the requirements that assets and projects in each sector must meet to be eligible for certification. The Certification Scheme requires issuers to obtain independent verification, pre- and post-issuance, to ensure the bond meets the requirements of the Climate Bonds Standard. It is essentially a method of due diligence for the climate credentials of the bond. It does not replace the need for the appropriate financial due diligence. In 2018, the Climate Bonds Standard & Certification Scheme was used to certify 15% of green bonds issued globally.

2.5 Climate Resilience Principles for the Climate Bonds Standard

When first introduced, the Climate Bond Standard & Certification Scheme incorporated sector-specific screening Criteria only with respect to climate change mitigation impacts. New sector Criteria have incorporated climate resilience considerations, as advised by technical experts on a case-by-case basis. In summer 2018, the Climate Bonds Initiative and WRI committed to develop an overarching set of principles for screening Criteria for climate resilience to guide all future development of sector specific climate resilience Criteria and thereby ensure consistency and harmonisation of all climate resilience Criteria across all sectors.

Key takeaway

To be certified, all assets and projects must be resilient to climate change

For this purpose, the Adaptation and Resilience Expert Group (AREG) was convened with the aim to co-author these Climate Resilience Principles ("the Principles"). The Principles will provide the framework within which sector-specific climate resilience Criteria will be developed by sectoral Technical Working Groups (TWGs) going forward. The Principles provide the high-level guidance for determining when the intended use of proceeds may be deemed to contribute appropriately and sufficiently to reducing physical climate change risk and improving climate adaptation or resilience by that asset or activity specifically and/or by the broader system of which they are part. Only under these conditions will such use of proceeds be

deemed eligible for a bond to be certified under the Climate Bonds Standard. For this purpose, the Principles aim to provide an optimal balance between scientific theory, robustness and practicality.

The Climate Bond Standard sector-specific screening Criteria will in time incorporate the Principles for all eligible use of proceeds, across all sectors.

The Principles reflect what is possible today and are expected to mature to address what is desired in the marketplace in the future. The Principles will undergo periodic review and be updated as understanding, methods, and metrics for assessing and enhancing resilience improve, and as bond market actors become more competent at applying them.

Box 3 provides more information on the process by which the Principles were developed.

Box 3: Timeline of development for the Climate Resilience Principles

- June 2018: CBI and WRI conducted initial background research for potential Climate Resilience Principles
- Summer 2018: CBI created an Adaptation and Resilience Issues Paper, led by Ujala Qadir and June Choi, as a foundation for subsequent work.
- October 2018: CBI convened the AREG, a group of global adaptation and resilience members who agreed to participate in a seven-month collaborative process. Joyce Coffee, president of Climate Resilience Consulting, contracted to be the AREG technical lead and CBI, WRI, and the AREG lead worked together to establish a content creation and review process schedule for the AREG.
- November 2018 - February 2019: AREG members met monthly via webinar, aiming to complete a principles and framework document by early Summer 2019, concurrent with e.g. the European Technical Expert Group on Sustainable Finance (TEG).
- March - April 2019: CBI invites applications from external experts interested in reviewing AREG work product. CBI and WRI selected 10 reviewers in April.
- April-June 2019: External experts reviewed the draft principles and framework, providing feedback on the feasibility and usability of these Principles in the green bond market. Internal experts from WRI reviewed the Principles and provided feedback. In addition, CBI TWG members from the Forestry and Water Infrastructure Groups reviewed the Principles members and provided feedback.
- July-Aug 2019: Principles finalised, taking into account internal and external review feedback. Climate Bonds Standard Board approved the release of the Principles.
- Remainder of 2019, existing sector Criteria to be reviewed and refined as needed to align with the Principles.
- On an ongoing basis, some AREG members will continue to update the Principles and review new sector criteria to ensure alignment with Principles

2.6 Alignment with other initiatives

The Principles have been designed to be consistent with related materials in the marketplace, including guidance from the Task Force on Climate Related Financial Disclosure (TCFD), various multilateral development bank initiatives described in this document, the UNFCCC's Paris Agreement and related Nationally Determined Contributions (NDC) and, the European Union Technical Expert Group (TEG) on Sustainable Finance, which is developing a set of principles and criteria for environmentally sustainable economic activities under the EU Taxonomy. [37]

[37] This Taxonomy aims to provide clarity and transparency on environmental sustainability to investors, financial institutions, companies, and issuers, thereby enabling appropriate disclosure and informed decision-making in order to foster investments in environmentally sustainable activities. Climate Bonds Initiative staff Sean Kidney, Anna Creed, and Ujala Qadir participated in the TEG, as well as three AREG members, Cinzia Losenno, Craig Davies, and Carel Cronenberg. The AREG technical lead and other advisors assisted TEG members in their deliberations through adaptation workshops.

3 Unpacking Climate Resilience - Factors shaping the Principles

3.1 A working definition of climate resilience

The CBI Climate Resilience Principles build on the IPCC 5 definitions of adaptation and resilience.

Adaptation: "the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects."[38]

Resilience: "The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation."[27]

The Climate Resilience Principles further offers the below definition to inspire investors and issuer engagement:

Climate resilience investments improve the ability of assets and systems to persist, adapt and/or transform in a timely, efficient, and fair manner that reduces risk, avoids maladaptation, unlocks development and creates benefits, including for the public good, against the increasing prevalence and severity of climate-related stresses and shocks.

While the Climate Resilience Principles acknowledge that, in general terms, climate change *adaptation* is what is done (actions) in order to achieve climate change *resilience* (a condition or state), the concepts are combined and uniformly referred to as Climate Resilience throughout this document.

Key takeaway

The Climate Resilience Principles acknowledge IPCC climate resilience definitions, and issuers are also invited to use the CBI climate resilience definition above

3.2 Applicable to two types of climate resilience investments: asset-focused and system-focused

It is essential that all physical assets that provide goods and services to human and eco-systems are resilient to climate risks so that they can keep providing those goods and services, and so that whatever additional assets, projects, activities and services are needed explicitly to enhance the resilience of wider economic, social and eco-systems are provided and are themselves also resilient to climate risks.

With this in mind, two types of climate resilience investments are identified and defined, for the purposes of explicitly highlighting the full range of resilience investments possible and needed:

Asset-focused: Where the intention is to enhance the resilience of an asset or activity to climate change, for example by upgrading, replacing, and/or adding spare capacity) to ensure that the asset or activity is 'fit-for-purpose' over its design lifespan. In many cases, this will also contribute climate resilience benefits to the system of which the asset or activity is part.

System-focused: Where the investment is explicitly intended to deliver climate resilience benefits to the broader system (i.e. going beyond merely ensuring an asset's or activity's performance over its design lifespan). To be effective, such assets or activities will also need to have a sufficient degree of resilience to climate change.

[38] IPCC, "Annex II: Glossary in Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change" (Geneva, Switzerland: IPCC, 2014).

Examples of the former might include upgrading, replacing, or relocating critical and non-critical infrastructure[39], and using drought resistant crops for agricultural production or training of farmers on sustainable farming practices. Examples of the latter might include the construction and operation of desalination plants, wild brush clearing, and climate monitoring and data management technologies and services. It is noted that scaling up climate resilience will require not just investments in hard infrastructure, but also increased investment in 'softer' areas such as technologies, tools, services, supply chains etc that have a key role to play in enabling climate resilience.

Attention is drawn here to the key point that both 'asset-focused' and 'system-focused' investments address the resilience of both the asset or activity, and of the system of which it is a part, but in different ways. The difference between the two types lies in whether the *primary intention* of the issuer is to increase the resilience of an asset or activity, or to increase the resilience of the wider system. In terms of resilience *outcomes*, however, there are significant overlaps between the two types of investments.

Key takeaway

The Climate Resilience Principles address both asset- and system-focused resilience investments. System-focused investments are those with an explicit intention to deliver resilience benefits beyond asset boundaries

In many cases, asset-focused investments are likely to simultaneously deliver resilience benefits to a system. For instance, a private utility investing in the resilience of its grid assets automatically enhances the resilience of the population dependent on that grid. Although this benefit to the surrounding system may neither be explicitly documented by the utility, nor be its explicit intent, the utility's actions to ensure that its assets are resilient have beneficial spill-over effects.

On the other hand, a system-focused investment can only deliver system resilience benefits as long as any asset involved is itself resilient to climate change. For instance, the construction of a desalination plant to prepare for future water crises is a system-focused investment as it is built with the explicit intention of supporting a population that is experiencing frequent water shortages. However, the resilience of the desalination plant asset itself is a requirement for the plant to successfully deliver its objective.

Understanding the interconnections between individual assets or activities and systems is useful when considering the wide range of investments that could be undertaken in the name of resilience. For example, if a building is retrofitted to cope with climate change impacts over the next 50 years, this would be considered an 'asset-focussed' investment. A specific example is Nordic real estate company Vasakronan's investment in climate risk analysis and adaptation of its buildings to withstand greater snow loads and increase onsite stormwater capacity.[40] However, if the building's purpose is to provide key services critical to systemic resilience such as a data centre or backup systems to maintain essential services for a city, recognising this function may prompt additional resilience measures that might have been overlooked when focusing only on protecting the building itself.

This distinction between asset-focused and system-focused investment is common in discussions on climate resilience interventions, although the language and terms used to describe the distinctions vary. Table 4 summarises definitional distinctions across different organisations.

[39] Discussion was had on whether investment in critical infrastructure should be classed as 'asset-focussed' or 'systems-focussed' investment. It has been determined that this is 'asset-focussed', as the focus is on the resilience of the infrastructure in question, with benefits for the resilience of the system. Furthermore, if investment in the resilience of non-critical infrastructure were deemed 'asset-focussed' and investment in critical infrastructure were deemed 'system-focussed', it would then be necessary to determine what is critical infrastructure and what isn't. This is challenging as it is context specific.

[40] Vasakronan Green Bond Framework and Company Overview. 2017. https://wwwvasakronanse.cdn.triggerfish.cloud/uploads/2018/10/vasakronan_green_bond_framework_.pdf

Table 4: Asset-focused and system-focused in the context of other organisations' definitions

	Asset-focused resilience	System-focused resilience
Global Adaptation and Resilience Investment Work Group (GARI)	Resilience as a ***feature*** or ***attribute***	Resilience as the ***primary purpose*** / as a primary product or service
World Bank Group "Resilience Rating System"	Resilience **of** investments and projects, i.e. resilient investments	Resilience ***through*** investments and project
EU Sustainable Finance Taxonomy (in consultation)	Resilience **of** economic activities by investment in those activities	Resilience of economic activities **by** investments in other economic activities

3.3 Understanding and framing the system

As noted above, risk assessments are necessary to understand the scope and impacts of the climate risks faced by assets, activities and / or systems, to ensure that investments in resilience are appropriately targeted and designed.

A robust risk assessment requires understanding the asset or activity's boundaries and interdependencies with surrounding infrastructure systems. Interdependencies are specific to local context but are often connected to wider systems through complex relationships that depend on factors 'outside the asset fence' that could cause cascading failures or contribute to collateral system benefits. The asset owner or manager's existing risk management framework should include consideration of these interdependencies. For the purposes of these assessments, boundaries should be set so as to include what may be directly affected by the establishment and/or operation of the asset or activity, going beyond what the asset or activity owner has sole control over (e.g. by contract or obligation).

It is challenging to define precisely the nature of the "system" in question here, given that any "system" is a complex interplay of environmental, economic and social factors. In turn, climate resilience is determined by a combination of local vulnerabilities and exposures to climate hazards. However, it is again noted that the remit of the Climate Bonds Standard is climate, and not broader environmental and social issues. Where an investment seeks to enhance social, economic or ecosystem resilience to climate change, then these may be considered in scope for the purpose of risk and benefit assessments. But this should not be seen as an automatic inclusion of all social, economic and environmental factors. The link between these elements and enhanced climate resilience must be demonstrated.

As an example, water infrastructure assets may feasibly be required to use a watershed system boundary in their risk and benefit assessments. This watershed might be affected by not only the assets under assessment, but also by other water infrastructure assets that supply large networks and/or local communities, agricultural irrigation systems, hydropower facilities within the watershed, forestry projects etc. The interdependencies between these assets and activities and their associated stakeholders should be taken into account in any assessment of climate risks and resilience benefits to the watershed. This is important for any assessment of whether the water infrastructure is 'fit-for-purpose.' From a climate resilience perspective, the water infrastructure cannot be deemed to be 'fit for purpose' if it leads to failure chains or maladaptation for the infrastructure itself or in the watershed in which it operates or other stakeholders in the watershed.

3.4 A need for context and location specific risk assessments, risk reduction measures and benefit assessments

As noted above, the primary objective of asset-focused investments is to ensure that assets or activities are able to withstand climate risks, and the primary objective of system-focused investments is to go beyond protecting assets and activities is to deliver resilience benefits to the system. For this reason, two different assessments are needed: 1) a climate risk assessment for both asset- and system-focused investments, and 2) a benefit assessment for system-focused investments, to check how the investment intends to deliver resilience benefits.

Two points are made regarding these assessments.

Key takeaway

Identifying appropriate resilience investments requires understanding of context specific climate risks, reducing the risks, and identifying opportunities for enhancing resilience

Firstly, there should be no special treatment or exceptions from the assessment requirement for any investment, despite the advantages of this in terms of avoiding the time and expense of determining compliance with the Principles, which would have the benefit of supporting significant uptake of such investments via green bonds. This is because even investments that might initially appear to deliver significant contributions to resilience under any circumstance, regardless of context and without risk of maladaptation, may still have the potential to do significant harm. For example, seawalls risk causing additional inundation beyond their boundaries. Further, even where risks of maladaptation are minimal, there is still a need to ensure that all assets and activities are themselves resilient to climate change.

Secondly, issuers must take into account the specific context and location of the asset and system, to ensure that the relevant climate risks are identified and appropriately addressed and to examine and evaluate the resilience benefit potential in that context. Where insufficient data is available to do this, this should be an area of focus and support to improve data availability to enable the appropriate identification of and response to climate risks.

There are a number of relatively well-established tools and methodologies for undertaking these assessments, examples of which can be found in the accompanying Technical Annex.

It is noted that a critical part of these assessments should be the addressing of the context-specific risks identified.

That said, it may be that as climate resilience becomes more prevalent in the green bonds market, a pool of resilience investments might emerge that may potentially be deemed safe to exempt from adaptation and resilience screening criteria. The Climate Bonds Initiative will monitor developments in this area, and each sector TWG will be asked to consider the existence of any investments in their sector that may safely be exempted from the Climate Resilience Criteria.

3.5 Focus on physical climate risks

These Principles have been developed specifically for use in the Climate Bond Standard & Certification Scheme, which focuses on low carbon and climate resilient investments that are consistent with transition pathways to the 2ºC warming limit described in the Paris Agreement, and the need to address climate risks associated with much greater warming scenarios. The Principles' focus is therefore on addressing physical climate risks, and not other non-climate change related physical risks.

Of course, delineating which physical risks are climate related and which are not is challenging. As climate science is rapidly evolving, it is becoming increasingly clear that many physical hazards have been, and will continue to be, exacerbated by the amount of warming that is already locked in. To assist in the identification and assessment of climate resilience investments, further guidance is therefore needed in terms of the physical climate risks against which resilience measures must protect.

Two types of physical climate risks are delineated: chronic (associated with long-term shifts in climate patterns, such as rising sea levels from higher temperatures) and acute (event-driven, such as extreme weather events).

In its recent recommendations for a Sustainability Taxonomy, the EU Technical Expert Group classified chronic and acute physical climate hazards per Table 5 below. This classification is focused on weather and climate related hazards, split into events related to water, temperature, wind and solid-mass movements. The significance of these hazards will vary significantly across different businesses, sectors and geographies, depending on their level of exposure and vulnerabilities to these hazards, Figure 4 below demonstrates how some of these climate change hazards lead to various impacts on operations, local environments and communities.

This list of hazards was proposed by the EU Technical expert group as a compromise between different existing classification systems e.g. the PERILS classification used in the insurance sector and the WMO classification of over 50 weather, climate and water related hazards. Almost all hazards on those lists are included in this proposed hazard classification which are referenced in the EU Technical Expert Group recommendations. Given this, and to ensure alignment with the EU Sustainability Taxonomy proposals, it is proposed that this list of physical climate hazards is used as the basis for the risk assessments proposed in the Principles.

Table 5 Classification of climate-related hazards [41]

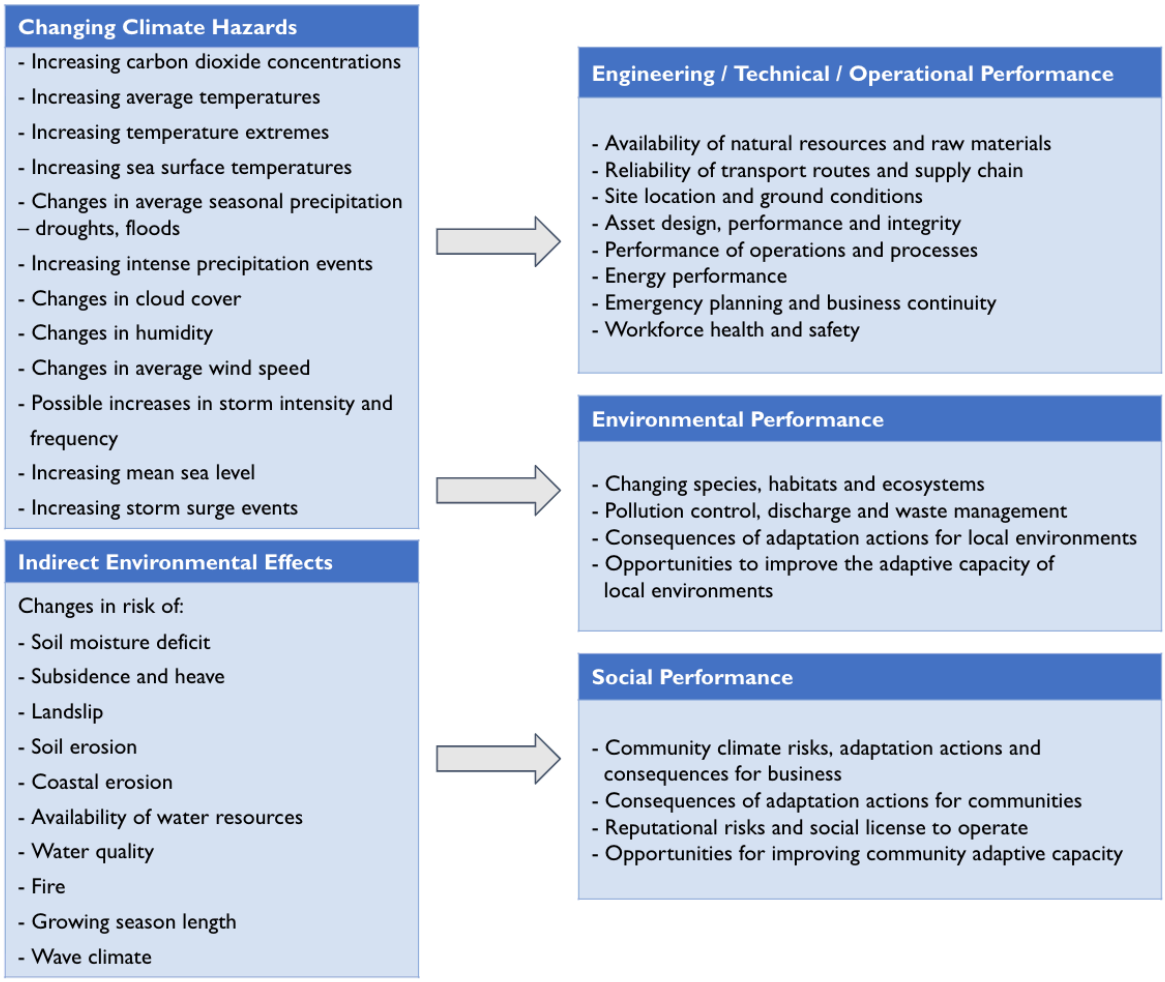
	Changes in climate patterns and in the frequency/severity of climate-related events that are:			
	Temperature-related	Wind-related	Water-related	Solid mass-related
CHRONIC	Changing temperature (air, fresh water, marine water)	Changing wind patterns	Changing precipitation patterns and types (rain, hail, snow/ice)	Coastal erosion
	Heat stress		Precipitation and/or hydrological variability	Soil degradation
	Temperature variability		Ocean acidification	Soil erosion
	Permafrost thawing		Saline intrusion	Solifluction
			Sea level rise	
			Water stress	
ACUTE	Heat wave	Cyclone, hurricane, typhoon	Drought	Avalanche
	Cold wave/frost	Storm (including blizzards, dust and sandstorms)	Heavy precipitation (rain, hail, snow/ice)	Landslide
	Wildfire	Tornado	Flood (coastal, fluvial, pluvial, ground water)[42]	Subsidence
			Glacial outburst[43]	

[41] https://ec.europa.eu/info/sites/info/files/business_economy_euro/banking_and_finance/documents/190618-sustainable-finance-teg-report-taxonomy_en.pdf

[42] Not noted in the EU Taxonomy, but to include ocean swells as very common in the Caribbean.

[43] In the EU Taxonomy, the risk here was identified as 'glacial lake outburst'. However, non-lake related glacial flooding is a significant risk in many locations, such as the Andes. So this risk has been amended here.

Figure 4: Impacts of climate hazards



Adapted from: Page 19 Advancing TCFD guidance on physical climate risks and opportunities44

3.6 Dimensions of climate risk: understanding hazard, exposure and vulnerability

In order to be confident that assets and activities are robust and flexible in the face of climate change uncertainties, it is essential that the climate risks being assessed and addressed cover those which most relevant to those assets and activities.

For this, it is important to recognise three different dimensions that determine risk severity: the nature of climate change hazard, exposure to those hazards, and vulnerability to negative impacts as a result of that exposure. Though these concepts are often used interchangeably, in fact they relay different information about both the underlying sources of risk and the different levers needed and available for fostering climate resilience.

For example, whether an asset will be impacted by a flash flood will not only depend on whether it is in the flood zone, but also whether it is vulnerable to such floods e.g. due to outdated infrastructure, and/or a lack of flood protection measures.

Key takeaway

The Principles define climate change risk as the combination of climate change hazards, exposure and vulnerability

[44] European Bank for Reconstruction & Development (EBRD) and Global Centre on Adaptation (GCA). "Advancing TCFD Guidance on Physical Climate Risk and Opportunities". 2018. https://s3.eu-west-2.amazonaws.com/ebrd-gceca/EBRD-GCECA_draft_final_report_full_2.pdf

Finally, the concept of risk is mediated by both the probability / likelihood / return-frequency of occurrence and the consequence of failure and damage.

Below are the formal climate risk definitions that are used by the Climate Resilience Principles:

1. **Climate change hazard:** The specific climate related events (shocks) or variations (stress) that have the potential to materially impact the asset, activity or system.
2. **Climate change exposure:** The degree to which the asset, activity or system is exposed to climate change hazards, based on its geographical and sectoral position.
3. **Climate change vulnerability:** The degree to which the asset, activity or system is sensitive to related losses from exposure to climate change hazards.

By understanding these different components of risk, issuers have agency in determining a variety of resilience actions, such as reducing exposure by moving out of a flood zone, reducing vulnerability by using more resilient materials and designs, and/or by changing the probability of occurrence through better drainage or by minimising the consequences of failure through better emergency management protocols and mitigation of infrastructure failure chains. All these interventions reduce risk by addressing its different components. Box 4 below provides guidance on what risk reduction entails taking into account these three components of risk.

Box 4: Guidance on identifying risk reduction measures

Identifying climate exposure reduction measures may entail:

- Involving the various stakeholders that are exposed in a participatory process.
- Considering specific changes that may be needed based on the investments' interdependencies and potential to negatively impact infrastructure systems.
- Considering whether an investment should adjust its location or be relocated entirely

Identifying climate vulnerability measures may entail:

- Prioritising vulnerabilities, focusing on reducing those that could significantly impair the ongoing performance of the asset, project or service.
- Considering both structural and non-structural climate resilience measures (e.g. employee capacity building, improved monitoring, etc.) to address climate vulnerability.
- Considering different responses to the vulnerability: What can be done before an asset is built to reduce vulnerability? What are the options for adjustment after the system is built? How can operational practices be improved to increase resilience?

3.7 Using appropriate climate scenarios and dealing with uncertainty

The Climate Bond Standard & Certification Scheme focuses on rigorous scientific criteria to ensure that bond proceeds are invested in assets and activities compatible with a transition to a low carbon, climate resilient economy. For this, it is necessary to recognise the likelihood that warming will exceed 2ºC and resilience planning will require consideration of multiple climate scenarios well beyond conditions and changes being experienced today.

Of course, climate change acts as a risk multiplier, characterised by multiple intersecting and uncertain future hazards, interacting with other stressors to create new risks, and altering existing ones.[45] Climate models cannot reveal with certainty the potential range of climate hazards associated with a specific temperature, nor do they reveal the full range of climate impacts that may be experienced locally, though some models, particularly bottom up models, provide greater insight than others. Therefore, much of resilience planning requires flexibility to continually adapt and respond where there is a high degree of uncertainty, and robustness where there is lower uncertainty (e.g. around sea level rises).

[45]Clarke, L. et al. (2018). Chapter 17 : Sectoral Interdependencies, Multiple Stressors, and Complex Systems. Impacts, Risks, and Adaptation in the United States: The Fourth National Climate Assessment, Volume II. Washington, DC.

Issuers are therefore encouraged to implement climate resilience measures that offer flexible solutions that are robust and flexible in a variety of scenarios.

For this reason, a variety of climate models and data sets should be used that address projected climate risks and impacts for local contexts and capture the degree of temporal granularity required to capture climate change impacts. These approaches should include a variety of bottom up impact models and also top down models such as Global Climate Models (GCM) and aligned with Representative Concentration Pathways[46] (RCP) of 8.5 at a minimum and RCP 4.5 if available.

3.8 Using appropriate time horizons

Climate risks and resilience benefits must be assessed over a timeframe that is long enough to address growing physical climate risks that will impact the asset or activity and the wider system over the operational life of the asset or activity (including both risks and benefits to communities) and which will likely be more significant over time. It is noted that there are greater uncertainties associated with longer time horizons.

Key takeaway

The Principles are to be applied over the operational life of the asset, not simply the life of the financial instrument

The timeframe will need to be appropriate for the operational lifetime of the asset or activity in question. Infrastructure assets and agricultural assets, for instance, will have different lifespans depending on how long they are expected to last. Thus, issuers must both acknowledge and describe the different results that can be reported over the operational lifetime of the asset.

For some climate resilience investments, there may be a mismatch between investor and issuer climate resilience time-horizons since the impacts of physical climate risks that an asset or project is designed to withstand may be projected beyond a shorter-term time frame of an investor's or analyst's pricing scenario, or the timeframe of the investment.

Time horizons can also vary depending on the type of climate risk. The financial impact of chronic physical climate risks may accumulate incrementally over the long-term in the form of increasing operating or capital expenditures, while acute physical climate hazards (i.e. disaster-related disruptions) may be written off under a force majeure clause, removing liability from otherwise responsible parties.[47] On the other hand, as climate events become predictable and foreseeable, force majeure clauses are likely to be increasingly disputed.

3.9 Appropriate outcomes for climate resilience investments

A key question when evaluating climate risk investments is whether it is sufficient to evaluate *solely* that a robust analysis of climate risks has been undertaken to guide the risk reduction measures or outcomes, or whether to *also* evaluate the effectiveness of the proposed risk reduction measures.

For the purposes of the Climate Bonds Standard, which aims to provide assurance over the climate integrity of the underlying asset or activity that the bond proceeds are used for or linked to, it was determined that it is necessary to go beyond a requirement for robust analysis of climate risks, and also require that at a minimum, 1) assets or activities are 'fit-for-purpose' to successfully deliver their services over their operational lifetime in the face of the uncertain impacts of climate change and that 2) the investment will do no significant harm to climate resilience itself.

There is some flexibility in terms of what 'fit-for-purpose' might mean in different circumstances. However, for asset focused investments this is expected to be interpreted as the asset or activity achieving certain minimum risk tolerance (keeping with current sector norms) over the operational lifetime of the asset, and being flexible enough to achieve that in the face of climate change uncertainty, with levels of incident and disruption that are acceptable and affordable to manage. For system-focussed investments, this is expected to be interpreted as the asset or activity delivering its climate resilience service to the system in line with certain minimum risk tolerance (keeping with current sector norms) over the operational lifetime of the asset or activity, and being flexible enough to achieve that in the fact of climate change uncertainty, with levels of incident and disruption that are acceptable and affordable to manage.

[46] https://www.ipcc-data.org/guidelines/pages/glossary/glossary_r.html

[47] Anecdotally, there have been instances where project finance companies have written off assets destroyed by climate hazards under force majeure clauses, allowing the company to not bear liability. Keeping track of such instances would allow a greater understanding if the market is truly reacting to climate hazards of if a moral hazard is being created to compound the climate hazard

Depending on the context, the threshold of risk tolerance and an issuers' ability to reduce residual risks will be constrained by cost and best available technologies. Issuers are not expected to reduce residual risks completely, but that they have a plan in place to manage residual risks. This requirement applies at both the asset or activity level (the asset or activity is expected to perform over its entire lifetime) and at system level (the asset or activity will significantly contribute to system climate resilience).

As examples, depending on context and circumstances, fit-for-purpose considerations might include:

- Acceptable tolerances for service loss of critical infrastructure;
- Minimum availability of public transport routes during flooding and other extreme events;
- Forward looking annual average losses for houses and businesses within acceptable levels for typical insurance, mortgages and business lending;
- Restart times of power, water and telecoms systems within current industry best practice.

Secondly, the asset or activity should do no significant harm to climate resilience itself, i.e. increasing risk of adverse climate-related outcomes or eroding preconditions for sustainable development by indirectly increasing society's vulnerability, across time, location, or scale. These adverse outcomes should be identified and compensated for by the issuer. Such outcomes might include, for the asset, activity or system:

- Increased climate hazards, i.e. increased GHG emissions;
- Increased exposure to climate hazards, increasing vulnerability to climate change;
- Reductions in incentives to adapt;
- Creation of path dependency.

In addition to the above two outcomes, it is recommended that climate resilience investments demonstrate alignment with local and regional strategies and targets as these are designed to reflect local/national development priorities. However, in most cases, demonstrating compatibility, relevance, and contribution to related adaptation and resilience goals outlined in the SDGs, Sendai Framework, NDCs, NAPs and NAPAs will not be enough to qualify as a climate resilience investment at this stage, as these documents do not sufficiently cover the above two outcomes, nor do they require climate risk assessments. Efforts are underway to raise the ambition of the NDCs and develop long-term resilience strategies, and some NDCs have already articulated some quantitative targets for adaptation (Appendix 3).

Key takeaway

The Principles need to ensure climate resilience investments deliver assets and projects that at a minimum are fit for purpose and do no significant harm to adaptation itself

There are a wide range of climate change risk and benefit assessment methodologies with examples of climate change risk measures for different geographies, risks and asset types, Examples are given in the accompanying Technical Annex. Table 6 offers some sector specific examples of systems-focused assessment measures. However, the AREG notes the particular challenges in defining and evaluating climate resilience benefits to a system. To help address this, the sector-specific TWGs will also be requested to provide guidance on appropriate metrics and indicators for evaluating climate resilience benefits for climate resilience assets and activities in that sector. The potential range of resilience benefits to a system that could be captured are wide-ranging. In some cases, the same metrics that are used to measure climate risk may be used to calculate expected resilience benefits).

As the market matures, CBI will revisit the requirements for assessing climate resilience benefits.

Table 6: Sector-Specific Examples of System-focused Investments, their Climate Change Risk Indicators and Resilience Benefit Indicators48

System-focused Investment Examples by Sector Investments that aim to increase the resilience of the broader system.		**Climate Change Risk Indicators** For evaluating climate risks to the asset	**Climate Resilience Benefit Indicators** For evaluating the benefits delivered to the broader system
Water	Flood and stormwater defence	E.g. Risk in insurance premiums or withdrawal of insurance, regularity of floods, loss of service days for commercial assets, projected change in high-tide, sea level rise, storm surge levels	E.g. reduction in flood damage costs to commercial facilities and residential property, reduction in service outages, reduction in insurance premiums, total number or length of sewerage and drainage networks at risk from flooding, reduced investment in repair of sewer networks damaged by precipitations, rainstorms and/or flooding, number of properties affected by sewer flooding quantity of contaminated flow into drainage quality of water in surrounding water bodies, reduced number of infectious disease patients during outbreaks following flooding
	Rainwater (precipitation) harvesting	E.g. fall in projections of annual runoff, annual groundwater recharge, freshwater withdrawal rate, water dependency ratio, access to reliable drinking water	E.g. additional water made available, either through water savings or through the provision of additional useable water (change in m^3/year)
	Desalination	E.g. water dependency ratio, access to reliable drinking water	E.g. additional water made available, either through water savings or through the provision of additional useable water (change in m^3/year)
Agriculture	Landscape or supply chain interventions to restore or enhance the overall productive capability of agricultural land, e.g. via water management and allocation systems, restoration of natural habitats, pest control measures, development of climate resilient seeds able to cope with more variable water, salt,	E.g. Reduction in yields of traditional varieties	E.g. additional capacity for agricultural potential, additional agricultural production, diversified agricultural income, % cropping area with less susceptible crops/varieties, % production from controlled agriculture % cropping area with integrated pest control measures, % area with mffm and (s)nv within a defined region, % cropping area with soil conservation measures % susceptible cropping area with perennial soil cover % susceptible cropping area set aside

[48] Note that some of these measures may be used interchangeably for measuring risk and resilience benefits. Table inspiration Implementing the EBRD Green Economy Transition: Technical Guide for Consultants. page 23 Table 2: Units used to measure physical climate resilience outcomes; EU Taxonomy for Sustainable Activities. June 18, 2019. https://ec.europa.eu/info/sites/info/files/business_economy_euro/banking_and_finance/documents/190618-sustainable-finance-teg-report-taxonomy_en.pdf

	wind or other conditions.		
Buildings	Green roofs and walls, water retention gardens, porous pavements.	E.g. level of stormwater runoff during extreme precipitation and storm events	E.g. reduced damage to buildings and households, reduction in clean water demand
	Greener cities to reduce urban heat zones	E.g. urban heat stress.	E.g. less infrastructure degradation due to heat, (number of e.g. rail or tarmac replacements) reduced demand for worker and resident cooling stations (number of new centres not built)
Forestry	Wild brush clearing at landscape level,	E.g. increased frequency of wildfires, fire risk,	E.g. Reduction in wildfires and associated loss of biodiversity, infrastructure, lives from wildfire
	Regeneration or extension of natural forests and coastal natural buffer zones to create coastal barriers	E.g. soil/ land or coastal erosion, associated loss of infrastructure, biodiversity, lives	E.g. Reduction in soil/ land erosion, increases in biodiversity, reduced exposure of communities to typhoons, reduced evapotranspiration and increased soil quality, increases in timber yields, increased soil carbon and nutrients, increased regeneration of ecosystems, increased non-food forest/timber products, reduced land degradation, increased water catchment capacity
Energy	Grid resilience, back-up generation, and storage, Adoption of structural strengthening of hydropower facilities (e.g. dams, spillways, turbine houses, switchyards, ancillary infrastructure, etc.), Increasing the height of poles supporting power lines, installing conductors with hotter operating limits, Using 'low-sag' conductors	E.g. dependency on imported energy, fall in electricity access, increased customer service days at risk of loss	E.g. annual probability of loss of power events (events per year), number of customers disrupted (customers suffering loss of power per year), Increased electricity production (MWh), Reduction in downtime due to acute "land mass" events (days) Reduction in annual damage due to acute "land mass" events, Reduction of efficiency losses during period of temperature > design temperature, Reduced repair costs or decreased number of downed power lines during storms
ICT	Climate monitoring and data collection, early warning systems, vulnerability reduction to loss of power and direct disruption during extreme events, etc.	E.g. number of residents that cannot be reached with existing emergency management protocol, customer service days at risk of loss, lack of capacity to predict climate hazard events	E.g. increase of flood-proof telecommunications assets (decreased connection loss per year during extreme weather events), improved range and quality of warning systems, decreased number of residents requiring post-event evacuation

3.10 Incorporating climate resilience requirements into the Climate Bonds Standard

As noted above, when first introduced, the Climate Bond Standard incorporated screening criteria only with respect to climate change mitigation impacts. These screening criteria aimed to ensure that only assets and activities compatible with the transition to a low carbon economy where global warming is limited to no more than 2°C, and ideally 1.5°C, would be eligible for inclusion in a Certified Climate Bond. The Climate Bonds Initiative now intends to expand the criteria to ensure that all assets and activities linked to Certified Climate Bonds are also compatible with the need for assets, activities and systems to be resilient to global warming at the scale represented in the RCP 4.5 and RCP 8.5 scenarios.

However, in certain cases, some assets or activities which address climate resilience risks and deliver climate resilience benefits may be highly emissions intensive, in construction and/or operation, or lock-in other emissions intensive assets or activities. Examples might include the installation and operation of air conditioning, or desalination plants, or investments in electricity grids critical for ensuring the resilience of cities prone to disasters but currently powered with a high concentration of fossil fuel power.

Key takeaway

For the purposes of certification under the Climate Bonds Standard, the Principles need to consider the circumstances under which mitigation criteria could be relaxed in light of significant climate resilience impacts

The Climate Bonds Initiative will need to consider under what circumstances certification under the Climate Bonds Standard would be extended to use of proceeds like these examples which enhance climate resilience but may be neutral or even negative in terms of tackling GHG emissions and moving us along a transition pathway compatible with limiting global warming.[49]

If certification were to be extended to such use of proceeds, a rule set would be needed to determine when a trade-off between climate mitigation and climate resilience goals would be acceptable. This rule set might consist of a revised set of mitigation criteria for high emissions assets or projects that deliver significant resilience benefits, or a more broadly applicable set of 'trade-off' rules for exceptional circumstances under which mitigation criteria do not apply.

The former approach would be akin to the approach proposed by the EU TEG for the EU Sustainability Taxonomy, where activities are recognised as sustainable if they make a substantial contribution to climate adaptation, and 'do no significant harm' to climate mitigation. What 'do no significant harm' to climate mitigation might mean in practice is still under discussion by the EU TEG, with proposals due later in 2019.

For the latter approach, the AREG considered a number of quantitative approaches for assessing trade-offs between climate resilience and mitigation. However, the group concluded that there is insufficient evidence that such quantitative approaches could be robustly used to make complex trade-off decisions, and that therefore none of these methods would be used at this time.

The AREG also considered whether the issuer might be permitted to undertake or purchase offsets for their carbon emissions. However, this approach does not fit within the overall approach to setting criteria under the Climate Bonds Standard, where the objective is for each sector (and associated assets and activities) to reduce its emissions to the best of its ability based on available technologies and best practices at this time. Therefore, this option was not pursued further.

Instead, the AREG recommend a more qualitative approach. To assist with this, the AREG has considered the circumstances under which less stringent mitigation criteria could be applied based on a consideration of both the development context and the potential trade-offs between the delivery of climate resilience benefits and climate mitigation benefits.

This is challenging and no definitive proposal has yet been agreed. One option is that for countries with high climate change risks and limited responsibility for global GHG emissions, protecting human communities and ecosystems might override mitigation considerations. More specifically, if a community, country or region has demonstrated high adaptation needs and the investment addresses those critical needs, it may be appropriate that Climate Resilience assets and activities that address those needs may not be required to demonstrate zero GHG emissions impact, but instead

[49] It is important to note here that at present the climate mitigation criteria of the Climate Bonds Standard do not include embedded carbon in any assessment of emissions associated with that asset for the purpose of assessing whether the asset meets the mitigation criteria. Therefore, in the immediate term, the decision is whether to allow certification of bonds which enhance climate resilience but at the cost of high operating emissions. In the longer term, as embedded carbon is accounted for in the Mitigation Criteria of the Climate Bonds Standard, then the decision will be whether to allow certification of bonds which enhance climate resilience but at the cost of high construction and/or operating emissions.

show that other less emissions intensive options have been considered and ruled out for valid reasons[50] and that the resilience investment is not unduly locking in high emissions assets or technologies or would inhibit the country from meeting its UNFCCC commitments. A broader view of GHG impacts might also need to include avoided GHG emissions that might be incurred in the event of a disaster.[51]

At this time, further thinking is needed on appropriate 'trade-off' rules and sector-specific TWGs are requested to give additional guidance on this when using these Principles to develop specific Climate Resilience Criteria for assets and projects in that sector.

A decision also needs to be made regarding whether such trade-offs would be permitted only for system-focussed investments or also asset-focussed investments.

It is noted that relaxing mitigation requirements for eligible use of proceeds for a Certified Climate Bond would be a significant change for the Climate Bonds Standard & Certification Scheme, which at present requires that both climate mitigation and climate resilience criteria are met for a bond to be certified. Therefore, these proposals will need the particular review and approval of the Climate Bonds Standards Board to take forward.

3.11 Reflections on the cost and other practical implications of complying with the Climate Resilience Principles

Robust evidence derived from, inter alia, authoritative and peer-reviewed models, analyses and reports, relevant national and/or regional strategies and policies, and academic research must be used in the climate risk and climate benefit assessments. There may be costs involved in procuring these resources and information, although CBI's aim is not to place an undue burden on issuers, recognising that actionable climate science data are increasingly available from public sources. Furthermore, in the course of creating a climate resilient project, the asset owner will likely have carried out the majority of what compliance requires. The additional cost will thus be largely related to accessing the information and making it available to verifiers

In addition, the Principles attempt to reduce cost burdens by encouraging boundary setting as part of typical project decision making, simplifying complex climate risk information and referring to established methodologies.

[50] Such as the lack of a viable low carbon alternative.

[51] Infrastructure damaged or destroyed in a disaster can result in significant increases in carbon emissions. For example, rebuilding roads and power plants are carbon-intensive activities. While installing a sea wall also involves a high level of embedded carbon, it would prevent the future need to rebuild other high-carbon infrastructures.

4 The Climate Resilience Principles

4.1 Summarising the Principles

As noted above, the Principles set forth a framework that will enable each of the TWGs convened by the Climate Bonds Initiative to develop sector-specific criteria that appropriately evaluate the climate resilience relevance, efficacy, and benefits/impacts that result from assets and activities in that sector.

In layman's terms, the Principles require issuers to understand the climate risks faced by the asset and/or activity and system which is the focus of the bond's use of proceeds, or impacted by it, and to address those risks through flexible risk-reduction measures which take account of inherent uncertainties around climate change, and ensure the asset, activity and/or system is 'fit-for-purpose' in the face of that uncertainty. Regular monitoring and (re)evaluation of the climate resilience performance of assets and activities is required to ensure adjustments to risk reduction measures are made over time as needed. For assets and activities focused on increasing resilience of a system, the Principles additionally require issuers to assess and address climate resilience benefits.

The Climate Resilience Principles are divided into three parts, illustrated in Figure 5 and briefly summarized in Table 1:

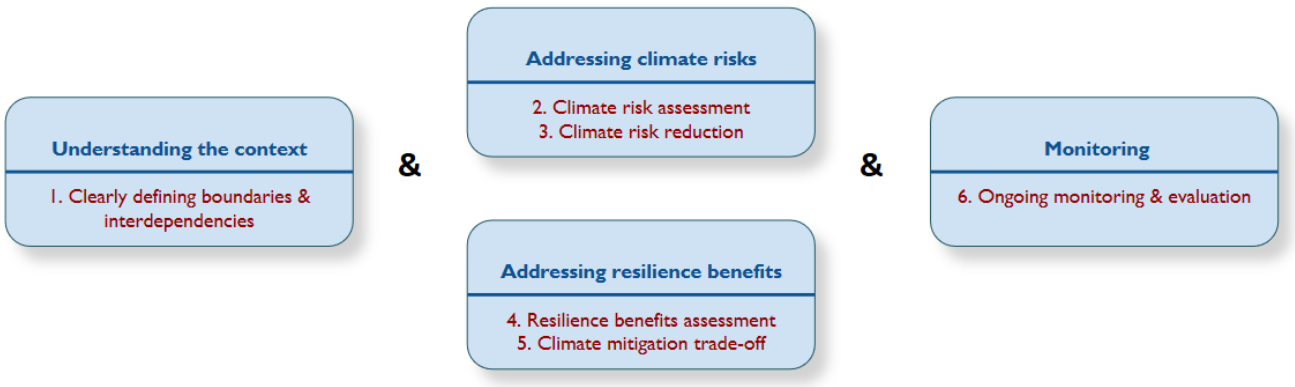
Part 1: Framing principle: This addresses the key preliminary aspects that need to be considered as they inform the risk and benefit assessments undertaken in Part 2, namely determining the asset's or project's boundary and interdependencies with the systems of which it is a part.

Part II: Design principles: These address the climate risk assessment that needs to be undertaken in order to design, implement and operate assets and activities that appropriately address those risks. This includes understanding physical climate hazard, exposure and vulnerability, and potential trade-offs between climate resilience and climate mitigation impacts. For assets and activities focused on enhancing the resilience of the system, this also includes a resilience benefits assessment.

Part III: On-going management principle: This addresses the need for ongoing monitoring and evaluation by the issuer to enable assets and activities to remain in step with evolving climate hazards, exposures and vulnerabilities, and changing opportunities and needs for resilience benefits.

As a bundle, the three-part Climate Resilience Principles form the framework for Climate Resilience Criteria to be applied to all assets and activities included in a bond seeking certification under the Climate Bonds Standard.

Figure 5: Overview of the Climate Resilience Principles



4.2 Climate Resilience Principles Part 1: Framing Principles

This section presents the Climate Resilience Principles and focuses on the preliminary aspects that are mandatory for issuers to consider as they inform the risk and benefit assessments undertaken in Part 2.

Table 7: Climate Resilience Principles - Framing

Principle	Description
1. Assets and activities being invested in must have clearly defined boundaries and identify interdependencies for assessing climate risks and resilience impacts	The boundaries of all assets and activities must be clearly defined, as well as the internal and external interdependencies between those assets and activities and the broader system affected by them. These boundaries and interdependencies are important for scoping risk and benefits assessments, for reducing risks and maximizing benefits, for ensuring the asset or activity is fit-for-purpose, for avoiding potential failure chains and for avoiding maladaptation – all concepts addressed in the below Design Principles. Ideally, the boundaries and the interdependencies within those boundaries will include what is affected by the asset or activity and go beyond what the asset or activity owner has control over (e.g. by contract or obligation), in order that both potential critical or cascading failures within the system and contributions to collateral system benefits over the lifetime of the asset or activity are taken into consideration. It is recognised that some interdependent risks may be costly to evaluate and address, with implications that are beyond the sphere of influence for the asset or activity owner or manager. Nonetheless, issuers must assess, document and allow for interdependencies to the extent possible.

4.3 Climate Resilience Principles: Part 2: Design Principles

Part 2 of the Climate Resilience Principles addresses the requirement that the asset or activity being invested in does substantially mitigate climate risks to the asset or activity itself and/or the system it is part of. Specifically, it determines that:

- The asset or activity is fit-for-purpose in the face of climate change over its intended lifespan. See Table 8.
- System-focused assets and activities deliver resilience benefits. See Table 9.

Lastly, part 2 of the Principles also addresses potential trade-offs between climate mitigation and climate resilience benefits that can sometimes arise, and must be reduced to the full extent possible, in resilience projects. See Table 10.

Table 8: Climate Resilience Principles - Risk Assessment

Principle	Description
2. Physical climate risk assessments for assets and activities being invested in	Assessments of physical climate change hazards, exposures and vulnerabilities must be undertaken to ensure changing climate conditions throughout the full operating life of the asset or activity are identified and addressed as needed, in a manner which is robust and flexible given the inherent uncertainties over the impacts of future climate change and resulting climate hazards, vulnerabilities and exposure. The level of assessment detail should match the expected level of hazard identified both in the current and expected future climate during the asset or activity's lifetime. As with other environmental impact assessments, if a screening does not flag a major risk, no further assessment will be required. Assessing **climate change hazards**-requires the use of appropriate climate modelling to identify the likely events (shocks) or variations (stress) that have the potential to materially impact the assets or project. Hazard assessments will require consideration of multiple climate scenarios (i.e. RCP 8.5 at a minimum and RCP 4.5 if available) and use bottom up climate impact models to determine the context specific climate hazards and impacts as appropriate for the size, type, location and lifespan of the asset or activity. For major climate hazards, assessment methods should provide projected levels of hazards in a number of key forms: annual probability of

	failure, annual costs of loss or damage, and indirect transfer of risk to or from the project, such as insurability thresholds. Assessing **climate change exposure** requires considering the degree to which an asset or activity is exposed to a specific climate hazard, depending on its geographic and sector market. Exposure assessments generally reference different hazard zone(s) as relevant to the asset or project and identify the people, property, systems, and other elements located within a hazard zone. Assessing **climate change vulnerability** requires determining the degree to which the asset or activity is sensitive to losses from exposure to climate change hazards. Vulnerability assessments generally entail[52] defining an appropriate timeframe, material to the asset or project's goals, working lifetime and impacts, over which climate change impacts should be assessed and managed and identifying asset- or project-specific vulnerabilities that may result in material loss for the issuer.
3. Risk reduction measures for the identified climate resilience risks	It must be demonstrated that the risks identified through the risk assessment have been mitigated to a tolerable level such that the asset or activity is fit-for-purpose, and does no significant harm to the resilience of the system of which it is a part, taking into account the asset or activity's boundaries, interdependencies and sector. As examples, depending on context and circumstances, fit-for-purpose considerations should address minimising annual average loss and the probability of failure over the asset or activity's operational lifetime, and therefore include: - Acceptable tolerances for service loss of critical infrastructure; - Minimum availability of public transport routes during flooding and other extreme events; - Forward looking annual average losses for houses and businesses within acceptable levels for typical insurance, mortgages and business lending; - Restart times of power, water and telecoms systems within current industry best practice And doing no significant harm to climate resilience itself means *not*: - Increasing climate hazards, i.e. increased GHG emissions; - Increasing exposure to climate hazards, increasing vulnerability to climate change; - Reducing in incentives to adapt; - Creating path dependency. Issuers are encouraged to compare and select risk mitigation options that offer flexible solutions that are robust in a variety of scenarios. It is likely that they will need to go beyond current insurability thresholds and codes/regulations. It is also recommended that climate resilience considerations demonstrate alignment with local and regional strategies and targets as these are designed to reflect local/national development priorities. Identifying climate exposure reduction measures may entail: - Involving the various stakeholders that are exposed in a participatory process. - Considering specific changes that may be needed based on the investments' interdependencies and potential to negatively impact infrastructure systems. - Considering whether an asset or activity should adjust its location or be relocated entirely Identifying climate vulnerability measures may entail: - Prioritising vulnerabilities, focusing on reducing those that could significantly impair the ongoing performance of the asset or activity. - Considering both structural and non-structural climate resilience measures (e.g. employee capacity building, improved monitoring, etc.) to address climate vulnerability. Considering different responses to the vulnerability: e.g. What can be done before an asset is built to reduce vulnerability? What are the options to adjust after the asset is built? How can operational practices be improved to increase resilience?

[52] Banco Interamericano de Desarrollo (BID) et al., "2016 Joint Report On Multilateral Development Banks' Climate Finance" (Banco Interamericano de Desarrollo (BID), September 11, 2017), https://doi.org/10.18235/0000806.

Table 9: Climate Resilience Benefit Assessment Principles

Principle	Description
4. Expected climate resilience benefits assessment undertaken for system focused assets and activities being invested in	The climate resilience benefits of system focused assets and activities should be assessed and demonstrated, using specific and quantifiable performance standards or thresholds to serve as benchmarks for expected benefits to the broader system. Specifically, it must be demonstrated that the asset or activity is fit for purpose in the sense that it significantly contributes to enhancing climate resilience at a systemic level. As examples, depending on context and circumstances, fit-for-purpose considerations for system focused assets and activities might include: - Minimum availability of, or acceptable tolerances, for service provision; - Services operable for the range of climate hazards indicated by existing current experience through to implications of RCP 8.5, as informed by bottom up climate risk models and assessments Issuers are encouraged to compare and select benefit options that offer flexible solutions that are robust in a variety of scenarios. It is likely that they will need to go beyond current insurability thresholds and codes/regulations. It is also recommended that system focused climate resilience assets and activities demonstrate alignment with local and regional strategies and targets as these are designed to reflect local/national development priorities. Identifying and assessing climate benefits would also ideally entail: - Demonstrating how the asset or activity delivers the stated resilience objectives to a set of beneficiaries - Consideration of public goods creation, even in the case of a private asset, going beyond an issuer's assets under direct ownership; - Describe how the asset or activity contributes to transformative change (e.g. reduces market and policy barriers for other resilience assets or activities to enter the market) More specific guidance for this Principle may emerge over time, as the market gains understanding of metrics and methodologies for calculating resilience benefits appropriate to each sector.

Table 10: Addressing trade-offs with climate mitigation targets

Principle	Description
5. Mitigation trade-offs assessed	Mitigation requirements may be lowered or considered inconsequential for climate resilience focused assets or activities whose resilience benefits considerably outweigh associated emissions. Discussion is ongoing on the rule set for relaxing mitigation criteria. If and when established, demonstration of compliance with this rule set will be required in the event the asset or project does not meet the mitigation requirements in the appropriate sector-specific Criteria under the Climate Bonds Standard. Options under discussion: - Exception based on location: e.g. in a country with specific and high climate resilience risks and needs; - Exception based on inclusion on a list of exempt assets or activities which are pre-screened to assess likely relative contributions to climate change resilience and mitigation e.g. cooling systems to avoid loss of food or desalination plants to secure water supplies; and - A more flexible rule set to be applied on a case-by-case, context-specific basis.

4.4 Climate Resilience Principles Part 3: Ongoing Climate Resilience Principle Requirements

These Principles address the need for ongoing monitoring and evaluation to ensure resilience actions remain in step with evolving climate hazards, exposure and vulnerability, and changing opportunities and needs for resilience benefits. See Table 11.

Table 11: Ongoing Climate Resilience Principles: Ongoing monitoring and evaluation

Principle	Description
6. Ongoing monitoring and evaluation	Issuers should have a viable plan to undertake ongoing monitoring of climate risks and benefits linked to the assets and activities to enable them to determine whether they continue to be fit-for-purpose and maintain any climate resilience benefits as climate hazards, exposures and vulnerabilities evolve. In terms of ongoing reporting to the Climate Bonds Initiative, the issuer must annually verify this ongoing monitoring and evaluation of climate resilience performance. This reporting will only be required for the lifespan of the Certified Climate Bond.

5 Taking this Work Forward

5.1 Advice to Sector Technical Working Groups

As explained above, these Principles will be applied by the sector specific TWGs to establish Climate Resilience Criteria for investments in assets and activities in that sector. Once sector-specific Climate Resilience Criteria are finalized, those Criteria will be used to screen bonds' eligibility for Climate Bond Certification. This will, it is hoped, incentivise bond issuers to mainstream climate resilience into climate investments. It is hoped also that these Principles and the sector specific Criteria arising from them can also serve as a model for other certification and assessment schemes for climate resilient investments, especially governments that are considering promoting green bonds at national and local levels.

For the purposes of stimulating appropriate investment in resilience in the sector, and developing appropriate climate resilience screening criteria for those investments, the TWGs are asked to identify:

- The types of asset-focused and system-focused assets and activities that might be seen or are needed in that sector, with specific examples;
- Potential for climate resilience benefits from this sector, with examples of assets and activities and the types of benefits they might deliver; *and*
- Potential for adverse climate resilience or sustainable development outcomes within the sector, and/or particular assets and activities that pose a high risk of adverse outcomes.

With that in mind, each TWG is asked to reflect on and make specific recommendations in respect of the following aspects to add further precision to the application of the overarching Principles described here:

- Appropriate geographic or other spatial boundaries for climate risk and benefits assessments for assets and activities in that sector, taking into consideration the broader system affected by those assets and activities;
- Expected internal and external interdependencies between assets or activities in that sector and the system(s) it serves or impacts upon, including highlighting potential failure chains and opportunities to maximise resilience benefit;
- Appropriate time horizons for climate resilience assessments for the assets and activities in scope for that sector, based on the lifetimes of assets in that sector and the duration of system impacts;
- The key climate risks – including hazards, exposures and vulnerabilities - likely to be experienced by assets and activities in that sector;
- Models, methodologies and data sets that would be most appropriate for determining likely physical climate risks to be faced in context for activities and assets in that sector;
- Climate change risk assessment methodologies and climate resilience benefit methodologies that might be especially relevant or appropriate for assets and activities in that sector. This includes determining which if any risk or benefit assessment methodologies or processes could be adopted as a 'pre-approved proxy' indicator of sufficient performance, such that any asset or project or associated investment assessed using it could be deemed to have automatically met some or all of these Climate Resilience Principles53. Though none are created explicitly for the Principles, examples of various tools that may include useful information for certain Standards application are included in the accompanying Technical Annex;
- Climate change risk and benefit measures and metrics for assets and activities in that sector. These measures to incorporate an interpretation of what 'fit-for-purpose' and 'do no significant harm' means for assets and projects in that sector under the uncertainty of climate change scenarios, addressing levels of minimum risk tolerance in keeping with current sector norms. This requirement applies at both an asset and activity level (the asset or activity will perform as per the specification over its entire lifetime in the face of the uncertainties over future climate change impacts) and at system level (the asset or activity will significantly contribute to system resilience with levels of incident and disruption that are acceptable today and affordable to manage);
- Any assets or activities in that sector that might be considered to deliver resilience benefits without risk of maladaptation and any implications in terms of how the Principles might be applied for those assets and projects;
- Any assets and activities or more granular solutions in that sector that offer flexible solutions to addressing climate resilience that are robust in a variety of scenarios, and might be privileged above other options;

[53] Climate Bonds Initiative is currently in discussion with the World Bank regarding their Resilience Rating System to explore the potential that this could be adopted as a pre-approved proxy, following assessment on a sector by sector basis.

- Any assets or activities where resilience benefits might be deemed sufficiently high to justify relaxing any mitigation criteria for that sector, and the rationale for that, including a trade-off rule set specific to those assets or projects; and
- Appropriate frequency of climate risk and resilience benefit reassessments for assets and projects in this sector as part of an ongoing monitoring system.

When undertaking this work, the TWGs are reminded of the overarching requirements for all sector Criteria for the Climate Bonds Standard: that they are practical, and within the scope of time, resources, data, and skills available to bond issuers and verifiers. Specifically, issuers should:

- Be able to use existing public or commercially available science-based climate scenarios, hazards, exposure and vulnerability data provided by government agencies or the IPCC where possible to allow comparability and ensure data quality;
- Be able to prepare the assessment within a reasonable amount of time;
- Be able to be achieve the assessment preparation at reasonable cost; *and*
- Be able to prepare an assessment that cover all the Climate Resilience Principles, so that an approved Climate Bonds Standard verifier can check that the assessment meets the requirements of the Climate Bonds Standard & Certification Scheme.

6 Appendices

Appendix 1: Insurance Linked Securities

Insurance-linked Securities (ILS) are financial instruments the underlying value of which is dependent on insurance-related events. ILS support collateralized (re)insurance, usually protecting against low-frequency-high-severity events such as natural catastrophe and life/mortality disasters, transferring such risks to capital market investors from insurance companies.

Catastrophe Bonds (Catbonds) constitute the most common form of ILS. Catastrophe bonds are reinsurance contracts that allow the issuer to access higher levels of capital in the event of a triggering event through a special purpose vehicle set up solely to issue the bond, usually a captive or other form of Self-insurance Company. Investors take the risk of an event occurring in exchange for an attractive yield and access to assets uncorrelated to traditional asset classes. Catbonds do not necessarily involve traditional debt issuance, with covers typically provided for natural catastrophe exposures and typically no restriction on the use of the proceeds of the catastrophe bond.

Parametric Solutions relate to a type of trigger attached to an insurance product or an ILS instrument which payout based on the threshold or index of specific hazard incidence within a predetermined geographical zone. Once these thresholds are met (for instance wind speed, timeframe without rain, volume of precipitation in a timeframe) and surpassed an automatic payment is generated.

Appendix 2: Examples of quantitative adaptation goals and targets in NDCs[54]

Sector	Examples
Water	- Ensure full access to drinking water by 2025 (Benin) - Increase water storage capacity from 596 m^3 to 3,997 m^3 in 2015–2030 (Bolivia) - Increase desalination capacity by 50% from 2015 by 2025 (Antigua and Barbuda)
Buildings	- By 2030, all buildings are improved and prepared for extreme climate event (Antigua and Barbuda)
Agriculture	- Convert 1 million ha of grain fields into fruit plantations to protect against erosion (Morocco) - Increase the amount of irrigated land to 3.14 million ha (Afghanistan) - Reduce post-harvest crop losses to 1% through treatment and storage
Ecosystems and Biodiversity	- Protect 20% of marine environments by 2020 - Regenerate 40% of degraded forests and rangelands - Establish 150,000 ha of protected marine areas
Forestry	- Increase forest coverage to 20% by 2020 and 30% by 2025 (Ethiopia) - Maintain 27% forest coverage - Achieve 0% deforestation rate by 2030
Energy	- Ensure that hydropower generation remains at the same level regardless of climate change impacts - Increase the proportion of renewable energy to 79–81% by 2030

[54] Pg. 68. UNFCCC (2016b). Aggregate effect of the intended nationally determined contributions: an update. Synthesis report by the secretariat. Bonn, Germany: United Nations Framework Convention on Climate Change. Retrieved from http://unfccc. int/resource/docs/2016/cop22/eng/02.pdf

Kato, T., and Ellis, J. (2016). Communicating progress in national and global adaptation to climate change. Paris, France: Organisation for Economic Co-operation and Development. Retrieved from https://www.oecd-ilibrary.org/docserver/5jlww009v1hj-en.pdf?expires=1563780165&id=id&accname=guest&checksum=B38380F79C48EB416A23A0233333C831