WATER CLIMATE BONDS STANDARD

Defining Expectations for Water-Related Climate Bonds in a Dynamic Climate

Background Paper to Eligibility Criteria

Water Technical Working Group

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We, the Consortium Partners, would like to extend our sincere gratitude to John Matthews, Secretariat Coordinator for the Alliance for Global Water Adaptation (**AGWA**) and lead specialist on the Technical Working Group for the Water Climate Bonds Standard. John was instrumental in driving the development of the Standard and for leading the discussions with the TWG.

We would also like to thank all members of the Technical Working Group and Industry Working Group for their time and valuable expertise that helped shape the Standard.

Lastly, thank you to the Ceres team, in particular Lital Kroll, for providing additional support during the development process.

1. Introduction

Water-related projects are a growing subset of the green bonds market that encourages investments for a low carbon and climate resilient economy.

The **Water Climate Bonds Standard** is intended to provide investors with verifiable, science-based criteria for evaluating water-related bonds, and to assist issuers in the global corporate, municipal, sovereign and supra-sovereign markets in differentiating their green bond offerings.

By establishing this screening tool, we aim to maintain credibility in the green bonds market, which reached almost US$40bn in annual issuances as of 2014 and could be valued at US$1tn by 2020[1].

This standard can be used to evaluate projects as diverse as industrial water efficiency, reuse, catchment or watershed restoration and or large-scale water supply infrastructure development.

This document provides the necessary methodology and process to evaluate a project's likely compatibility with the **Water Climate Bonds Standard**, whether you are a project sponsor, an underwriter, an auditor or a bond investor.

This Standard should be recognized as a starting point and can be supplemented by other relevant standards that cover areas such as stakeholder engagement, social or human rights.[2] We emphasise that the proposed criteria are provisional and may be adapted either due to public feedback or future developments in the water sector.

The Water Climate Bond Standard Consortium[3] and Technical Working Group (TWG) have undertaken best endeavors to present a comprehensive first version of the Standard, however it is acknowledged that revisions will be needed over time.

Accordingly, **feedback** is welcomed in order to ensure the Water Climate Bonds Standard are as robust, credible and practical as possible.

We also recommend that the Standard be reviewed at least annually in the first three years of its use.

Questions which we would particularly welcome responses to are highlighted in italicized, blue boxes throughout the document.

[1] http://www.climatebonds.net/2015/04/media-digest-march-emerging-mkts-standards-green-bond-principles-top-agenda-%E2%80%93-fin-times

[2] For an example of standards and protocols relevant to social issues related to water please see *Guidance on Water-Related Human Rights and Social Risks for Issuers, Underwriters and Bond Buyers* by the Consortium in **Appendix E**

[3] Climate Bonds Initiative, Ceres, CDP and WRI

2. The Green bond market and the opportunity for the water sector

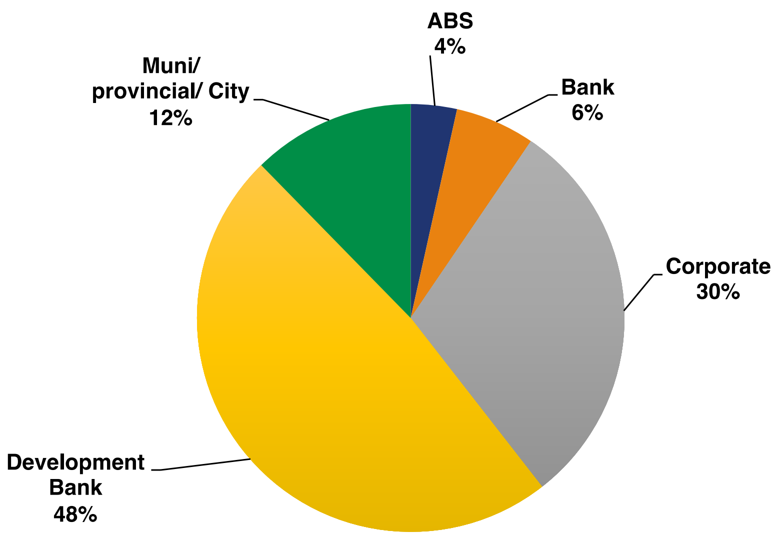
State of the market

The European Investment Bank and World Bank were the first entities in the global market to offer green bonds (See **Box 1** for terminology around green and climate bonds). Since those initial offerings in 2007-2008, the labeled green bond market has experienced explosive growth, from US$3bn in 2012 to US$36bn in 2014 to an anticipated $50bn 2015[4].

The growing attraction to green bonds is in the underlying assets these financial instruments offer investors: proceeds are directly used to finance climate change solutions and related environmental activities. Projects funded by green bonds are located across the globe and have focused on a variety of goals, from increasing the resiliency of water systems to boosting energy efficiency.

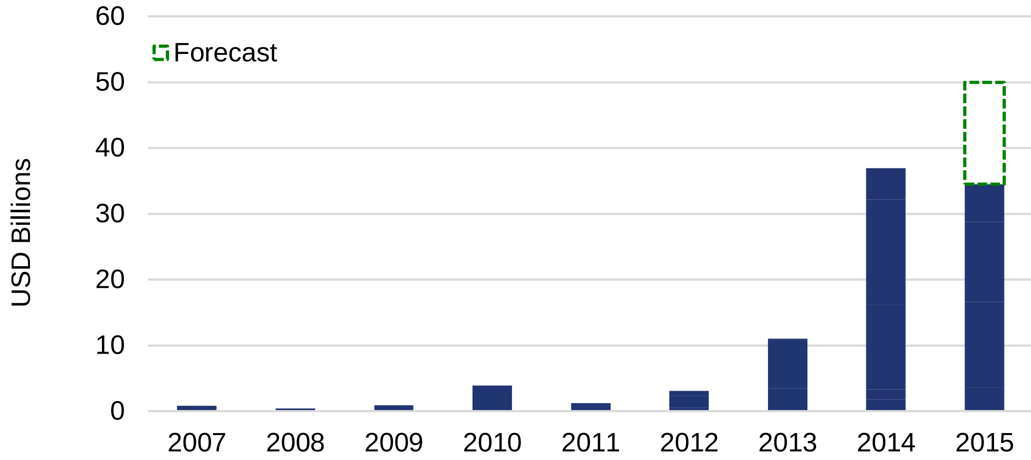
Since the original emergence of green bonds offered by the multilateral development banks, the market has diversified to include offerings from government agencies, municipalities, utilities and corporations.

Figure 1: Green bond issuers by issuer type



[4] Climate Bonds State of the Market Report 2015

Figure 2: Amount of green bonds issued to date in US$



Box 1: A bond by any other name

The terms used to describe bonds funding projects with environmental objectives have proliferated nearly as quickly as the number of green bonds in the marketplace.

Green bonds are the most common and comprehensive term for labeled bonds that claim to be directed toward projects and assets with environmental benefit. The "environment" may refer to a specific locality, such as a particular river or wetland, or to a more generalized benefit, such as lower greenhouse gas (GHG) emissions.

Climate bonds are aimed at projects and assets to reduce or avoid GHG emissions or to facilitate adaptation and resilience to climate change.

Blue bonds is a term sometimes used to refer to bond offerings that drive capital toward water-related projects and assets.

The Water Climate Bond Standard is intended for use in determining the eligibility of bonds financing water-related projects and assets for inclusion in indices or portfolios in the green bond market.

The opportunity for the water sector

The relationship between the management of water for economic purposes and water as a part of the natural landscape is often articulated through engineered water infrastructure — hydropower turbines, desalinization facilities, dams, groundwater pumps, canals, diversions, storm water structures, flood protection, irrigation systems, wastewater treatment facilities and other facilities.

These are the types of assets that most of us think of when we hear the phrase "water projects." The era of smart infrastructure is also expanding water infrastructure to encompass the world of data and monitoring, such as smart metering and real time systems management.

Yet many investments in water management may not be described or envisioned as "water projects," though water is an integral component of their operation, design, and function. These include projects that use water, such as mining, manufacturing, power-generation, refinery systems, general cooling uses and irrigation as part of agricultural production.

In some cases, improvements to water projects may involve energy or water efficiency or the allocation of water to new or existing stakeholders, such as underserved communities or ecosystems.

Governments may be investing in these types of water projects, but so too are corporations seeking to access water or to manage their exposure to growing water stress.

Water projects may be aimed at managing the impact of too much water as well as too little, altering water quality, or water that arrives seasonally too soon or too late Investments to respond to potential coastal inundation or adaptation initiatives directed at flood-prone inland areas may also be considered to be water projects. Water quality projects are very common for cities and farms

Water infrastructure has in recent years also come to encompass natural systems that provide, among other ecosystem services, the treatment, capture or delivery of water. These natural systems may include forests that filter water, aquifers that store water for drinking or for flood control, and wetlands that attenuate storm surge or process wastewater effluent.

Investment in the protection or restoration of these natural forms of infrastructure should also be considered "water projects."

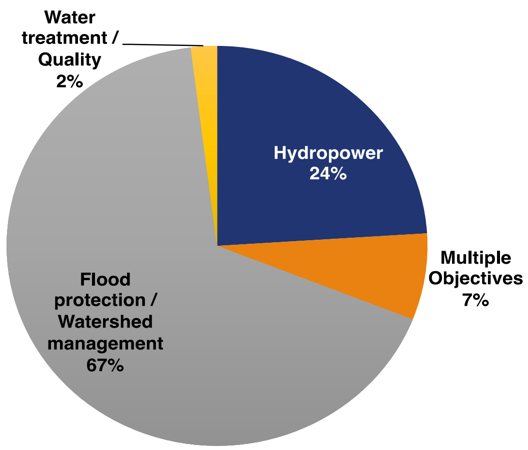
Investments in all of these types of water projects are happening in the public sphere and private markets throughout the world. Developed countries still spend the bulk of global capital directed to water investments, typically favoring the maintenance, expansion, and re-commissioning of existing assets.

The developed world is also expanding its water investments into new water projects as their economies and populations grow with associated increase in demand for energy, potable water, and more stable agriculture.

While the developed world is *improving* water security, the developing world is attempting to *establish* water security. Much of the investment in the developing world is focused on new, expanded infrastructure. More than 300 hydropower facilities are in development in the Himalayas and many more are now planned in the Mekong basin in southeast Asia is an example while recent estimates suggest comparable numbers for the Andes. and Africa.

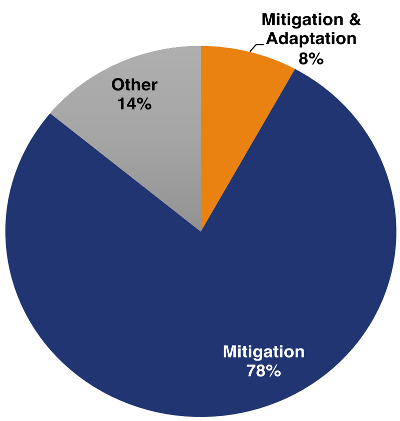
Given the global need for both new and rehabilitated water infrastructure, investments in both categories could be eligible for green bonds.

Figure 3: Types of Water Projects Funded by Green Bonds in the Market



Climate change has been a core component driving the development of the green bond market. Many of the offerings to date have included water projects, even when water was not explicitly addressed.

Figure 4: Purpose of historic green bond offerings



Most of the green bonds issued to date have been for the purposes of climate mitigation—the reduction or avoidance of GHG emissions (See Figure 4). Energy production, reduced energy consumption, and carbon storage and sequestration are all climate mitigation projects.

Climate adaptation projects are focused on addressing existing or projected climate impacts, such as increasingly severe droughts and floods.

Water projects and assets offer the potential to invest in both climate mitigation and adaptation projects to climate change, where in some cases both mitigation and adaptation are relevant to a single project.

How Green Bond Certification Can Grow the Market

Standards are critical to ensuring the continued credibility and growth of the green bond market. A **Water Climate Bonds Standard** should ensure that labeled green bonds for a wide variety of water-related projects and assets are held to common standards of robust, low-carbon and climate resilient water management. All water-related projects and assets that are certified under the **Standard** should continue to bring environmental and climate benefits over the operational lifetime of the project.

In order to meaningfully grow the market, water-related green bonds should meet the needs of both investors and issuers.

For bond investors, this means eligibility criteria should promote bond issuances that are:

- Relatively straightforward, predictable, and easy to understand (e.g., in terms of the source, and reliability of expected cash flows);
- Transparent regarding use of proceeds and intended impacts, allowing independent third-party scrutiny;
- Sizable and liquid, and preferably rated;
- A comparable investment opportunity relative to non-green-labeled bonds.

For bond issuers, this means eligibility criteria should:

- Allow a relatively wide scope for eligible project and assets;
- Not restrict innovation or appropriate local solutions and tradeoffs;
- Demonstrate efficacy and expertise that promote trust and confidence;
- Clarify how environmental risks are reduced or eliminated, and how the issuance will ultimately promote environmental benefits.

3. Process for developing the Water Climate Bond Standard

The **Water Climate Bond Standard** is one of several sector-specific standards developed under the Climate Bonds Standard & Certification Scheme (CBSCS). The objective of the Scheme is to catalyze increased investment in projects and assets that support a transition to a low-carbon and climate resilient economy. Achieving this objective necessitates the development of verifiable, evidence-based criteria for certifying bond offerings linked to water-related assets and activities that result in beneficial climate-related impacts.

The Consortium

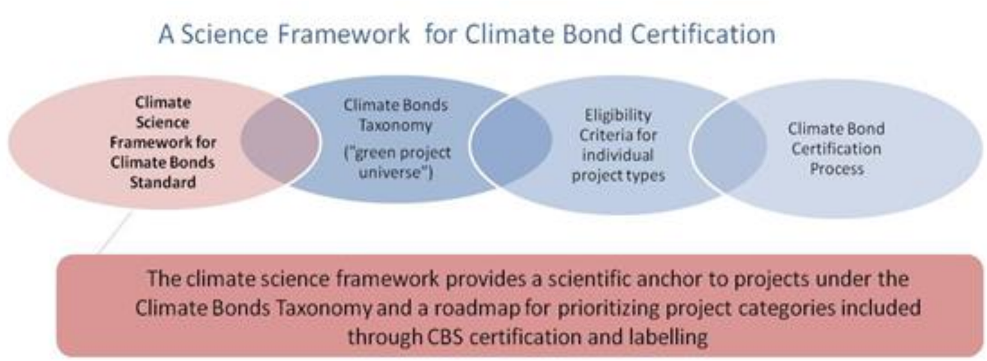
The Climate Bonds Initiative in conjunction with Ceres, World Resource Institute (WRI), and CDP [the Consortium], oversaw the development of the Water Climate Bond Standard according to the criteria development process governed by the Climate Bond Standards Board as outlined below. For more information on the Consortium, see **Appendix C.**

Governance

The Climate Bond Standards Board provides independent oversight over the implementation and operation of the Climate Bonds Standards & Certification Scheme. All standards and documentation relating to guidance and strategic development of the Scheme are approved by the Board. Decision-making is implemented through consensus. The Board members comprise a range of asset owners' civil representatives and NGOs with approximately US$34tn of assets under management. For more information on the Board, see **Appendix J.**

Climate Science Framework

The Climate Bonds Scientific Framework is a rigorous, scientifically grounded analysis on emission mitigation pathways, technology options and impact that anchor the Climate Bonds Taxonomy and certification criteria of the Climate Bonds Standard to the latest views of the climate science community. It provides a sound, coherent foundation for continued development of sector-specific eligibility criteria that prospective debt issuances must meet in order to be certified as Climate Bonds.



The Climate Bonds Scientific Framework is overseen by the Climate Bonds Initiative Board and implemented by Climate Bonds Initiative staff and a network of climate research institutions led by the Potsdam Institute for Climate Impact Research (PIK). PIK is the world's leading institution in energy-economic modeling of global carbon budgets and mitigation pathways.

Technical Working Groups

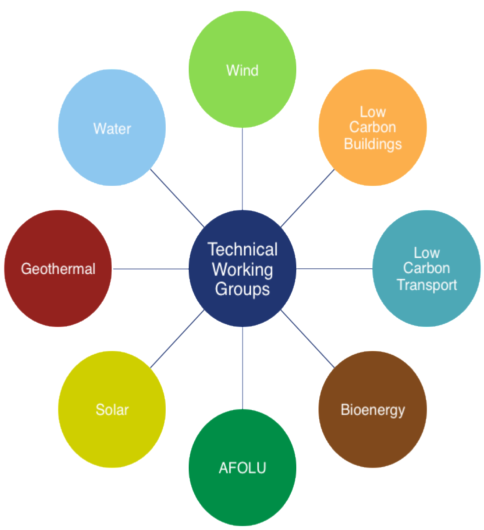
Technical Working Groups (TWG) consisting of key experts from around the world representing academia, international agencies, industry and NGOs develop low carbon eligibility criteria for each sector of the global economy under the Climate Bonds Standard. There are eight TWGs responsible for defined areas as reflected in **Fig 5**.

Technical Working Groups are responsible for:

1. Drafting a research brief that identifies the key issues and investment opportunities for the sector;
2. Developing a discussion paper that reflects the technical working group process with proposed eligibility criteria for the key investment areas within the sector;
3. Making final recommendations about eligibility criteria to the Climate Bond Standards Board.

Participants in the Technical Working Group for the Water Climate Bond Standard can be found in **Appendix G**.

Figure 5. Technical Working Groups under the Climate Bonds Standard



Industry Working Groups

The Industry Working Groups (IWG) consisting of commercial banks, companies, public sector entities and development banks consult on structure and content of the sector-specific standards.

They also comment on proposed eligibility criteria and processes for standard compliance, to ensure they are practical and conducive to a rapid diffusion of the standard in the market.

Participants in the Industry Working Group for the Green Water Bond Standard can be found in **Appendix H.**

Key issues in developing a climate bond standard for water

Climate Change: A Central Element

Water management systems, especially water infrastructure, can have relatively long operating lifespans — usually decades, sometimes centuries— and these long life cycles have important implications for how we conceive of “sustainable” infrastructure. Projects we design and build today, particularly those aimed at security of water supply, quality, reuse and increasingly, adaption initiatives, will likely reflect similar lifespan characteristics generally inherent to water infrastructure.

This presents significant challenges to defining what sustainability should look like. These challenges are especially large given the sensitivity of the water cycle to ongoing climate change and the difficulties in how we can determine future climate impacts with accuracy, precision, and confidence. The need for comparative standards is critical for the long-term management of water infrastructure investments, whether measured over the asset lifetime or financing timescales.

Professionals in the water field have been actively developing methodologies to determine the best means of designing and operating water infrastructure that will function safely, profitably, and sustainably in a highly uncertain future. Climate change is one of the factors creating that uncertainty. For financial analysts, assessing water-related investments’ exposure to climate risks has been largely opaque and ill defined. Awareness of the need to consider climate risks related to water are growing (WEF 2014), but progress has been slow.

The impacts of climate change on the water cycle are often complex. Shifts in the frequency and severity of droughts, flooding, and tropical cyclones are obvious trends that have been widely identified, but even these can be unpredictable. In 2015 the U.S. state of California declared a severe drought in terms of an absolute decrease in the amount of precipitation it has received (a drought that has been linked to climate change in the scientific literature[5]). Both Oregon and Washington to the north of California have received relatively normal amounts of annual precipitation, but they have already declared drought emergencies. Their winter precipitation fell almost exclusively as rain instead of a mix of both rain and snow in 2014–2015.

Instead of facing a long dry season for 2015 with ample groundwater recharge and extensive snowpack “stored” in their mountains, these US states have experienced severe shortages because of shifts in the *types* of precipitation, not its quantity. Such impacts are completely novel in the experience of local decision makers. These impacts have been affecting urban infrastructure, energy generation, agriculture, the forest fire regime, and environmental management tradeoffs.

Other common impacts from climate change on the water cycle derive from shifts in the timing and seasonality of precipitation, a pattern already seen in areas such as South Asia with increasing variability in the Indian monsoon; shifts in the qualities of so-called climate engines such as El Niño–La Niña cycling

El Nino Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO), which influence precipitation over large regions; and water quality impacts, those seen in China's Yangtze basin indicate more frequent and intense eutrophic conditions (which support algal blooms) observed even in southern China’s winter.

If the design and operation of water projects do not anticipate such shifting climate conditions, the ability of water projects to function and be fit for purpose maybe compromised.

[5] Source: http://www.ldeo.columbia.edu/news-events/warming-climate-deepening-california-drought

Perhaps the best-known example of a major water project being compromised by changing climate conditions is the Hoover Dam in the USA's Colorado River Basin. The dam was designed and built in the 1920s and 1930s using assumptions of much higher mean river flows, yet over the last two decades, the timing and amount of precipitation in the upper basin have been deviating substantially from these assumptions. Under these unanticipated conditions, the dam's ability to supply water and generate hydropower is reaching operational limits, necessitating considerable investment in auxiliary infrastructure to maintain historic levels of service.

Box 2: *Climate mitigation, climate adaptation, and mitigating impacts*

Terminology gaps between policy, investor, and water management worlds can be enormous in the context of climate change, especially around the terms "adaptation" and "mitigation."

Climate mitigation refers to efforts to reduce rates of accumulation or absolutely lower levels of atmospheric carbon. Climate mitigation projects may include low-carbon energy generation sources, such as solar power and wind, or avoiding carbon-emitting activities such as deforestation. Climate mitigation has occupied the overwhelming amount of policy efforts within global climate governance, and has also been the primary focus of national level climate policy in most developed or middle-income countries.

Climate adaptation refers to efforts devoted to addressing climate impacts, such as increased drought frequency, sea level rise or earlier snowpack melt. These impacts may have already appeared or may be anticipated as future events (i.e., adaptation to climate change).

For most water managers, corporations, and operational personnel, "mitigation" normally refers to "fixing negative impacts," such as mitigating damage to ecosystems through wetlands remediation. Thus, some project-scale climate adaptation literature refers to "mitigating climate impacts" (i.e., reducing negative impacts) without intending to imply a reduction in greenhouse gases. These terms are confusing. Worse, "adaptation" is a complex, rich biological term used in many aspects of natural resource management, which has little relevance to "climate adaptation." Given the history of green bonds, this document will refer to the climate change policy frame of reference for "mitigation" and "adaptation."

In summary, climate change is altering the risk profile for water projects in ways that led the Technical and Industry Working Groups to conclude that climate mitigation as well as adaptation must be a fundamental component of the Water Climate Bond Standard across a wide range of project and asset types.

While the techniques to assess and reduce water and climate change risks are evolving quickly, there is no clear consensus about best practices in the engineering, water management, climate science, or finance communities. Defining certification standards therefore faces the added challenge of knowing that current insights are likely to evolve significantly and rapidly in the near future, even as finance mechanisms, financial flows, and policy priorities direct increasing attention to both climate mitigation and climate adaptation.

For this reason, the Consortium views this Standard as a starting point, to which additions and revisions will be needed over time including potentially broadening the climate focus. We therefore recommend that the Standard be reviewed at least annually in the first three years of its use.

Documenting Effort versus Defining Fixed, Universal Targets

While climate mitigation is a relatively well-defined field, with significant coherence around standards and evaluation methodologies e.g. UNFCCC Clean Development Mechanism, Voluntary Carbon Standard, American Carbon Registry, Reducing Emission from Deforestation and Degradation (REDD+), the same is not true for climate adaptation.

The practice of designing and operating long-lived infrastructure to operate under a range of inherently uncertain future conditions is in a state of rapid evolution and without full convergence among practitioners.

Moreover, climate adaptation typically involves tradeoffs between risks and opportunities negotiated as highly context-specific situations.

Risk exposure, and allocation and governance arrangements may lead to very different but equally valid adaptation pathways.

As a body of practice, climate adaptation is inherently complex and less developed than climate mitigation, with more points of possible intervention. How then, the TWG asked, can a water standard that incorporates climate adaptation define specific goals?

Both the Consortium and Technical Working Group instead chose an approach that documents how specific issues related to current and future climate have been considered in the design and operation of the project to be financed by the green bond and what are the broad qualities that characterize effective, thoughtful vulnerability assessment and adaptation planning.

For instance, the Technical Working Group emphasized the need to consider the role of so-called "soft" or policy interventions for climate adaptation. These may include knowledge systems, monitoring networks, and legal and governance frameworks for avoiding and reducing conflict and preventing and managing crisis events without loss of service or catastrophic damage.

Evaluating the eligibility of a project for a green bond therefore requires an evaluation of the non-infrastructure component of climate adaptation, including how water is shared, negotiated, governed, and allocated among different stakeholders.

Although the general practice of climate adaptation is still a comparatively young field in both theory and application, its role in the water sector is becoming increasingly important. This focus arises in part due to the overlap with water sustainability issues around resource security, supply and energy use.

Accordingly, the Technical Working Group agreed that a Climate Bonds Standard should consider not only mitigation projects but also projects and assets that focus on climate adaptation.

Doing so reflects an emergent body of practice among water managers and professionals that will only become more widely understood and accepted as the climate adaptation sphere becomes more accurately defined and evaluated through new measuring and assessment frameworks.

Perhaps in the future, evaluating the climate adaptation characteristics of a project can be achieved through a framework focused on programmatic goals, such as targeting specific reductions in flood risk. But this level of prescriptive measurement will take time to achieve.

Meeting the Needs of Diverse Audiences: Structuring the Standard

A Water Climate Bond Standard must ultimately meet the needs of a diverse set of stakeholders that include:

- Institutional investors, who have a fiduciary duty to assess and compare investment risks;
- Institutions seeking financing, who must be able to identify standards that are relevant to their finance needs and sector;
- Technical decision makers such as engineers and water managers, who must be able to connect broad policy issues around climate mitigation to operational level decision-making; and
- Civil policy makers and office holders who have a public finance, regulatory or water service provision responsibility

In many ways, the **Water Climate Bond Standard** developed by the Technical and Industry Working Groups seeks to bridge all of these needs with several key elements:

1. An interface that determines the starting point for each project as either climate mitigation or climate adaptation (although these categories are not necessarily mutually exclusive)

2. Two overall scores for each theme (climate mitigation and climate adaptation)

3. Scores that are calculated in a checklist format for simple review and assessment.

4. Major sections of each theme divided into water management decision-making categories, such as the development of a Vulnerability Assessment under the climate adaptation theme.

Table 1: The interconnection of climate mitigation and adaptation theme for different types of water projects.

Climate Relevance	Rarely	Sometimes	Almost always
Reduces greenhouse gas emissions			• Energy from sewage methane • New sewage infrastructure • Agricultural waste/nutrient management • Watershed protection
Involves justifiable or reasonable energy use or emissions	New drinking water treatment plants	• Water delivery infrastructure • Water storage infrastructure (temperate) • Water management efficiency • Water recycling • Desalination • Water treatment upgrades • Wastewater storage infrastructure • Combined sewer upgrades • Irrigation • Artificial groundwater storage / recharge • Urban runoff reduction • Financial risk management • Subsidence management	• Adaptation to protect water/sewage infrastructure • Flood defence mechanisms • Rainfall capture/harvest systems • Products to reduce water demand
Potentially excessive energy use or emissions		• Water storage infrastructure (tropical) • Desalination (conventional)	

The Working Groups concluded that climate risk assessments (Vulnerability Assessments) and infrastructure asset management plans in response to climate risks (Adaptation Planning) are becoming increasingly mainstream elements in water resources management and civil engineering. However, the finance community is slow to request disclosure of this planning and explore this topic systematically to date.

As a result, the Adaptation Theme should be a means for reputable investments to demonstrate their low levels of climate risk rather than add an additional burden for offering institutions.

4. Proposed Water Climate Bond Standard

The criteria for evaluating water-related projects set out in this Water Climate Bond Standard should be understood as a starting point in a process of refinement, focusing, and broader engagement. We believe these criteria should be reviewed at least annually for the first three years of use, and every two years hence for the foreseeable future.

Steps for Project Evaluation

This section lays out the sequential steps for evaluating whether a water project may be eligible for climate bond certification, the theme through which the project should be evaluated, what materials will be required for evaluation and how scoring translates into a determination of certification.

There are 5 steps (**Figure 5**) for navigating the Water Climate Bond Standard certification process:

Step 1: **Identify** the theme most appropriate for the project to begin assessment

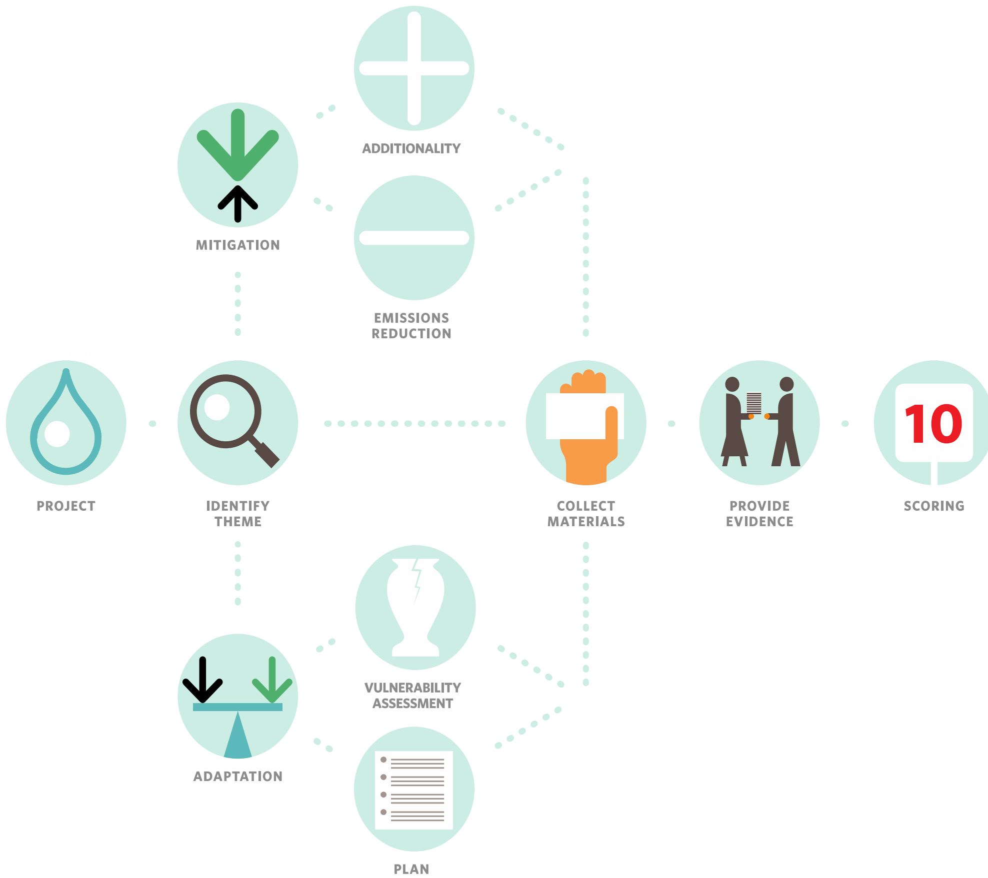
Step 2: **Collect** evidence materials relevant to each theme

Step 3: **Provide** disclosure or evidence for each of the scoring components of those categories

Step 4: **Adjust scores** for each category based upon Notching Factors (NF)

Step 5: **Sum total score** and compare to Water Climate Bond Standard certification levels for scoring at superior, acceptable, or not acceptable levels

Figure 5: Steps for project evaluation



Step 1: Identify the theme most appropriate for the project to begin the assessment

An eligible project will begin assessment against the standard under one of two themes, either a climate mitigation or climate adaptation offering. These categories are not mutually exclusive.

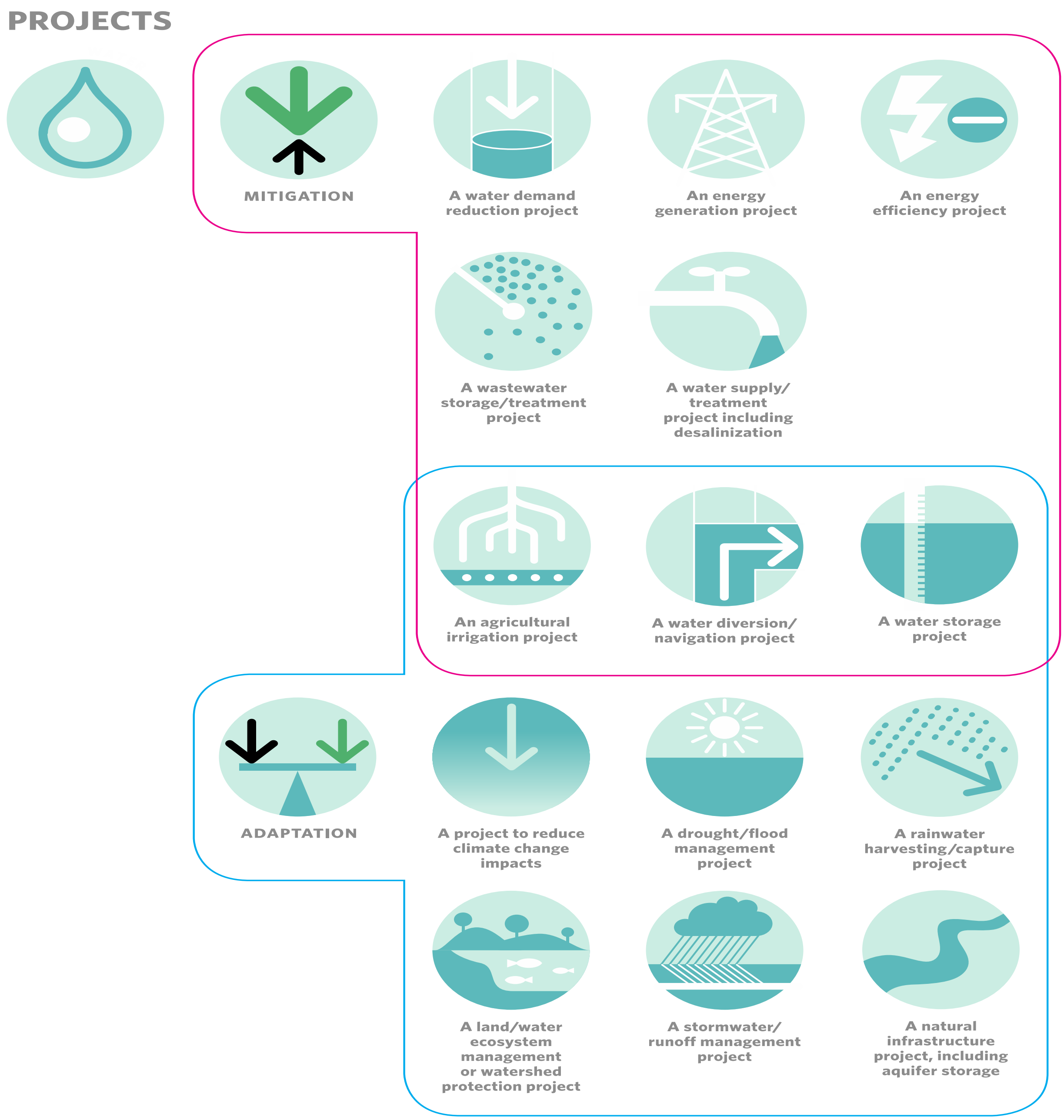
Projects that begin with the *climate mitigation* theme are green bonds that focus primarily on energy, emissions, efficiency, and/or carbon sequestration. In some cases, these assets will also be evaluated in terms of their vulnerability to climate change impacts and will thus also need an adaptation theme score (see Table 2**).**

Projects that do not need a climate adaptation score will only report a climate mitigation score.

Projects that begin with the *climate adaptation* theme are green bonds that may be focused on adapting to climate impacts such as flooding or water storage, ecosystem restoration or the implementation of green or natural infrastructure, or fund projects for long-lived infrastructure with potential vulnerability to climate shifts. In most cases, these offerings will be intended to increase the resilience of engineered systems, local ecosystems, industries, and/or communities.

If no climate mitigation features are relevant for the project, then a climate mitigation score is unnecessary. The project will only report a climate adaptation score.

Figure 6: Climate Development Mechanism (CDM) broad categories



Some types of projects may be conceived as both mitigation and adaptation offerings, such as agricultural irrigation, which can be framed as both increasing agricultural security while increasing water and energy efficiency. In those instances, project sponsors may begin assessment against the standard with either theme.

If a project is required to use the adaptation theme, this does not mean that the project will have to demonstrate a climate impact; climate impacts may not be relevant or significant for a particular project or location. In this case, projects may show during the vulnerability assessment that there is no impact from climate change (or expected in the future), so a corresponding climate adaptation plan is not necessary.

Table 2: Determining Project Theme

	Start with mitigation	**Start with adaptation**	**Mitigation-initiated projects that should include adaptation**
Intended environmental benefit	If focused on GHG emissions / concentrations	If focused on local / regional ecosystem benefits	Must include for ecosystem- related projects, e.g. wetland restoration & natural infrastructure e.g. coastal floodplains
Project's operational lifetime	<20 years	>20 years, although some project types can optionally begin with mitigation	Must include for projects >20 years of operational lifetime
Projects that can be described as non-coastal wastewater treatment, capacity building, or hydro- met monitoring networks	Yes	No	Optional — adaptation score unnecessary

Water projects are currently not eligible for climate bonds certification if the following circumstances apply:

- The project focuses on local/regional environmental benefits (e.g., environmental water quality, ecosystem restoration, natural infrastructure development) and *does not assess* realized and potential climate change impacts through a vulnerability assessment with a corresponding Adaptation Plan. As the standard potentially evolves to encompass a broader set of criteria these projects may qualify in the future.

- The project focuses on energy efficiency, greenhouse gas emissions or fuel shifts; is designed to operate for 20 years or more; and does not assess climate vulnerability and include a corresponding Adaptation Plan. The vulnerability assessment may show that the project does not have significant exposure to climate change, but the documentation that climate vulnerability has been considered is necessary.

Step 2: Collect materials for the categories relevant to that theme

As mentioned previously for many infrastructure projects climate vulnerability or adaptation assessments are becoming routine. The standard catalyzes greater disclosure and understanding of the importance of these assessments to investors.
Where assessments are not taking place the standard may reinforce the importance of climate planning and the need for protecting the longevity of these investments.

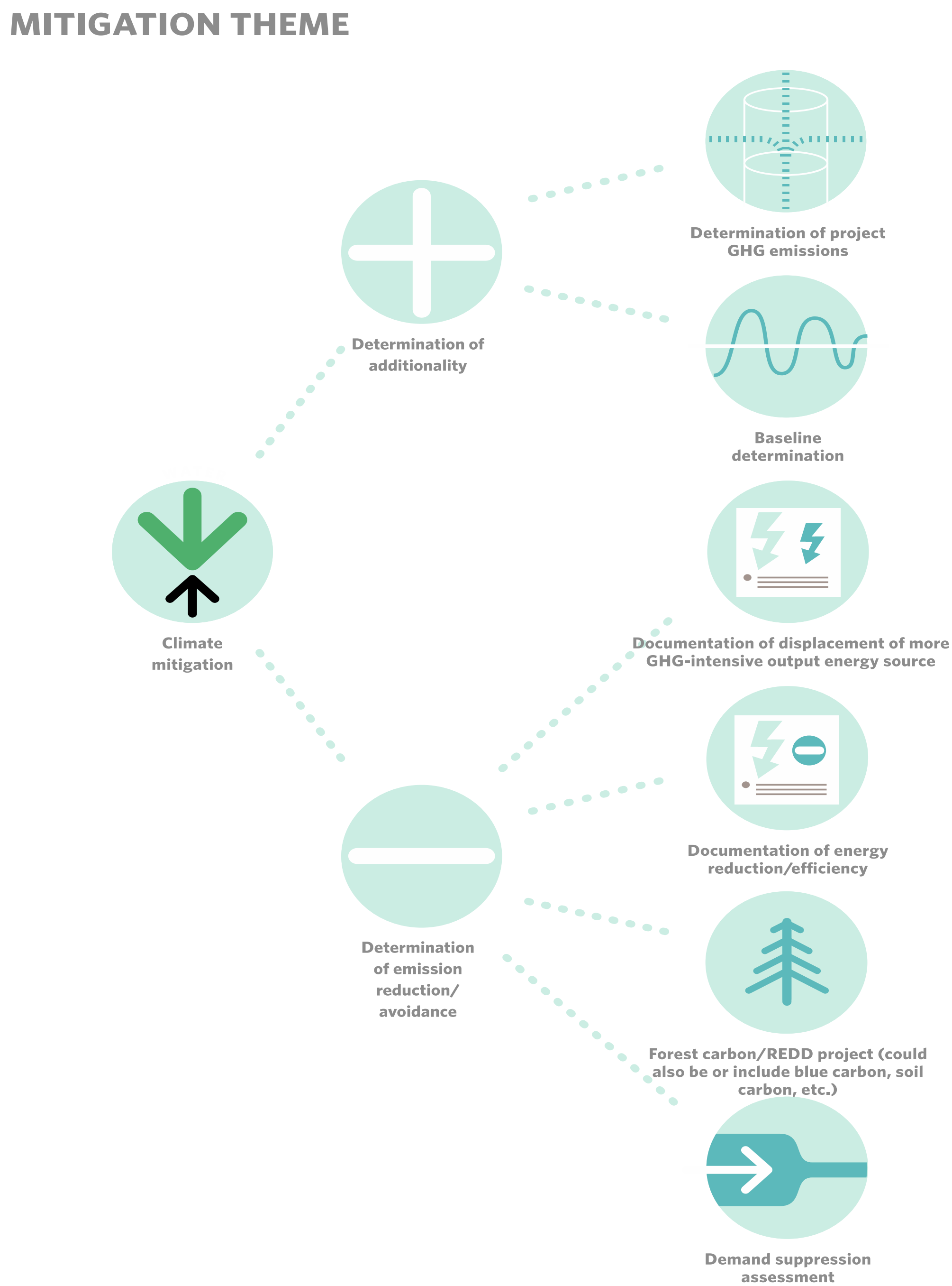
In order to proceed with scoring, there will need to be some preparation and assessment of relevant materials related to the mitigation and/or adaptation themes. These materials should ideally also be available for scrutiny and transparency post issuance.

A. Mitigation Theme

Climate mitigation projects — focusing on energy generation, efficiency, emissions, and GHG reduction or sequestration —are addressed in the **Water Climate Bond Standard** through the Mitigation Theme.

The Mitigation Theme has two major categories: (1) *the determination of project-related emissions*, and (2) *determination of emissions reduced/avoided*. The full pathway is described in the Figure 7 below.

Figure 7: Mitigation theme



“Project-related emissions” (Additionality) refers to calculating an emissions baseline, including associated emissions connected to operations, construction, and other relevant processes.

Determining the carbon baseline (aka carbon emissions under a business as usual scenario) allows for the calculation of “additionality” in the emissions reduced/avoided relative to some baseline[6].

The baseline may be in reference to the emissions of an existing facility that is being rehabilitated (e.g., using a more energy-efficient water treatment system) as well as the associated emissions connected to operations and other relevant processes for a new or rehabilitated project.

The determination of baseline conditions is not important for all bond offerings; only those that seek certification based upon reductions in carbon emissions (see Table 3).

Table 3: Determine need for baseline mitigation conditions

Project	Determine baseline mitigation conditions?
A mitigation project focused on increasing energy efficiency	Yes
A change to a lower GHG-emitting fuel source / GHG destruction (e.g., methane capture)	Yes
Shifts in land / water management intended to maintain / increase water quality with carbon sequestration / storage co-benefits	Yes
Suppressing energy / water demand (independent of increasing efficiency)	Yes
A new clean energy or water delivery project, not involving rehabilitation / re-commission	No
Water recycling — new project	No
Water recycling — rehabilitation project	Yes

“Determination of emissions reduction / avoidance” is based on the estimated operational lifetime of the project (specified in the screening questions).

Baselines can be determined through credible methodologies such as (but not limited to) the UNFCCC’s Clean Development Mechanism (CDM), Climate Action Reserve, American Carbon Registry or national and state approaches.

[6] For further discussion of additionality see: http://www.co2offsetresearch.org/consumer/Additionality.html and http://ghginstitute.org/wp-content/uploads/2015/04/AdditionalityPaper_Part-1ver3FINAL.pdf

Project emissions can result from the operations, calculated on a mean annual basis. Methane emissions from water storage are an important consideration, especially for clean energy projects such as hydropower.

Both "project-related emissions" and **"**determination of emissions reduction/avoidance," can be evaluated using the Clean Development Mechanism (CDM) protocols (or any other credible, robust methodology) for the specific project type. The Checklist in **Step 3** is used to support the scoring on the evidence provided.

For climate mitigation projects that are expected to have climate change related impacts or will create exposure for eco-hydrological systems[7], a score for the climate adaptation theme is necessary as well. This ensures that the climate mitigation benefits are resilient to climate impacts over the operational lifetime of the project (Table 4). For example, such projects may include hydropower facilities whose generation capacity may be diminished by shifts in precipitation patterns or snowpack accumulation.

Table 4: Determining need for Climate Adaptation Theme

Project	Climate adaptation theme necessary?
Displacement of more GHG-intensive energy source & energy reduction / efficiency assets, with operational lifetime >20 years	
Hydropower — new or rehabilitation	Yes
Methane capture	No
Water storage	Yes
Water recycling	No
Desalinization	No
Irrigation / nutrient management	Yes

B. Adaptation Theme

Climate adaptation projects — projects focused on reducing vulnerability to current or potential climate change impacts —are addressed by the Water Climate Bond Standard through the **Adaptation Theme**.

The Adaptation Theme has two documents that are produced for the project with the support of the checklist (see Step 3): a *narrative vulnerability assessment (assessment of climate risks)* and a corresponding *narrative adaptation plan (response/management of climate risks)*.
These are not expected to be long documents, but short statements.

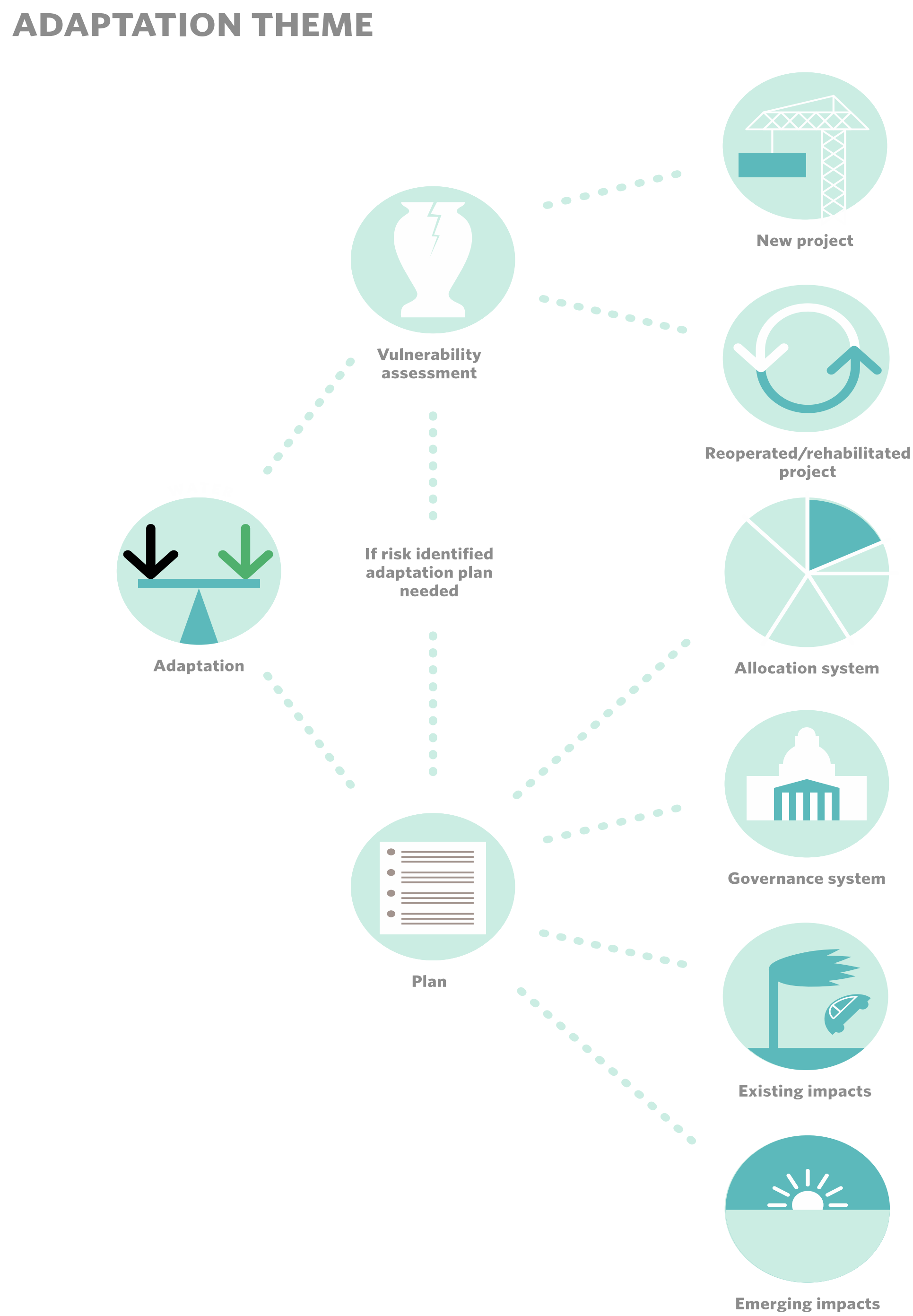
[7] Defined as the interaction between ecosystems and water

It is important to note that the Adaptation Plan will not be necessary *if* the vulnerability assessment does not find that climate change will impact the project.

Checklists to support scoring and evaluation of these documents have been developed (see Step 3). These checklists ask for "evidence" of analysis or research or ask for "disclosure" of relevant regulatory, governance, or legal documentation. Ideally, supplemental documents would also be available for investors to reference.

The checklist is there to support the scoring process but does not replace the prepared Vulnerability Assessment and its corresponding Adaptation Plan.

Figure 8: Adaptation Theme



Vulnerability Assessment

The Vulnerability Assessment evaluates how the project will affect current and future eco-hydrological conditions. For more detail, see **Annex A.**

The Vulnerability Assessment requires disclosure or evidence about potential vulnerabilities (risks), as specified in the checklist (see Step 3). The potential impacts or stressors identified in the vulnerability assessment must also be addressed in the adaptation plan.

The Vulnerability Assessment process requires that a list of realized and potential vulnerabilities be provided for investors:

- For **new projects**, how will construction and operation impact current and future eco-hydrological conditions?
- For **rehabilitated / re-commissioned projects**, can lost hydrological functions be restored, does the asset match its existing climate, and how will impacts shift with climate over the operational lifetime?
- For **all projects**, what is the current ecological status, and how will climate alter these systems in the future?

These statements should include a list of current or potential impacts, which will then need to be addressed in the adaptation plan. It is possible that the Vulnerability Assessment will show that the project will not be affected by climate change impacts — but this outcome should be demonstrated. In such cases, an adaptation plan will not be required.

Again, the checklist supports the process of scoring and evaluation but does not replace the vulnerability assessment.

Adaptation Plan

The Adaptation Plan is a written statement that responds to any climate impacts identified in the vulnerability assessment. If the vulnerability assessment shows that climate change is not impacting the project, an adaptation plan is not necessary.

For more detail, see **Annex B**.

The Adaptation Plan assumes that adaptation is not purely associated with the infrastructure project or that all uncertainties can be addressed.

Instead, the adaptation plan asks for responses to the vulnerability assessment through four lenses (see **Figure 10** below):

1. an accounting of **allocation** arrangements
2. an accounting of **governance** arrangements
3. responses to realized (**current**) climate impacts
4. responses to potential **future** climate impacts over the operational lifetime of the asset.

"Allocation" refers to the formal and informal mechanisms that are used to decide who has a given quantity of water at a given time. Since these are water-related bonds, the use of environmental flows protocols is highly recommended (but not required) and evidence of consideration of these flows would potentially increase scores (**see Notching Factors in Annex B**)

In contrast, "governance arrangements" refer to the systems in place to address shifting needs, resolving conflicts, renegotiation processes, and enforcement mechanisms for how water is allocated.

How the project issuer plans to respond to existing and emerging impacts of climate change should be outlined in the adaptation plan describing actual and potential impacts and responses.

The Adaptation Plan requires disclosure or evidence about potential vulnerabilities, as specified in the checklist (see Step 3).

Step 3: Checklist: provide disclosure or evidence for each of the scoring factors under the relevant categories

The Checklist is the scoring framework that details the factors for which each of the categories in the Mitigation Theme and Adaptation Theme will be evaluated.

A. ***Mitigation Theme***

Scores for both the project-related emissions and determination of emissions reduction / avoidance.

Use an external credible methodology for the determination of Additionality and the calculation of emissions reduced/avoided (e.g. CDM, American Carbon Registry etc.)

Question 1:

A critical early decision in the standard development process was to not duplicate the efforts of other organizations that have created project-specific methods and processes for quantifying the additionality and GHG emissions reduced or avoided.

Groups such the UNFCCC, for instance, have created widely implemented, highly specific, and regularly updated methods and systems for technically scoring the proposed elements of the climate mitigation theme.

In some cases, there may be regulatory requirements that must use a similar framework for specific industries or jurisdictions at the national, international (e.g., EU), or provincial/local level.

However, leveraging these proxies under the Water Climate Bonds Standard so that a clear and consistent score can be achieved remains an area in which we need additional input, especially since scoring should be standardized across these different methodologies.

In addition, we believe that we need some additional input into how to develop some broad categories for how to judge these scores across categories of investments.

A fuel shift bond, for instance, should presumably not be judged by the same quantitative evaluation for emissions avoided / reduced as a major hydropower plant.

1. *Is the UNFCCC's Clean Development Mechanism (CDM) an appropriate proxy to account for the mitigation component of water projects under the Mitigation Theme of the Standard? If so, how can the CDM results feed into the scoring framework?*

2. *If CDM is not appropriate, what other credible, robust methodologies should be leveraged and how could their process fit into the scoring framework?*

3. *How do we judge scores across different categories of investments?*

B. Adaptation Theme

The Scoring Framework asks for “Evidence (E)” of analysis or for “Disclosure (D)” of relevant regulatory, governance, or legal documentation.

For certification within the Adaptation Theme, the factors detailed in the Scoring Framework must also be presented in the written vulnerability assessment and its corresponding adaptation plan.

For full Checklist, see Annex C

Step 4: Adjust scores for each category based upon Notching Factors (NF)

Notching factors (NF) reflect use of best practices such as advanced hydrological modeling; spatial scales, measures of ecological integrity, use of environmental flows, and diverse sets of data in the analysis of future climate, for example.

Notching factors can improve a project’s score but are not necessary for achieving a score for certification.

Step 5: Sum total scores and compare to scoring levels for certification

An “overall” score is reported for each of the relevant themes. Each of the relevant themes to be repeated here for reference.

Theme scores are reported as one of three levels:

I. Superior

ii. Acceptable

iii. Not acceptable

Question 2:

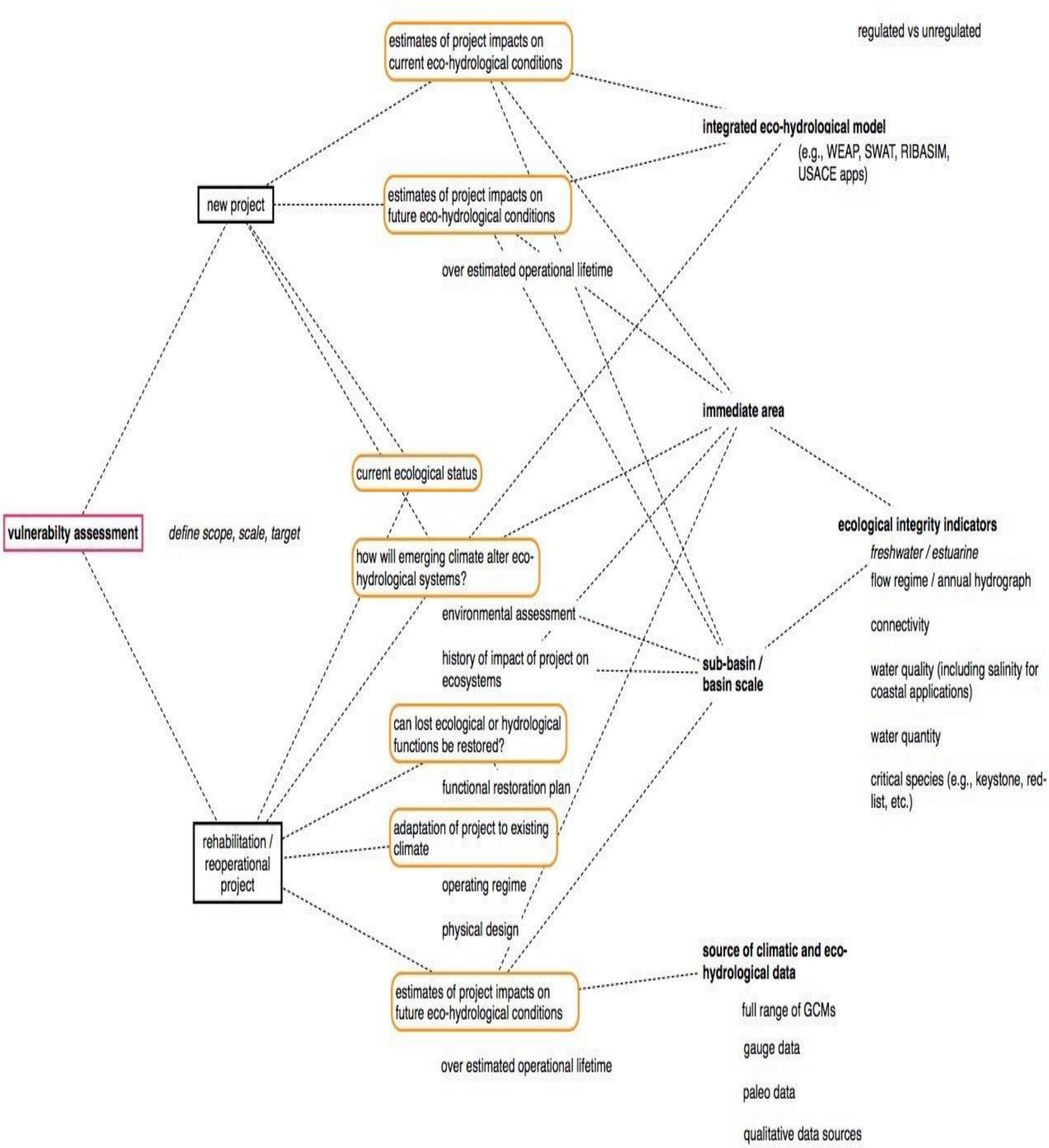
Each theme will have a minimum threshold set for a project to qualify for certification but the thresholds for determining the above scores still need to be developed.

Although the adaptation scoring checklist generates a numeric score (mitigation scores should also produce quantitative scores), we believe that qualitative scores should be reported: superior, acceptable, and not acceptable.

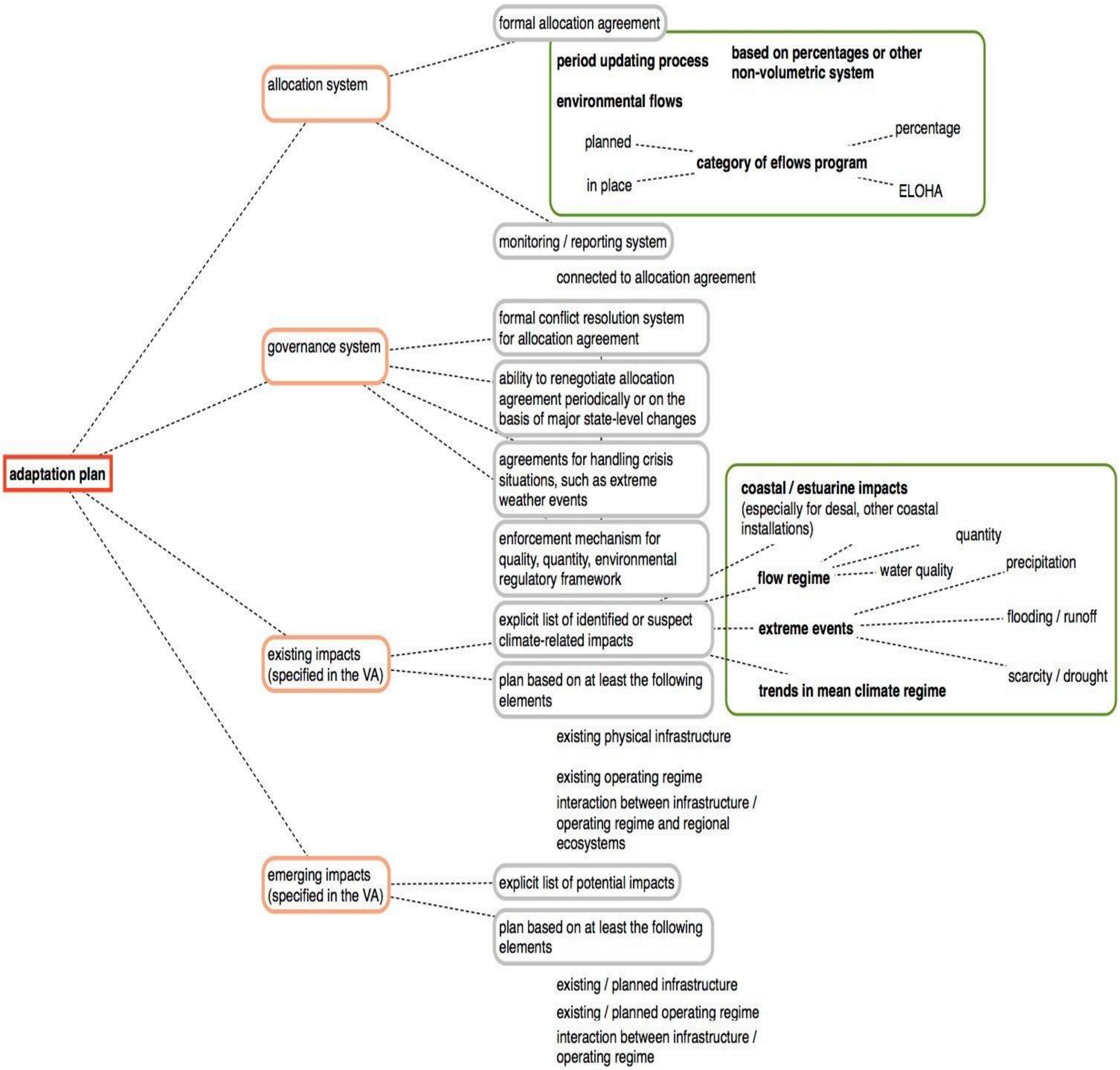
How should we set cut offs for these grades—should they be absolute, across all project types, or should they be sensitive to project categories.

Calibrating these grades will be critical for ensuring that these scores are robust and meaningful for investors.

Annex A: Vulnerability Assessment Flow Tree



Annex B: Adaptation Plan Flow Tree



Annex C: Checklist:

A. Mitigation Theme

As discussed above, the Mitigation Theme has two major categories: (1) *the determination of project-related emissions*, and (2) *determination of emissions reduced/avoided*. Eligibility for certification under this theme is determined through existing methodologies deemed acceptable under the Water Climate Bonds Standard (e.g. CDM, American Carbon Registry, etc.) (see Step 3, Mitigation Theme)

B. Adaptation Theme

1. Allocation

Criteria	Citation/ Reference	Evidence (E) Disclosure (D)	Max Score	Actual Score
Are there accountability mechanisms in place for the management of water allocation that are effective at a sub-basin or basin scale?		D	1	1
Are the following factors taken into account in the definition of the available resource pool? **A. Non-consumptive uses (e.g., navigation, hydroelectricity)** **B. Environmental flow requirements** **C. Dry season minimum flow requirements** **D. Return flows (how much water should be returned to the resource pool, after use)** **E. Inter-annual and inter-seasonal variability** **F. Connectivity with other water bodies** **G. Climate change**		E	6	A=1 B=1 C=1 D=1 E=0 F=0 G=0
What arrangements are in place, if any, to accommodate the potentially adverse impacts of climate change on the resource pool? (E.g. using best available science to plan for future changes in availability, undertaking periodic monitoring and updating of available pool.)		E	1	0
Is there a distinction between the allocation regimes used in "normal" times and in times of "extreme/severe" water shortage?		E	1	0

Notching Factor (NF): If yes, how are "exceptional" circumstances defined? (E.g. extended drought, etc.) How does this affect the allocation regime? (E.g. triggers water use restrictions, reduction in allocations according to pre-defined priority uses, suspension of the regime plan, etc.) ***Who is the responsible authority for declaring the onset of "exceptional" circumstances?***		E	0.5	0
For international / transboundary basins, is there a legal mechanism in place to define and enforce water basin allocation agreements?		D	NA	NA
Are water delivery agreements volumetric or otherwise inflexible, or are they defined on the basis of actual *in situ* seasonal/annual availability?		E	1	NSF
Has a formal environmental flows (e-flows)/sustainable diversion limits or other environmental allocation been defined for the relevant sub-basin or basin? *If preexisting,* has the environmental flows program been updated to account for the new project?		E	1	1
Have designated environmental flows program been assured / implemented?			1	1
NF: Has a mechanism been defined to update the environmental flows plan periodically (e.g., 5 to 10 years) in order to account for changes in allocation, water timing, and water availability?		E	0.5	0.5
Is the amount of water available for consumptive use in the resource pool linked to a public planning document? (E.g. a river basin management plan.) **A. Yes, the limit is linked to a river basin management plan** **B. Yes, the limit is linked to another planning document, please indicate: ______________** **C. No, the limit is not linked to any planning document**		D	1	B = 1

NF: If yes: ■ ***Who is the authority responsible for preparing the planning document?*** ***B. Is the plan a statutory instrument that must be followed or a guiding document?***		D	0.5	0.5
Total			**14.5**	**8**

2. Governance

Criteria	Citation/ Reference	Evidence (E)/ Disclosure (D)	Max Score	Actual Score
How are water entitlements defined? **A. Purpose that water may be used for** **B. Maximum area that may be irrigated** **C. Maximum volume that may be taken in a nominated period** **D. Proportion of any water allocated to a defined resource pool** **E. No formal definition exists** **F. Other, specify: _____________** **A - D = 1; E = 0. F requires documentation.**		D	1	1
Is the water system currently considered to have? ***A.*** *Over-allocated* **(e.g. current use is within sustainable limits but there would be a problem if all legally approved entitlements to abstract water were used)** ***B.*** *Over-used* **(existing** *abstractions* **exceed the estimated proportion of the resource that can be taken on a sustainable basis)** ***C.*** **Neither over-allocated nor over-used** **A = 0.5, B = 0, C = 1** *Question 3* *Should groundwater and surface waters be broken out?*		E	1	C =1

How are limits on the amount/rate of abstraction defined? **A. There is a limit in the volume of water that can be abstracted** **B. There is a limit to the proportion (e.g. percentage) of water that can be abstracted** **C. There are restrictions on who can abstract the water (but no limit on how much water can be abstracted)** **D. There is no explicit limit on water abstraction** **A = 0.5, B = 1, C = 0.5, D = 0**		E	1	NSF
Are governance arrangements in place for dealing with exceptional circumstances (such as drought, floods, or severe pollution events), especially around coordinated infrastructure operations?		D	1	0
Is there a process for re-evaluating recent decadal trends in seasonal precipitation and flow OR recharge regime, in order to evaluate "normal" baseline conditions?		D	1	0
Is there a process for dealing with new entrants and, for existing entitlements, increasing, varying, or adjusted use?		D	1	1
Is there policy coherence across sectors (agriculture, energy, environment, urban) that affect water resources allocation, such as a regional, national, or basin-wide IWRM plan?		E	1	1
NF: Are obligations for return flows and discharges specified and enforced?			0.5	0.5
Is there a mechanism to address impacts from users who are *not* required to hold a water entitlement but can still take water from the resource pool?			1	1
Is there a pre-defined set of priority uses within the resource pool? (e.g., according to or in addition to an allocation regime)		D	1	1

NF: If yes, please indicate the sequence of priority uses below: ***Agriculture*** ***Domestic*** ***Industrial*** ***Navigation*** ***Energy production*** ***Environment*** ***Transfer to the sea or another system*** ***National security (e.g. protection of infrastructure and critical dikes, nuclear plants)*** ***Other, specify:***		D	0.5	NSF
If there are new entrants and/if entitlement holders want to increase the volume of water they use in the resource pool, can new entitlements be issued or existing entitlements be augmented? **Yes, without restriction** **No, catchment is closed** **Yes, conditional on:** **Assessment of third party impacts** **Environmental impact assessment (EIA)** **Existing user(s) forgoing use** **Other, specify: _________** **Yes = 0, No = 1, Restrictions = conditional**			1	1
Are withdrawals monitored, with clear and legally robust sanctions? If so, how (i.e., metering, aerial, surveillance, or other)?		E	1	1
Are there conflict resolution mechanisms in place? Yes ❒ No ❒ a) If yes, briefly describe them and indicate which institutions are involved:		E	1	1
Total			**13**	**9.5**

3. *Vulnerability Assessment*

Criteria	Citation/ Reference	Evidence (E)/ Disclosure (D)	Max Score	Actual Score
Does a water resources model of the proposed system (or proposed modifications to existing system) exist? ***Specific potential model types. Scale should be to at least sub-basin.***		E	1	1
Can the system model the response of the managed water system to varied hydrologic inputs? varied climate conditions?			1	1
Are environmental performance limits specified?		E	1	1
Can these be defined and quantified using the water resources model?		E	1	1
NF: Have these limits been defined based on expert knowledge/analysis?		E	0.5	0.5
NF: Are these limits linked to infrastructure operating parameters?		E	0.5	0.5
NF: Are these limits linked to an environmental flows regime? Confer Allocation		E	0.5	NSF
For new projects, is there an ecological baseline evaluation describing the pre-impact state?		E	NA	—
For rehabilitation / reoperation projects, is there an ecological baseline evaluation available before the projects was developed?		E	1	1
Has there been an analysis that details impacts related to infrastructure construction and operation that has been disclosed?		E	1	1
NF: Are lost species and/or lost or modified ecosystem functions specified in the environmental evaluation?		E	1	0

Does the model include analysis of regression relationships between climate parameters and flow conditions using time series of historical climate and streamflow data?		E	1	0
Does the model include climate information from a multi-modal ensemble of climate projections (e.g., from the Climate Wizard or the World Bank's Climate Portal) to assess the likelihood of climate risks for the specified investment horizon(s)?		E	1	0
Are changes in the frequency and severity of rare weather events such as droughts and floods included?		E	1	0
Are sub-annual changes in precipitation seasonality included?		E	1	0
Is GCM climate data complemented with an analysis of glacial melt water and sea level rise risks, where appropriate (e.g., high or coastal elevation sites)?		E	1	0
NF: Is paleo-climatic data (e.g., between 10,000 and >1000 years before present) included?		E	0.5	0
NF: Is the number of model runs and duration of model runs disclosed?		E	0.5	0
Is directly measured flow data available for more than 30 **years and incorporated?**		E	1	1
Is directly measured climate data available for more than 30 **years and incorporated into the VA?**		E	1	0
Does the VA show that climate change has already had an impact on operations and environmental targets? Are these impacts specified and, to the extent possible, quantified? ***Confer*** **Adaptation Plan**			1	0
Does the VA show that climate change will have an impact on operations and environmental targets over the operational lifespan? Are these impacts specified and, to the extent possible,			1	0

quantified? *Confer* Adaptation Plan				
Is there a discussion of the uncertainties associated with projected climate impacts on both operations and environmental impacts?		E	1	0
Total			**19.5**	**5**

4. Adaptation Plan

Criteria	Citation/ Reference	Evidence (E)/ Disclosure (D)	Max Score	Actual Score
Is there a plan to restore or secure lost/modified ecosystem functions / species? *Confer* VA		E	1	0
Is the adaptation plan for environmental targets / infrastructure robust across specified *observed / recent* climate conditions? *Confer* VA		E	1	0
Is the adaptation plan for environmental targets / infrastructure robust across specified *projected* climate conditions? *Confer* VA		E	1	0
Is there a plan to reconsider on a periodic basis the VA for operational parameters, governance and allocation shifts, and environmental performance targets?		E	1	0
Total			**4**	**0**

Annex D: Existing Standards and Processes

For water management, relevant standards for water climate bonds are not common or widespread. A number of relevant resources exist already to use as the basis for a set of water related criteria for bonds, briefly described here.

Green Bond Principles

These principles have been proposed as an overall reporting basis for green bonds for transparency. If investors and bond issuers follow the principles then we may expect a reporting standard to develop so that bonds can be compared and potentially ranked according to how they meet sustainability and resilience measures.

World Bank Green Bond Criteria

The World Bank established green bonds in 2007 with explicit reference to climate mitigation and adaptation. They have an internally defined process for qualifying bonds that engage directly with Bank clients (normally countries), often involving regional and technical support divisions of the Bank.

The Bank's procedures are not described in detail and it is unclear how these are applied in principle or what types of internal criteria are used to define offerings. Presumably, there is a strong interaction with the client to make the offering "greener," though green in practice has diverse meanings. Water projects to date have varied over an order of magnitude in the size of bond offerings (up to several hundred million USD), spanning irrigation, hydropower, and many multi-purpose infrastructure projects.

Sustainability is defined quite broadly by the Bank; sustainability criteria include consideration of the disruption to social and natural systems. Indeed, water bonds issued by the Bank have included money for resettlement of populations due to creation of new reservoirs (though this may not be viewed as a social consideration for some audiences).

Barclays MSCI Green Bond Index

The Barclays MSCI index provides a measure for fixed income securities where the funds are used on projects with direct environmental benefits. This index was launched on 14 November 2014 following the trend of corporate investment in green bonds that began towards the end of 2013. The Barclays MSCI index, like other indices of this type, follows the principles laid out by Ceres. The index currently consists of approximately 70 percent government related issuances and 30 percent corporate issuance.

Eligibility and classification is defined by the MSCI ESG Research group, and is based on the use of funds. To be eligible the use of proceeds must fall into one of the following five categories or have 90 percent of the issuer's activity encompass one or more of the categories. As of 2015, these categories are under active review and several aspects (notably in relation to hydropower) are likely to see significant revision.

- *Alternative energy* -- Wind, Solar, Geothermal, small hydro, biogas, biofuels, biomass, waste energy, wave tidal
    - Small scale hydro is defined as 25MW or less and is the only type of hydropower currently qualified as green.
- Energy Efficiency -- This category includes a wide range of efficiency projects, essentially any project that improve efficiency while minimizing environmental impact.
- *Pollution Prevention & Control*

- ***Sustainable water*** -- Products, services, and projects that attempt to resolve water scarcity and water quality issues, including minimizing and monitoring current water use and demand increases, improving the quality of water supply, and improving the availability and reliability of water.
    - Infrastructure and engineering projects developing new or repairing existing water and sanitation pipelines, including equipment and technology providers resulting in improved quality and/or water use efficiency
    - Technologies and products that reduce, reuse, or recycle water as a means of conservation (smart metering devices, low-flow equipment, and rainwater harvesting systems).
    - Advanced materials, equipment, technologies, and services that filter or chemically treat wastewater for consumer or industrial use, including desalination
    - Investments in protection of land, forests, and other vegetation in the upper watershed as means to improve the quality of water bodies and groundwater recharge areas
    - Not eligible under this category: distribution of drinking water without measurable improvements to water quality, water efficiency, or climate change resilience component
- *Green Building* -- LEED certification for example
- *Other* -- Includes **climate resilience projects** (flood relief, mitigation) and sustainable forestry/afforestation

Although the index defines water sustainable projects as addressing both quality and quantity, currently these terms are not well defined. For example, projects that have an efficiency component are eligible, potentially conflating efficiency gains with sustainability. Similarly, water conditions are implicitly defined as static and fixed, unchanging in the future, which is problematic for projects that involve long-lived infrastructure.

Water Utilities Standards

Perhaps the best organized and defined group for integrating climate mitigation and climate adaptation are water utilities. Groups such as the Water Utilities Climate Alliance (WUCA) have been active for about a decade, while professional organizations including the International Water Association (IWA), the International Water Resources Association (IWRA), the Chartered Institution for Water and Environmental Management (CIWEM), the American Water Works Association (AWWA), and the American Water Resources Association (AWRA) have all actively been developing guidance on how to implement and integrate climate mitigation and adaptation, often led with the support of particular members (e.g., Seattle Public Utilities and DC Water in the US). Some cities have even published urban standards along these lines (e.g., San Francisco Public Works).

Hydropower Sustainability Assessment Protocol (HSAP)

In 2010, the International Hydropower Association (IHA) published a framework for evaluating the sustainability of a hydropower project at each stage of the project's life cycle, including early stage, preparation, implementation, and operation. The latter three stages can be scored according to criteria set forth by IHA. However, IHA does not define acceptable levels of scoring, which are left to the discretion of decision makers.

In early stages, the HSAP stresses the importance of considering social and environmental externalities in addition to the financial and economic risk and uncertainty that are most commonly found in investment standards.

Social and environmental externalities are common when markets for project services are not well defined. For example, consider a hydropower project that also provides storage services for irrigation agriculture. If the electricity market is well defined but the water market is not, there may be significant externalities present.

The preparation stage focuses on the need for conjoined water and energy services. In addition, HSAP identifies several documents that may be used as evidence of sustainability including environmental assessments, energy demand projects, climate adaptation plans, and other reports mandated by regional and national agencies among others. However, the HSAP does not include an explicit adaptation rating methodology or component.

Annex E: Guidance on Water-Related Human Rights and Social Risks for Issuers, Underwriters and Bond Buyers

Many investors recognize that water-related projects can be linked to complex social issues, given that access to drinking water is a basic human right and negative impacts on water resources can significantly affect other human rights (e.g. livelihoods, health etc.). The Climate Water Bond Standard assumes that any bond-issuing entity seeking certification is aware of and adhering to guidelines or standards related to water and hydropower development, some of which are listed below.

The Human Rights to Water and Sanitation:

In 2010, the United Nation's (UN) General Assembly and Human Rights Council explicitly recognized that water and sanitation are essential human rights.[8] There are various duties that states have with respect to ensuring the provision of sufficient, safe, clean, affordable and accessible drinking water and sanitation services to those within their jurisdiction.[9] Where companies have taken on this role, they have particular responsibilities. For companies that do not act as water service providers, their responsibility is to respect their rights –i.e. to avoid negatively affecting them through their operations or those of their suppliers or other business relationships. Several resources have been developed to help guide action in this area:

- UN Office of the High Commissioner for Human Rights, *Realising the Human Rights to Water and Sanitation: A Handbook by the UN Special Rapporteur Catarina De Albuquerque,* 2014,
- UN Office of the High Commissioner for Human Rights, *Guiding Principles on Business and Human Rights*, 2011.
- Interfaith Center on Corporate Responsibility, *The 2013 ICCR Water Roundtable: Stakeholder Responsibilities in Managing Access to Water*

[8] United Nations General Assembly, *Resolution 64/292,* August 3, 2010. http://www.un.org/waterforlifedecade/human_right_to_water.shtml
[9] UN Global Compact, The CEO Water Mandate*, Guidance for Companies on Respecting the Human Rights to Water and Sanitation: Bringing a Human Rights Lens to Corporate Water Stewardship,* January 2015. http://ceowatermandate.org/files/business-hrws-guidance.pdf

- UN Global Compact, The CEO Water Mandate*, Guidance for Companies on Respecting the Human Rights to Water and Sanitation: Bringing a Human Rights Lens to Corporate Water Stewardship,* January 2015.

Standards and guidelines related to Hydropower Development:

The overarching expectation of all hydropower development entities is the same as all entities that might seek certification, which is to respect human rights. Large infrastructure development - including hydropower – has in the past been associated with issues such as the displacement of people, loss of cultural property, and decreases in water access and/or quality.[10] Stakeholder engagement practices in particular are important in hydropower development.[11] There are a number of developed guidelines and standards directed at addressing the above and other issues[12], with a number of them listed below.

- International Finance Corporation, *Performance Standards on Environmental and Social Sustainability*, January 2012.
- International Finance Corporation, *Hydroelectric Power: A Guide for Developers and Investors*, Chapter 12: Environmental and Social Impact Mitigation. February 2015.
- International Hydropower Association, *Hydropower Sustainability Assessment Protocol,* November 2010.
- World Commission on Dams, *Dams and Development: A New Framework for Decision-Making*, Chapter 4: People and Large Dams- Social Performance. November 2000.
- The World Bank, *Operation Manual 4.10 – Indigenous Peoples,* July 2005.
- The World Bank, *Operation Manual 4.12 – Involuntary Resettlement*, December 2001.

This Annex was reviewed by the following individuals. Any errors, omissions or otherwise are our responsibility.

- **Rachel Davis** - Managing Director
  Shift Project
- **Patricia Jones -** Senior Program Leader, Human Right to Water
  Unitarian Universalist Service Committee
- **Jamie Skinner -** Principal Research, Natural Resources Group; Team Leader, Water
  International Institute for Environment and Development

[10] International Finance Corporation, *Hydroelectric Power: A Guide for Developers and Investors*, Chapter 12: Environmental and Social Impact Mitigation. February 2015. http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/learning+and+adapting/knowledge+products/publications/hydroelectric_power_a_guide_for_developers_and_investors

[11] See "Making Monkey Business: Building Company/Community Dialogue in the Philippines," Harvard University, for an example of some the issues and positive practices related to hydropower development. Available at https://www.youtube.com/watch?v=RBhJ-FdrCu4

[12] For a discussion of some of the differences between the standards and guidelines see "Watered down? A review of social and environmental safeguards for large dam projects," by Janie Skinner and Lawrence J. Haas, IIED. Available at http://pubs.iied.org/pdfs/17517IIED.pdf

Annex F: Unsettled and Emerging Issues

A number of topics are likely to be important areas of discussion and development in coming months and years. Within the working groups and consortium, these issues have not been resolved to a consensus state, with limited evidence for resolution at this time. However, these are areas where discussions should continue, and clarity should emerge.

Infrastructure-specific guidelines

At many points in the working group engagement, we witnessed a tension between maintaining a holistic view and approach across all types of water infrastructure and defining more specific guidelines that reflect particular nuances within investment categories. Hydropower represents a clear example of such a discussion, especially given the number of hydro power climate mitigation projects that have been offered as green bonds. However, many others seem likely to be focal points in the future, such as coastal defense, desalination, water utilities, and flood control mechanisms.

Environmental “restoration” projects, ecosystem-based adaptation, “green infrastructure,” and “green adaptation”

A growing number of climate adaptation projects globally are targeting ecological restoration and ecosystem management, and some green bond issuers such as the World Bank regularly engage in this area too. Indeed, for much of the press and the broader public, the term “green bond” has a strong implication of direct environmental benefit. From a water perspective, especially a water and climate change perspective, restoration is a complicated term. Restoration of hydrological function, such as removing structural blockages to a river or wetland or altering groundwater recharge patterns, clearly qualifies as having an environmental benefit.

Much recent controversy in the ecological and resource management literature exists, however, over the restoration of ecological communities to some past reference state that may not be achievable in current or near-term future climate conditions. No clear guidance has emerged over these issues, especially around fixed-area protected area management.

Similarly, there has been extensive advocacy around ecosystem-based adaptation, green or natural infrastructure, and green adaptation (Deltares 2012, Nairobi Work Program 2014), many of which have hydrological components or are designed to replace or supplement water infrastructure. The evidence for mainstreaming these approaches as formal, technical methods has been limited, and even their definition remains somewhat contested terrain and probably beyond the scope of this process currently to fully clarify.

When limited to eco-hydrological function as described above, these projects are probably very appropriate as green bonds offerings, assuming they include a climate adaptation component comparable.

“Blue carbon”

Forests and soils have received extensive attention at national and global policy levels for their role in sequestering and storing carbon, as well as their additional co-benefits (e.g., ecological restoration).

The UNFCCC Kyoto Protocol defined a funding mechanism to support climate mitigation efforts for such terrestrial systems called REDD.

Several organizations, such as Conservation International, the Ramsar Convention, IUCN, and Wetlands International, have also been attempting to describe a mechanism for accounting for the massive quantities of carbon that can be stored in near-coastal regions, such as estuaries, and in specific types of ecosystems, such as mangrove forests and seagrasses.

There have also been efforts to explore the role of tropical peatlands, frozen tundra, and freshwater wetlands more generally as carbon storage mechanisms. Given that these ecosystems could become the target of funding; they may well also be a candidate for future green bonds. However, the science and assessment / monitoring methodologies are nowhere near ready for application.

Water quality and forest management

Many progressive water managers also consider themselves land managers, especially in forested areas, since land management can have a significant impact on runoff patterns and water quality. It is presumed that we may see the emergence of offerings that integrate climate mitigation benefits from land management (e.g., forest and soil carbon storage/sequestration) designed with a water quality benefit. A clear application of how to link these two areas has not been developed as of yet.

The linkage of environmental, social and gender standards in water-related climate bonds

Our working groups clearly limited the scope of our work to environmental impacts and the bonds project itself. However, consistent with efforts such as the Equator Principles, HSAP, and other reference documents, the integration of these standards with topics such as the human right to water, gender, and equity issues remains a currently unaddressed potential area of work.

Methane emissions from water storage systems

Methane (CH_4) is a greenhouse gas that the Intergovernmental Panel on Climate Change (IPCC) reports is 34 times more powerful than carbon dioxide (CO_2), although it has a much shorter atmospheric lifetime (Magill, 2013). This GHG is released in varying amounts, perhaps most notably from hydropower reservoirs. Given that these investments are intended to be “clean” energy, some clear accounting of the relative size and impact of methane emissions is important to determine the significance of the emissions and the expected climate benefit. Studies tend to indicate that more methane is released from reservoirs in the tropics, but recent evidence suggests that there is much more nuance than latitude alone, and that the role of storage capacity, design, and operation can have important impacts. The issue of methane is important, but the pathway forward is not yet clear.

The emission of greenhouse gases from water storage facilities has been a significant area of controversy, particularly for hydropower dams with their advertised clean energy climate mitigation benefits.

Over the past 15 years, these controversies have centered on reservoir emissions — especially from methane — from tropical and subtropical regions, with often irreconcilable claims made about the quantity, duration, and cause of emissions. Some of the most extreme claims about GHG emissions from reservoirs would significantly erode the carbon mitigation benefits that hydropower proponents promise. Here, we review the state of science about these emissions, with special attention to hydropower as a green bond investment with climate benefits.

How does methane get released from hydroelectric reservoirs?

Reservoirs are created by flooding differing types of land. The "fuel" for methane emissions is the rotting of organic matter from the vegetation and soils flooded when the reservoir is first filled ("Reservoir Emissions," 2015). The release of methane is not a one-time occurrence in reservoirs, however. According to International Rivers, "The carbon in the plankton and plants that live and die in the reservoir, the detritus washed down from the watershed above, and the seasonal flooding of plants along the reservoir fringes, ensure that emissions continue for the lifetime of the reservoir" ("Reservoir Emissions," 2015).

Unlike the creation of CO2, methane generation is created anaerobically in reservoirs. Deep portions of reservoirs often have very low levels of oxygen due to the lack of physical water mixing and a high rate of oxygen consumption (Ashe, 2010). The bottom layers of the reservoir are almost completely free of oxygen, which means that decomposition happens anaerobically. The actual process of creating and releasing methane is as follows:

"When anaerobic degradation of carbon occurs by bacteria at the bottom of the reservoir, methane is produced as a byproduct. Then, this methane forms small bubbles at the bottom that bubble up and diffuse through the water column. This methane is transported directly to the air by the form of bubbling or by off-gassing of the waters. Methane is off-gassed from the water as it is transported through the spillway or when it is transported downstream" (Ashe, 2010).

Methane production does not decrease during the lifetime of a dam – in fact, it is quite the opposite. This happens as more organic carbon accumulates from upstream in the reservoir and slowly degrades. Because the dam blocks water passage, sediments rich in organic material are trapped in the reservoir instead of being transported downstream or to the ocean where they would have likely been degraded in a more oxygen-rich environment (Ashe, 2010). Instead of creating carbon dioxide, methane is created.

What are the ways methane is released?

Perhaps one reason that methane emissions from reservoirs have not been studied in depth is due to the complex nature of the system. Methane reaches the atmosphere in three ways, making it difficult to measure. Some is dissolved in the water and reaches the atmosphere by diffusion in a process called "diffusive flux". Some methane goes through the turbines and is released downstream.

The third way is through a process called "ebullition," wherein the bubbles of methane come directly to the surface and go straight into the atmosphere (Brown, 2014).

How do we measure CH_4 emissions?

When studying methane emissions from some sources (cows, oil and gas production), established methods exist.

For example, in the U.S. the EPA calculates methane emissions by "counting the number of cows, oil and gas wells and oil refineries in a region, then estimates total emissions based on how much methane each of those sources is expected to emit" (Magill, 2013). Data from these sources are input into a central database called the Emissions Database for Global Atmospheric Research, or EDGAR.

An alternative method is to collect actual methane emissions data gathered from towers, airplanes and other ground-level monitoring stations to calculate total methane emissions nationwide.

In other words, there are well-known methods for calculating methane from sources other than reservoirs and these data are reported, centralized, and closely monitored. Measuring and reporting methane emissions from hydroelectric reservoirs are not standardized and far less common.

For reservoirs, the process is complex. Think back to the three ways that methane is released: diffusive emissions (diffusive flux), bubbling emissions (ebullition), and degassing downstream of the turbines. We must calculate the emissions from all these sources.

In general, diffusive flux measurements can be measured directly from the reservoir by surface concentrations monitoring. Degassing from the downstream turbines and in the immediate downstream can be measured by direct flux measurements (Ashe, 2010). Bubbling emissions, which occur only at water depths lower than 10 m, are interpolated from funnel measurements (Abril et al., 2005). Degassing at the outlet of the dam downstream of the turbines can be calculated from the difference in gas concentrations upstream and downstream of the dam and the turbined discharge (Abril et al., 2005). Each methane emission source requires a different and complex methodology of measurement, including intricate equations and various pieces of technical equipment.

Differences between methane emission methods

The manner in which methane is released into the atmosphere is very important. In one study on the Nam Theun 2 Reservoir in Laos, "Ebullition accounted for between 60 percent and 80 percent of total emissions from the reservoir in the first years following filling" ("Ebullition causes," 2014). Rivers downstream of tropical reservoirs, despite their relatively small surfaces, can account for up to a third of CH_4 emissions (9-33%) across the reservoir surfaces (Guérin et al., 2006).

The timing of measurements is also important. Ebullition, which may make up more than half of a reservoir's methane emissions, varies in intensity throughout the day and seasonally. During the four months of the hot dry season (mid-February to mid-June), emissions reach their maximum because water levels are low (Brown, 2014).

Is the problem bigger in tropics?

Scientists have long thought reservoirs in warmer climates in the tropics emitted more methane than reservoirs in cooler climates, with one going so far as to claim that "90% of this reservoir CH_4 release is suggested to be released from the reservoir in the tropics," (St. Louis et al., 2000).

Many other studies support the claim that emissions are higher in the tropics. This is because emissions are based more on biome and location, with highest emission rates near the tropics and lowest emission rates at high latitudes (Barros et al., 2011). This latitudinal pattern is likely related to the corresponding gradient in water temperature.

Another factor may also lead to higher methane emissions from tropical reservoirs. Higher amounts of "flooded biomass in tropical regions [lead] to higher emissions and may increase the ratio of GHGs (for example CH4/CO2) that are released," (Barros et al., 2011).

But, more recent research from the higher latitudes of the U.S. Midwest provide a different story. A 2014 study conducted on Harsha Lake in Ohio, U.S.A. claims that reservoirs in mid latitudes may have high methane content similar to tropical reservoirs if they are located near agricultural areas. This is because methane-generating microbes feed on decaying algae (from farmland runoff), which means that lakes catching a lot of nutrient-rich agricultural runoff generate a lot of methane (Beaulieu et al., 2014).

The Scope of the Problem

In short, there is no consensus on the severity of this problem. Several studies indicate that emissions from reservoirs make up a significant portion of human-caused methane emissions. Others indicate that the impact has been overstated. Almost everyone would agree that we need to conduct more research to find out the scale and impact of these emissions.

Until recently, it was believed that about 20 percent of all man-made methane emissions come from the surface of reservoirs, but some new research suggests that the number may be much higher (Magill, 2014). How much higher is still unclear because there is not enough data to estimate.

A breakthrough study in 2007 published in a peer-reviewed journal by Ivan Lima and colleagues from Brazil's National Institute for Space Research (INPE) has often been used as a reference point emissions estimates. Their study claimed that large dams may be one of the single most important contributors to global warming. The study, in an estimate that included downstream degassing, estimated global methane emissions of 104 million metric tonnes of methane each year (Tg/year) from all large dams (Lima et al., 2007). By comparison, NASA estimates that global methane emissions associated with burning fossil fuels totals between 80 and 120 Tg/yr (Magill, 2014).

Some non-profit organizations are trying to bring this issue more attention. International Rivers has a campaign on the importance of reservoir methane emissions and seeks to educate climate policy makers and NGOs and the media about this issue. They often refer back to Lima et al.'s findings from 2007 as a basis for their campaign. Based upon findings from Lima et al.'s research, they tell their readers "The world's 52,000 large dams contribute more than 4% of the total warming impact of human activities. Dam reservoirs are the largest single source of human-caused methane emissions, contributing around a quarter of these emissions," ("4% of Global Warming," 2007). A different study by V.L. St. Louis et al. estimated that methane emissions from reservoirs could represent 12% of global CH_4 emissions. Discrepancies abound.

Other studies such as the research conducted by Nathan Barros et al. in 2011 state that reservoirs play a minor role in methane emission overall when considering the global-warming potential of CO_2 and CH_4. Barros et al. estimated that hydroelectric reservoirs emit about 3 Tg C as methane, corresponding to 4% of global carbon emissions from inland waters (2011). These measurements are from the reservoir surface only (diffusive flux) and do not include degassing or emissions in the outflowing river; however, they also state that GHGs emitted from these other two methods are unlikely to increase this estimate by more than twofold (Barros et al., 2011).

Going back to the original question, how big of a problem is this? It is difficult to reconcile the differences in estimations.

The 104 Tg/yr estimation from Lima et al. indicates that reservoirs' methane emissions are a big deal – comparable to fossil fuel emissions of methane. On the other hand, Barros et al. estimate only 3 Tg/yr from surface emissions (and up to 6 Tg/yr when considering all forms of methane emission). Although there are still large uncertainties and discrepancies between studies, more evidence than not suggests that the global emissions from hydropower are substantially greater than those estimated by Barros et al. (Li & Lu, 2014). No matter where one comes down, nearly everyone would agree that these emissions should be further studied and measured.

The importance of size and location of reservoir

When a dam is created a large area of land is flooded in order to create reservoir for the dam and can turn from a methane sink to a source. As an example, much of the Amazon Basin the terrain is extremely level. This means that more land typically needs to be flooded in order to generate the energy head needed for reasonable power generation capacity. But if a dam was built in a mountainous region the flooded area would be much smaller because less land would need to be flooded to make the reservoir deeper (Ashe, 2010). Another negative to shallow reservoirs has to do with the chemistry of methane. The shallower the reservoir, the less time the methane bubbles have to become oxidized and change form as they approach the surface of the water. The geography and size of the reservoir are very important.

The Executive Board of the Kyoto Protocol's Clean Development Mechanism (CDM) has acknowledged the importance of a reservoir's size when it comes to emissions. This is because "hydro plants in the tropics with large reservoirs relative to their generating capacity can have a much greater impact on global warming than fossil fuel plants generating equivalent amounts of electricity" (Reservoir Emissions, 2015). The CDM has ruled that hydro projects with very large reservoirs relative to their generating capacity ($<4W/m^2$) cannot currently apply for CDM carbon credits (UNFCCC 2014).

Annex G: Technical Working Group

In October 2014, the Consortium (See Annexe I) convened a Technical Working Group (TWG) of global water experts to inform development of the Water Climate Bond Standard.

The TWG provided guidance on the standard's scope, guiding framework, and scoring.

Technical Working Group Members

John Matthews, Alliance for Global Water Adaptation (AGWA), **Lead Specialist**
Xavier Leflaive, OECD
Torgny Holmgren, Stockholm International Water Institute
Christine Chan, Alliance for Global Water Adaptation (AGWA)
Dr. Cedo Maksimovic, Urban Water Research Group, Imperial College London
Bob Zimmerman, Charles River Watershed Association
Casey Brown, University of Massachusetts, Hydrology
Tim Young, Institute of World Development (IWD)
Mark Smith, International Union for Conservation of Nature IUCN
Bill Stannard, American Water Works Association AWWA
Cynthia Lane, American Water Works Association AWWA
Guy Pegram, Pegasys, South Africa
Matt Ries, Water Environment Federation
Junguo Liu, IIASA, Chinese Academy of Sciences
Will Sarni, Deloitte

Annex H: Industry Working Group

In December 2014, the Consortium convened an Industry Working Group (IWG) composed of prospective or active green bond market participants representing both issuers and buyers of green bonds, to inform development of the Water Climate Bond Standard. The IWG provided their insights into the evolving standard's scope, guiding framework, and scoring.

Industry Working Group Members

Paul Wood, Water Fund LLC
Jessica Robinson, Asria
Mike Brown, San Francisco Water
Piet Klop, PGGM
Manisha Singh, WiseLion LLC
Mark Kim, DC Water, U.S.A
Paul Fleming, Seattle Public Utilities
Arturo Buenaventura Pouyfaucon, Abengoa Water S.A.
Hannah Leckie, OECD
Cameron Ironside, International Hydropower Association
Eric Schellekens, Arcadis

Annex I: About the Water Climate Bond Standard Consortium Members

About Ceres

Ceres is a non-profit organization advocating for sustainability leadership. Ceres works to mobilize a powerful network of investors, companies and public interest groups to accelerate and expand the adoption of sustainable business practices and solutions to build a healthy global economy.

About CDP

CDP works to transform the way the world does business to prevent dangerous climate change and protect our natural resources. We see a world where capital is efficiently allocated to create long-term prosperity rather than short-term gain at the expense of our environment.

CDP holds the largest collection globally of self-reported climate change, water and forest-risk data. Through our global system companies, investors and cities are better able to mitigate risk, capitalize on opportunities and make investment decisions that drive action towards a more sustainable world.

About Climate Bonds Initiative

The Climate Bonds Initiative is an investor-focused non-profit organization working to mobilise debt capital markets for climate change solutions.

It works as an independent resource for the green bond market with the aim to educate, inspire, convene and steer a global collaboration of institutional investors, governments, development banks and industry to shift capital to climate investments – at speed.

About World Resources Institute

World Resources Institute (WRI) is a global research organization that spans more than 50 countries, with offices in Brazil, China, Europe, India, Indonesia, and the United States. Our more than 450 experts and staff work closely with leaders to turn big ideas into action to sustain our natural resources—the foundation of economic opportunity and human well-being.

Annex J: Climate Bonds Standard Board

California State Teachers Retirement Service (CalSTRS) represented by Paul Shantic, Acting Co-Director of Fixed Income.

California State Treasurer John Chiang, represented by California State Deputy Treasurer Alan Gordon.

CDP (formerly the Carbon Disclosure Project) , represented by Chris Fowle.

Institutional Investors Group on Climate Change (IIGCC) , represented by Eric Borremans.

The International Cooperative and Mutual Insurance Federation (ICMIF) represented by Shaun Tarbuck.

Investor Group on Climate Change represented by Andrew Major.

Investor Network on Climate Risk represented by **Peter Ellsworth at Ceres** .

The Natural Resources Defense Council represented by Douglass Sims.

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