



Emerging Trends in Mainstreaming Climate Resilience in Large Scale, Multi-sector Infrastructure PPPs

A GLOBAL KNOWLEDGE PRODUCT

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Executive summary

The climate is changing and the critical infrastructure at the foundation of global economic activity is increasingly at risk. Already, impacts from extreme weather cause damage in the billions of dollars annually. Last year alone, floods in India and Pakistan, a drought in Brazil, and severe winter weather in Japan led to over \$5 billion in losses each.¹ Without actions to build climate resilience, these costs will increase as climate impacts intensify. For example, in Africa hydropower facilities are forecast to see revenue losses of up to 60 percent in severe dry climate scenarios by 2050.²

Economic infrastructure is expensive and long-lasting, and the dams, power plants, roads and water treatment plants being built today must be able to withstand not yesterday's or today's climate, but a future, changing climate. Nowhere is this more relevant

than in developing countries, where governments and development partners are racing to fill the infrastructure gap, which in Africa alone is estimated to require \$93 billion annually over the next decade.³

This Global Knowledge Product highlights that climate resilience is not being considered in public-private partnership (PPP) policy frameworks for infrastructure, despite the fact that significant progress has been made by governments and multilateral development banks (MDBs) to develop policy frameworks, processes, tools and knowledge which promote climate resilience. Among the sample of 16 national PPP policy frameworks examined, not a single one was found to mention a changing climate, climate resilience or adaptation. This report emphasizes the missed opportunity—and indeed the risk—that this omission presents.

While climate risk is not assessed and included in PPP policy frameworks, the integrity of infrastructure and revenue

from PPP contracts can be in jeopardy, threatening development outcomes and benefits to PPP project partners. PPP policy frameworks for infrastructure have a critical role to play in the climate resilience efforts of developing (and developed) countries. PPPs are increasingly used to finance and operate infrastructure in many countries, particularly in developing regions, in conditions where other financing options are limited. The advantage of PPPs is that governments and private investors share investment risks by allocating risks to the parties best able to manage them. However,

climate change presents a dynamic risk factor for infrastructure projects.⁴ It alters the environmental conditions that infrastructure projects need to withstand, shifting the calculus for how infrastructure should be planned, designed, financed, constructed, and maintained.

Hydropower facilities in Africa could see revenues losses of 10–60 percent compared to the baseline under the driest climate scenarios by 2050.

—World Bank

There are many misconceptions about climate risk. This report challenges those myths. It has been informed by perspectives from climate resilience and PPP experts from across the development community, together with an extensive literature review. The report finds that scientific understanding of climate change is improving all the time and, coupled with approaches to robust decision-making in the face of uncertainty, this facilitates the inclusion of climate risk and resilience in PPP policy frameworks and projects.

Resilience-building adaptations to infrastructure are not expensive if incorporated early in the project lifecycle, with research demonstrating average incremental costs of 1 and 2 percent for infrastructure projects. What is more, the cost of financing adaptation measures at the early stages of an infrastructure project is small compared to other factors that can influence the future costs of building or repairing infrastructure. Preventive adaptation actions now can mitigate

or avoid high future costs as climate change worsens. If financed and built with climate risk in mind, infrastructure can be robust and provide its intended services effectively over the coming decades of climate change.

Nevertheless, governments may be concerned about adding any extra costs to PPP projects to address climate resilience; however financial instruments are available to support adaptation and can be applied more to PPPs. Climate finance instruments for adaptation are growing in scale, funding, and flexibility. They provide financial incentives (concessional loans, grants) and technical assistance to help deliver resilience-building measures. Financial risk mitigation instruments to address climate risk in PPP contracts, such as index-based weather derivatives, catastrophe risk deferred draw-down options (CatDDO), sovereign insurance schemes and property catastrophe risk insurance are still being developed, but can support addressing climate risk in PPP contracts as the industry grows and evolves.

This report shares insights for a global audience, and specifically for the international development community, on ways forward to incorporate climate risk and resilience in PPPs. Based on the findings of a literature review and interviews conducted with MDB experts, it highlights what has been done, what gaps remain, and what should be done next. It suggests actions for international development partners, governments and private sector actors to support adaptation mainstreaming. The emphasis is on upstream actions which help incorporating climate risk and resilience into policy frameworks. The key actions identified from the analysis are:

1. International development partners should foster political will to incorporate climate resilience in multisector policy frameworks in client countries.
2. International development partners should bolster technical assistance to governments on integration of climate resilience into PPP policy development and infrastructure design standards.
3. International development partners should encourage governments to add specific emphasis of climate risk and adaptation in public investment management frameworks as early action on adaptation is cost-effective.
4. International development partners should help to build capacity of government counterparts, investors and PPP experts on how to make robust decisions in the face of climate uncertainties.
5. International development partners should leverage climate finance and financial risk mitigation instruments to support PPP adaptation investments.
6. Governments can introduce flexibility into existing PPP policy frameworks to enable integration of climate resilience.
7. Governments should incorporate climate resilience in project preparation and transaction structures.
8. Governments should level the playing field by requiring inclusion of climate risk and resilience in PPP procurement.
9. Governments should harness private sector adaptation expertise.
10. Governments should review the language of PPP contracts to build flexibility into contract management and to differentiate 'Acts of God' from climate change.
11. Project companies should develop and implement climate resilience measures throughout the project lifecycle.
12. Lenders should require consideration of climate risk and resilience as lending criteria, and implementation of resilience measures through lending covenants.
13. Shareholders in project companies should ensure they understand the implications of climate change for investment performance.
14. Insurers should continue to promote awareness of climate risk, incentivize resilience-building actions and advise on novel risk mitigation instruments.
15. Professional advisors should develop capacity to address climate resilience in their support to PPPs.

“The cost of adapting to climate change, given the baseline level of infrastructure provision, is no more than 1–2 percent of the total cost of providing that infrastructure.”

—World Bank

1 The case for climate resilience in infrastructure

Scientific understanding of climate change is increasing and can be used to support robust decision-making on climate resilience. Simultaneously, public-private partnerships (PPPs) for infrastructure are increasingly common in many countries, particularly in developing regions, facilitating the development of infrastructure. PPPs are increasingly important as low income countries bridge the infrastructure gap. Global infrastructure investment needs are estimated at \$5 trillion per year until 2020 in agriculture,

transport, power and water.⁵ In Africa alone investment needs are \$93 billion a year for the next decade.⁶ However, climate resilience is not being integrated into PPP policy frameworks, putting the performance of these investments at risk. This Global Knowledge Product discusses why and how climate risk and resilience should be mainstreamed into policy governing the development of infrastructure PPPs. It is informed by insights and recommendations from experts at major international finance institutions across

FIGURE 1: Significant changes in climate will be experienced over the lifespans of infrastructure. (Lifespans shown here are based on data from North America, and they vary elsewhere depending upon environmental conditions and quality of construction materials, so this chart is indicative).

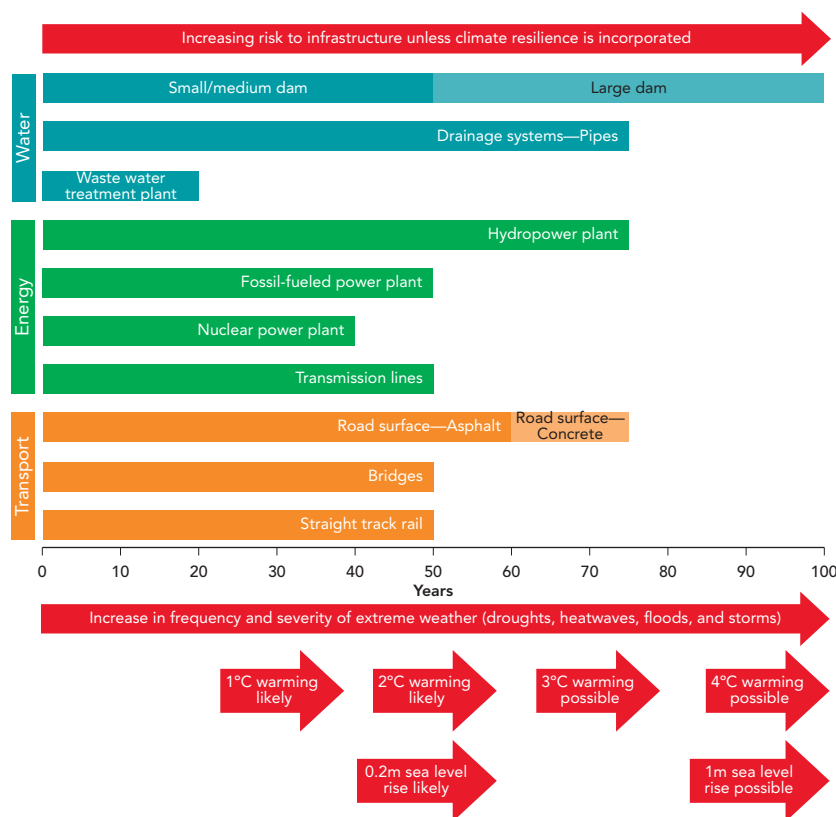
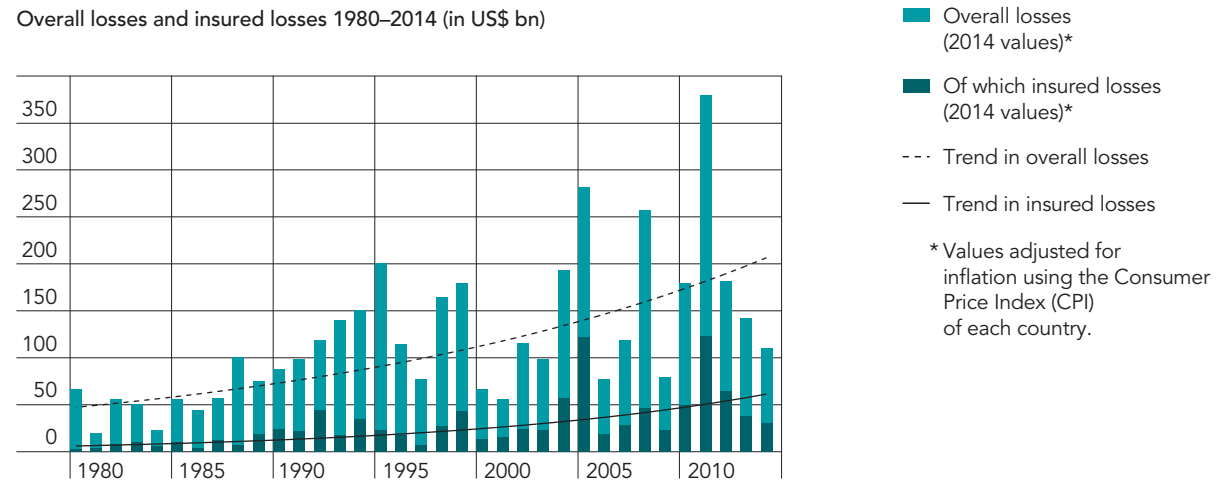


FIGURE 2: Overall losses (which include insured and economic losses) and insured losses alone worldwide due to major natural catastrophes have risen dramatically in recent decades.



Source: Munich Re.¹²

the world, and by a literature review that demonstrates that much remains to be done to address climate risk in PPP policy frameworks.

Economic infrastructure requires significant upfront investment that benefits the communities it serves and repays investors, whether government or private, over the project's lifetime. However, long-lived infrastructure investments designed today to withstand only current climate conditions are at risk, as inevitable climate change intensifies around the world (Figure 1). As developing nations race to bridge the growing infrastructure gap, there must be concerted efforts to incorporate climate resilience into infrastructure policy frameworks, including those for PPPs, to reduce costs and avoid losses at the project level.⁷

The costs of climate impacts and adaptation will grow as climate impacts increase in severity and frequency. Reinsurers including Swiss Re and Munich Re agree that the number and costs of loss events tied to climate and weather have dramatically increased in recent decades, leading to hundreds of billions of dollars of damage¹⁰ (for example, Figure 2 below shows Munich Re estimates). Already, extreme weather events are the largest source of insured losses, averaging \$64 billion annually over the last ten years.¹¹ The cost of economic and uninsured losses is significantly higher, particularly in developing countries where insurance coverage is less comprehensive.

Extreme weather events are the largest source of insured losses, averaging \$64 billion annually over the last ten years.

—Swiss Re

Climate impacts on infrastructure are expected to worsen significantly in the future as they increase and compound. For example, for the energy sector, rising temperatures and extreme weather can lead to unmet

energy demand, rising costs for cooling and asset damage. According to studies, reductions in annual gross domestic product (GDP) associated with energy sector impacts could be up to –0.6 to –0.7 percent in the United States by 2050 and –3 percent for Mexico by 2026. Developing countries are generally expected to see greater decreases in GDP as many will be exposed to greater increases in temperature.¹³

Adaptation actions will increasingly be required to address these impacts, and these too will bring costs. By 2050, the World Bank estimates that global adaptation costs will be between \$70 and \$100 billion dollars annually (at 2005 prices), up to \$27.5 billion of which would be for general infrastructure while another 14.4 for water supply and flood protection.¹⁴ Another report suggests that up to \$11 billion additional public investment will be required annually to address impacts in the water sector; the same study suggests that to adapt infrastructure in all low and middle income countries will cost between \$15.9 and \$63.2 billion in 2030.¹⁵

Most of these costs relate to adapting existing assets and infrastructure. However, when implemented early in the project lifecycle, resilience-building adaptations to

infrastructure are relatively inexpensive, incremental costs, averaging between 1 and 2 percent of the total cost of projects.¹⁶ What is more, under some climate scenarios infrastructure providers stand to miss benefitting from substantial revenues if projects are not designed to take advantage of future climate (e.g., a hydropower plant could generate more power if precipitation in its region increases).¹⁷ Examples of revenues that could be gained are provided in Section 2.1.

PPP policy frameworks need to give a clear steer to project sponsors and developers that they expect climate resilience to be factored into infrastructure, or they risk severe outcomes for communities and costly investment losses. For instance, when the International Finance Corporation (IFC) reviewed and helped finance the expansion of the Panama Canal in 2008, climate experts from IFC raised the question as to how a changing climate and hydrological conditions in the region would affect the operational and financial projections¹⁸ tied to a \$2.3 billion dollar loan package.¹⁹ While the project sponsors had met the standards for due diligence and environmental reviews, they did not consider climate risk. In December 2010 the canal closed due to flooding when Panama received more rain than in its recorded history, causing significant disruptions and loss of income.²⁰

Goals and objectives

Developing countries collaborate with many partners in the financing, design, construction, and maintenance of different sectors and types of infrastructure. To provide clarity and focus on climate resilience across sectors and geographies, it is best implemented at the level of national policy governing PPPs and later in pre-feasibility and feasibility studies prior to the construction of specific projects.²¹

The goal of this report is to encourage the development of this 'upstream' approach to climate resilience in infrastructure PPP policy frameworks. With this in place, countries and project sponsors can then implement the processes and tools that can be used to build resilience 'downstream' in specific PPP projects. This report therefore shares insights into how climate risks and resilience are best and most cost-effectively managed at a national, multi-sector level.

This report calls for climate resilience to be integrated into multi-sector and systems-wide frameworks for infrastructure planning.

The objectives of this report are to:

- discuss how climate resilience can be mainstreamed into large infrastructure policy frameworks and projects, particularly those partly or wholly financed by private investors;
- place the climate resilience of infrastructure PPPs on the international development community agenda;
- share examples of how practice in this area is developing; and
- provide high level actions for the international development community on mainstreaming of climate risk and resilience into PPP policy frameworks.

The main target audience for this report is the international development community, with a particular focus on the multilateral development banks (MDBs) that frequently support governments in the development of PPPs. Other target audiences include government decision-makers, PPP developers and financiers.

Approach

There are extensive bodies of knowledge on both climate risks to infrastructure and on how to implement PPPs for infrastructure, though there is little overlap between them. This report presents a synthesis of insights from both areas, building off of interviews with experts from MDBs, analysis of national policy frameworks for PPPs and adaptation, and a literature review, to identify where these topics do and should overlap.

Five interviews were conducted with PPP and climate resilience experts from the leading multilateral development

banks that provided a global perspective and insights which deeply informed this report. The interview questions are listed in Annex A and summaries of the interviews are provided in Annex B. Two detailed case studies from Australia and the United

Kingdom of how these countries integrate climate risk into infrastructure are shared in Annex C. The literature review explored published information on PPP policy frameworks, adaptation policy frameworks and mainstreaming of climate resilience into infrastructure planning (regardless of

governance structure) at the sector, multi-sector and regional scale. As part of this, particular attention was focused on how existing PPP and private finance initiative (PFI) frameworks, policies and laws integrate climate resilience, and in particular, in countries which are more climatically vulnerable and with potentially low adaptive capacity. A survey of the work that MDBs and other development partners are undertaking in these fields is also provided. The results are presented at length in Annex D.

Key terms

'PPPs' are defined broadly in this report as investments with private sector involvement and equity (e.g. build-operate-transfer) coupled with long-term government involvement. This excludes arrangements at the margins of the definition of PPPs, with privatization at one extreme and management contracts at the other.

'Climate risk' is category of potential impacts from a changing climate that can have consequences for an investment. Owing to climate change, the frequency and severity of extreme events is increasing, and events that were once considered unforeseeable or rare become more quantifiable

and more common. Changes in long-term average climate conditions, which can in turn affect infrastructure performance and demand, are also occurring.

The extent to which climate risks can be addressed is discussed in terms of 'resilience' and 'adaptation'. Though these concepts are sometimes used synonymously, there are some useful distinctions between them, which are defined here in regards to how they relate to infrastructure:

- **'Climate resilience'** relates to the ability of a system to withstand, bounce back, or absorb the impacts of climate variability and change. Resilience is a quality or characteristic of a system.
- **'Adaptation'** to climate change refers to an adjustment in a system in response to current or expected climate impacts. Adaptations can both be aimed at avoiding negative consequences or seizing positive opportunities from climate change.

In practical terms, 'increasing resilience' can be the goal of policy frameworks, infrastructure design, maintenance, and/or retrofitting. 'Adaptations' are the specific actions targeted at increasing resilience, such as making changes to operating procedures, upgrading technical specifications for infrastructure or using financial products to off-lay risk.

2 Embedding climate resilience into infrastructure planning policy

Global infrastructure investment needs are huge, estimated at around \$5 trillion per year until 2020,²² and infrastructure PPPs are gaining high importance, with private investment in infrastructure in low and middle income countries increasing from around \$100 billion in 2005 to \$200 billion in 2012.²³ These infrastructure assets will experience significant changes in climatic conditions over their long lifespans. While these changes are not accounted for in policy frameworks, they will increasingly threaten investment performance, leading to lower quality services, higher costs and reduced income.

Climate risks and resilience needs for infrastructure

Past climate conditions are no longer a reliable proxy for understanding future climate. Infrastructure cannot be safely designed and operations cannot be reliably forecast based on past environmental and weather conditions. Supply of, and demand for infrastructure services is affected by climate change (Table 1 to Table 3). Unless climate risks are managed appropriately, climate change will increasingly affect project performance and, ultimately, investments made in infrastructure projects, including those made through PPPs. These impacts will be from gradual changes in temperature, rainfall patterns, and sea level rise as well as an increased incidence and severity of extreme events such as heatwaves, droughts, floods and storms.

Across all infrastructure sectors, climate change can have impacts on financial, operational, environmental and social performance as well as market conditions.²⁴ For PPP projects, this can result in risks to both the public and

private sector partner—and ultimately the end-user of the service—through:

- asset damage and deterioration, and reduced asset life,
- increases in operating expenditure (OPEX) and the need for additional capital expenditure (CAPEX),
- disruption to service provision,
- loss of income,
- increased risks of environmental damage and litigation,
- reputational damage,
- changes in market demand for services, and
- increased insurance costs or lack of insurance availability.

To illuminate these points, brief summaries are provided below on the potential impacts of climate change on the water and sanitation, energy, and transport sectors. Examples of resilience-building measures are also given.

Climate change will affect supply of, and demand for infrastructure services.

Water and sanitation

Water is predicted to be the main channel through which the impacts of climate change will be felt by people, ecosystems and economies.²⁵ The economy-wide impacts can be through long-term gradual changes as well as extreme events. This has been illustrated clearly during previously recorded events. For example, the floods associated with the 1997–1998 El Niño and the drought associated with the 1998–2000 La Niña cost Kenya alone 11 and 16 percent of its GDP respectively.²⁶ Table 1 summarizes the potential impacts of climate change on a range of water services which in turn may have important implications for the economic, social and political stability of entire regions.

TABLE 1: Summary of water services vulnerability to climate change²⁷

Type of water services	Changes in climate	Possible impacts	Example resilience-building measures
Municipal and industrial water supply	Changes in precipitation patterns and quantities	Reduction in water availability, quality and security	Implement water use efficiency measures
Wastewater and urban storm water	More frequent heavy rainfall	Overload capacity of sewer systems and water and wastewater treatment plants	Increase capacity of drainage channels
	Periods of lower rainfall	Resulting lower flows lead to higher pollutant concentrations	Implement pollution warning system
Irrigation	Higher temperatures and levels of evapotranspiration	Greater demand for irrigation	Expand use of drip irrigation systems
	Increased variability in rainfall leading to reduced water availability	Increased pressure on existing sources of water for irrigation e.g. rivers and aquifers	Improve water efficiency

The cost of climate impacts to water and sanitation is expected to be high. For example, irrigation investments in southern African basins in dry climate scenarios are forecast to experience revenue losses of between 5 and 20 percent annually, or up to \$40 billion by 2050, if climate impacts are not accounted for.²⁸ Potential annual gains of to \$2 to \$4 billion by 2050 are anticipated in regions that experience wetter climate scenarios, but only for irrigation infrastructure designed to capture and utilize higher than historical rainfall.

Energy

Climate change can have impacts across the full energy services chain (generation, transmission, distribution and demand). Table 2 summarizes climate change impacts on common types of energy production and distribution, and outlines examples of adaptation actions.

The cost of climate impacts could be severe to energy investments if climate projections are not integrated into infrastructure. For example in Africa, in dry climate scenarios, hydropower revenue could fall by 5 to 60 percent by 2050

TABLE 2: Summary of energy sector vulnerability to climate change^{29,30,31}

Type of generation/distribution	Changes in climate	Possible impacts	Example resilience-building measures
Thermal (fossil fuel and nuclear) power plants	Increasing air temperature (average and extremes)	Reduced generation capacity and efficiency of turbines	Site at locations with cooler local climates where possible
	Increased water temperature	Increased risk of exceeding thermal discharge limits (into water bodies)	Temporary shut-downs during heat waves
	Decreasing water availability	Reduction in available generation capacity due to lack of cooling water	Increase efficiency of water cooling systems
		Increased competition from other water users e.g. local communities	
	Increasing intensity of storm events, sea level rise, and storm surge	Increased risk of physical damage and disruption to coastal facilities	Siting at locations outside high-risk zones
Increasing intensity and frequency of flooding	Increased risk of physical damage and disruption to inland facilities	Build flood protection barriers	

Type of generation/ distribution	Changes in climate	Possible impacts	Example resilience-building measures
Hydropower	Increase/ decrease in average water availability	Increased/ reduced power output Increased competition with other water users.	Schedule release to optimize income
	Increasing air temperatures and evaporative losses	Reduction in available generation capacity requiring changes in operational procedure	Schedule release to optimize income
	Changes in precipitation and/or decreasing snowpack	Reduction in available generation capacity requiring changes in operational procedure	Adjust water management
	Increasing intensity and frequency of extreme precipitation events and flooding	Increased risk of physical damage e.g. by debris carried from flooded areas, damage to dams and turbines, lost output due to releasing water through bypass channels Increased sedimentation of hydropower reservoirs	Increase storage capacity
Wind power	Variation in average wind patterns e.g. prevailing wind strength and direction	Impact on resource potential	Update site selection criteria
	Storm surges and sea level rise	Damage to structural integrity of offshore wind turbines	Update site selection criteria
	Extreme weather events e.g. changes in maximum wind speeds, direction and shear.	Damage to physical infrastructure	Adjust turbine design
Solar energy	Increasing air temperatures	Reduction in generation efficiency	Adjust design, increase cooling system capacity
	Changes in humidity and cloud cover	Change in power output	Apply rougher surface for PV panels that use diffuse light better
	Decreasing water availability	Reduction in potential generation capacity from concentrated solar power projects	Cool PV panels passively by natural air flows or actively by forced air
	Hail	Fracturing of glass plate cover, damage to photoactive material	Use reinforced glass to withstand hailstones
Wave and tidal energy	Changes in wave magnitude and frequency	Reduced power output Damage to infrastructure	Adjust design code
Transmission and distribution	Increasing intensity of storm events	Increased risk of physical damage	Create disaster mitigation plans
	Increasing air temperatures	Reduction in transmission efficiency and available transmission capacity	Adjust design code and planning criteria
	More frequent and severe wildfires	Increased risk of physical damage and decreased transmission capacity	Enhance design criteria
Energy demand	Increasing cold season temperatures	Reduced demand for energy for heating	Modify design criteria for buildings
	Increasing hot season temperatures and increasing frequency of heat waves	Increased demand for cooling energy	Improve building and industrial energy performance

as precipitation decreases, depending on the basin.³² However, in wet climate scenarios hydropower producers whose investments do not account for climate change face foregone revenues of up to 30 percent beyond baselines estimates.³³ These estimates do not take account to the cost of extreme events that can damage or destroy critical energy infrastructure.

Transport

The Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report notes that road, rail, shipping and air transport infrastructure are all likely to be affected by climatic changes.³⁴ Table 3 summarizes the possible impacts of changes in this sector and identifies some adaptation actions.

The costs of not adapting to climate change can be high for the transport sector. For example, the Colombian port Muelles el Bosque in Cartagena is at risk of sea level rise which would lead to flooding of the causeway that links the island where ships berth to the mainland areas of the port. Flooding disrupts movements of goods and the port cannot operate when the causeway is flooded. Depending on the rate of sea level rise, this could cost the port between 3 and 7 percent of its net income by 2030, or up to \$2 million.³⁷ The costs of adapting to sea level rise are significantly lower. In the case of this Colombian port, raising the causeway by a recommended 20cm would cost approximately \$380,000.³⁸

Risk allocation within PPP contracts

PPP contracts are long term (typically 20 years or so) and generally inflexible, so failure to address climate risk in them can create a long term burden. Associated tariff regulations can make them even more rigid, as tariffs cannot easily be changed. By contrast, one of the strengths of PPPs is that each partner holds the risks they are best suited to carry. However, risks must be identified and quantified to be allocated effectively. As highlighted above, climate change poses a dynamic risk factor that needs to be studied and allocated efficiently if the infrastructure financed by PPPs is to offer expected returns. Understanding the risks and increasing the climate resilience of PPPs is crucial if this form of financing is to remain successful in a changing climate.

In any contract, it is necessary to identify, analyze, and allocate project risks adequately. A PPP contract is no different to a conventional contract, in that the risks associated with the transaction or project need to be managed appropriately between the public and the private partners. This is true for climate risk as other risks. Failure to do so may have financial implications for the private sector as well as the public sector, which is usually left to manage unaccounted risks, and can prevent a project from achieving its objectives or functioning the full length of its expected lifecycle. Thus, at the project identification stage, in addition to assessing the sources of revenue linked with the affordability of the project, the government concerned must undertake a broad assessment of the risks that arise from the project requirements in order to manage them. This assessment should address climate change risks.

The general understanding of risk allocation is that a risk should be allocated to the party best able to understand and manage it, and thereby price it correctly. When analyzing the risks in any transaction, it is vital to consider that the transfer of a risk will only improve value for money if the price charged by the private sector to manage the risk is less than what it would cost the government in question to manage the risk itself. The transfer of risks to the private partner brings, in general, an increase in the price of the project, so it is essential to ensure that the public benefit of such transfers is greater than that increase in financial costs. Transfer of risk in PPP does not imply the transfer of all of the risks to the private partner. This additional cost derives from the risk premium that is required by the private sector to take on a particular risk. A risk matrix should be defined for each project where all the risks—including those related to climate change—are identified and allocated, their probability evaluated and their (financial) impact quantified. Finally, mitigation measures should be established for each type of risk. Some of these will be financial risk mitigation

measures (discussed further in Section 2.6).

Risks for PPP projects can broadly be categorized as commercial or legal and political:

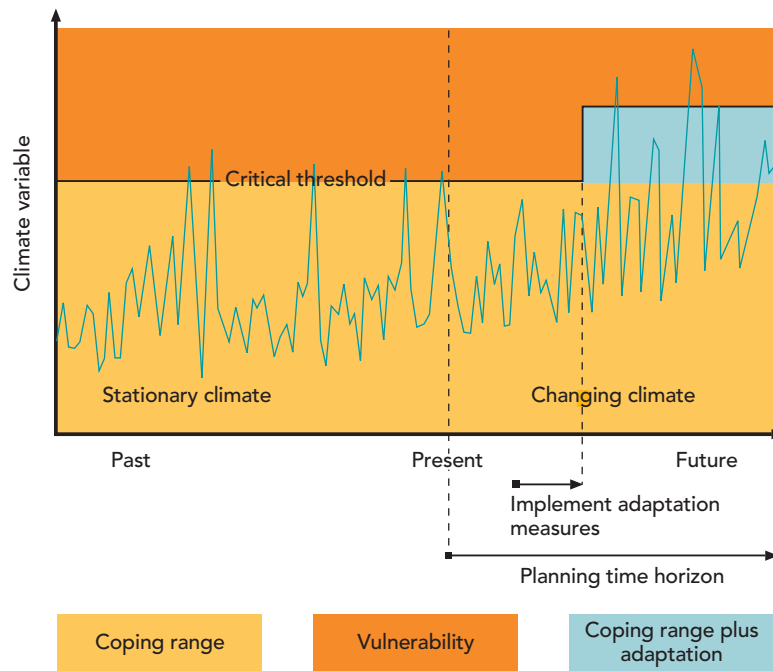
- Commercial risks can be divided into supply and demand risks. Supply risk covers the ability of the company set up to deliver the PPP project to provide the services under the contract. This risk includes both construction risk and operational risk, as these are the two main phases of the project. Construction and operational risks include financial

Climate change poses a dynamic risk factor that needs to be studied and allocated.

TABLE 3: Summary of transport vulnerability to climate change^{35,36}

Type of transport	Changes in climate	Possible impacts	Example resilience-building measures
Road	Increases in very hot days and heat waves	Deterioration of road surface integrity e.g. through softening and traffic-related rutting. Thermal expansion of bridge joints and paved surfaces.	Enhance design criteria to withstand extreme heat
	Increases in temperature in very cold regions	Changes in road subsidence and weakening of bridge supports due to thawing of permafrost	Enhance design criteria to withstand permafrost thaw
	Sea level rise and storm surges	Damage to highways, roads, underground tunnels and bridges due to flooding, inundation of coastal areas and coastal erosion	Update site selection criteria
	Increase in intense precipitation events	Damage to road infrastructure due to landslides Overloading of drainage systems leading to surface water flooding	Improve emergency repair procedures Upgrade drainage systems
	Increased drought	Damage to road infrastructure due to increased susceptibility to wildfires	Install fire barriers beside roads
Rail	Increased in average and extreme precipitation	Erosion of rail beds	Improve drainage around rail beds
	Melting of permafrost	Ground settlement and undermining stability of tracks	Use permafrost stabilization technologies
	Increase in extreme temperatures	Thermal expansion of rail causing buckling	Enhance design criteria of rails
	Increase in extreme temperatures	Greater cooling requirements in underground railway systems	Improve air-cooling systems
Shipping	Changes in average precipitation	Negative impacts on navigation of inland waterways as river flows are reduced	Implement navigation warning system
	Increased extreme rainfall	Reduced navigability of rivers due to increased magnitude and frequency of flooding and siltation	Implement navigation warning system
	Reduced sea ice extent	Improved navigability of certain sea routes, particularly in the Arctic region (potential climate change-related opportunity)	
	Sea level rise, increased storminess and storm surges	Damage to port infrastructure and equipment and loss of port operability	Increase height and strength of sea walls Facilitate ecosystem-based adaptation (e.g. mangroves)
Airports	Increases in very hot days and heat waves	Deterioration of runway surface integrity e.g. through softening and aircraft-related rutting	Enhance design criteria
	Increase in intense precipitation events	Surcharging of airport drainage systems leading to flooding	Expand drainage system capacity

FIGURE 3: In a changing climate, the coping range of infrastructure assets will be eroded over time, and critical thresholds will be exceeded more often, unless adaptation measures are implemented.



Source: Willows and Connell, 2003.³⁹

market risk due to, for example, changes in the cost of capital or changes in exchange rates and inflation. Demand risk relates to variations in user volumes compared to base case assumptions. The private sector partner carries risk if its income and profit are linked to its actual performance agreed under the PPP contract and where these would be impacted by any underperformance in the services to be provided. As already explained in Section 2, climate change can affect both supply and demand risks for infrastructure projects. In turn, this can translate into poorer commercial performance, affecting the project company and project financiers, and potentially the public sector.

- Legal and political risks would include the legal framework of the country in question, dispute resolution, the regulatory framework, government policy, taxation, expropriation, and nationalization.

It is often accepted that the private sector is better placed to assume commercial risks while the public sector is better placed to assume legal and political risks, as these are under its control. However, risk allocation varies greatly between PPPs, depending on the contractual arrangements in place.

Consequences for PPP risk sharing in a changing climate

A changing climate is likely to challenge and stress the risk sharing contractual obligations of all parties in a PPP, especially in contracts that have not adequately defined roles and responsibilities in the event that weather and climate change cause disruptions to the activities within a project's lifecycle.

A changing climate not only represents a risk in terms of increased frequency and intensity of extreme weather events, but also through gradual, longer term incremental changes. Figure 3 presents the relationship between coping range, critical thresholds, vulnerability, and climate-related success criterion of projects. A critical threshold is set at a level that achieves an economic and acceptable balance between infrequent and abnormal exceedance and associated costs of insurance and remediation. In a changing climate, unless the threshold is adapted, the coping range is gradually eroded over time. In the future, changes in the frequency and intensity of extreme events means that exceedances which were once considered infrequent may become the norm and of higher magnitude. The result is potentially more disruptive events increased operation and maintenance

costs, and the need for additional capital expenditure to increase the asset's coping range—factors which may not have been included in the business and financial model at the feasibility and design stages. Investors making decisions today about long term infrastructure assets needs foresight to address these issues at the right time, or risks lock-in to an underperforming and more costly investment.

In a changing climate, extreme weather events that are characterized today as “force majeure”, which is often defined as events beyond the control or reasonable anticipation of parties to a contract,⁴⁰ may be tomorrow's normal weather. Under force majeure then, weather events are a shared risk. However, there is still a need to draw the line in PPP contracts between weather and force majeure events, not only in terms of current climate, but also taking into account future changes. There does not appear to be an internationally standardized approach to defining force majeure in legislation or policy, nor is there a standardized

approach to allocating responsibility in PPPs to manage force majeure versus weather risks. Furthermore, not all countries include weather events within force majeure, leaving private investors to cover them through insurance.

Unless infrastructure designs and operations are adapted, their capacity to tolerate variations in climate will erode over time.

Climate risk and resilience in government policy frameworks

Governments are increasingly developing national adaptation policy frameworks and some have created specific legislation governing adaptation. Some countries also have policy frameworks for PPPs. The question then arises as to whether and how climate risk and adaptation are addressed in these PPP frameworks. This section answers this question by analyzing adaptation policy frameworks and PPP policy frameworks in 16 countries. These were chosen to provide as a representative sample of countries with PPP investments

TABLE 4: Summary of country adaptation frameworks and legislation⁴¹

Country	Adaptation Framework	Adaptation Legislation
Bangladesh	None	The Climate Change Trust Fund Act
Brazil	National Policy on Climate Change (established by Law 12187/2009) (2009)	Law 12187/2009, establishing the National Policy on Climate Change (NPCC), regulated by Decree 7390/2010
Bulgaria	National Climate Change Risk and Vulnerability Assessment Framework (2014)	Spatial Planning Act
Chile	National Climate Change Adaptation Plan (2014)	None
China	National Strategy For Climate Change Adaptation (2013)	12th Five-Year Plan for the Development of National Economy and Society (2011–2015)*
India	National Action Plan on Climate Change (2008)	None
Indonesia	National Action Plan on Climate Change Adaptation (2012)	Law 32/2009 Environmental Protection and Management
Jamaica	None	None
Mexico	General Law on Climate Change (2012)	General Law on Climate Change
Nepal	National Adaptation Program of Action (NAPA)	None
Nigeria	National Climate Policy (2013)	None
South Africa	National Climate Change Response Policy White Paper (2011)	None
Trinidad & Tobago	National Climate Change Policy (2011)	None
Turkey	Turkey's National Climate Change Adaptation Strategy and Action Plan (2011)	Act No. 5403 on Soil Conservation and Land Use

*Although the Plan is focused on mitigation, there is a requirement to increase forest coverage which can deliver adaptation as well as mitigation benefits.

in infrastructure with a broad geographic spread, as well as some developing countries with less PPP investment but high climatic vulnerability. They include: Albania, Bangladesh, Brazil, Bulgaria, Chile, China, Honduras, India, Indonesia, Jamaica, Mexico, Nepal, Nigeria, South Africa, Trinidad & Tobago, and Turkey. The results of the review are detailed in Annex D.

Government policy frameworks for adaptation

The Grantham Research Institute on Climate Change and the Environment recently published its 2015 Global Climate Legislation Study. Covering 98 countries, the study is intended to be a source of information for legislators, researchers and policy-makers. Table 4 draws key information from the study, presenting a summary of country-level adaptation frameworks and legislation for the countries listed above, with the exception of Albania and Honduras which were not covered in the 2015 Global Climate Legislation Study.

Some countries have developed national policy that requires climate risk be incorporated into the design and maintenance of infrastructure, regardless of the type of financing arrangement. For instance, the UK Government policy on infrastructure adaptation, the "Government Vision and Action Plan for a Climate-Resilient Infrastructure"⁴² outlines the main climate risk issues for the transport, energy, water and Information and Communications Technology (ICT) sectors. It sets out the UK Government's policy on ensuring those sectors are 'resilient to today's natural hazards and prepared for the future changing climate'. The policy promotes linkages between the UK National Adaptation Programme and ongoing efforts to improve the resilience of the country's most important infrastructure to present-day natural hazards, including the Critical Infrastructure Resilience Programme and Sector Resilience Plans (SRPs). (See Annex C for further details).

Government policy frameworks for PPPs in developing countries

A review was undertaken of country-specific PPP legislative (Acts, Laws, Regulations etc.), policy, framework, and other supporting documents for the 16 countries listed above. The documents, or other related reference sources if none

could be found, were reviewed for evidence of whether a changing climate or adaptation had been explicitly included.

The review demonstrated that none had clauses specifying that PPP agreements should take into account, or build resilience to, a changing risk landscape (e.g. a changing climate), despite the fact that 12 of these countries have adaptation frameworks and seven have adaptation legislation (per Table 4). One factor that can explain this gap is that adaptation policy frameworks and legislation in some countries are relatively recent, and their PPP policy frameworks may have been created earlier.

It was common, but not in all cases, for the countries reviewed to legislate that PPP contracts include provisions for, and allocation of, unforeseen risks which are categorized under force majeure. Force majeure typically includes "Acts of God", which encompasses extreme climatic events. However, the types of events, frequency, and intensity that comprise Acts of God were not defined in legislative documents, instead, transferring the onus of definitions and risk allocations to the PPP contract development stages.

In none of the government-issued model PPP agreements reviewed was climate change explicitly mentioned, nor was there reference to how today's force majeure events may change in the future, in terms of frequency or magnitude.

Policymakers and government stakeholders also have a number of tools and guidelines available with which to develop PPPs, though these were not found to include provisions for climate risk. For example, the Government of India provides a comprehensive web based "PPP Toolkit for Improving PPP Decision-Making Processes"⁴³ covering five infrastructure sectors including highways, water and sanitation, ports and urban transport. Although the toolkit is PPP-specific and intended for projects with long lifetimes, it does not contain explicit references to making projects resilient to a changing climate. The tool does however provide potential 'hooks' for consideration of climate resilience in its reference to: *"the parties involved in a project can affect the amount of risk by the level of influence they have over events and the level of information they have about the present and future... Information is directly related to risk. It is precisely because we usually don't have all the information that we can't predict future outcomes for certain. When we have better information we are better able to foresee and reduce risk."* The toolkit

Of the 16 national PPP policy frameworks reviewed based on our selection of countries, none referred to climate resilience, adaptation, or climate change.

also provides a comprehensive catalogue of risks within which climate change could readily be integrated. Other countries provide comparable tools, methodologies, or regulations for designing PPPs, for example Australia⁴⁴ and the Philippines,⁴⁵ though these also fail to mention climate change as a risk factor.

Many of the MDB interviewees consulted during the development of this report agreed that climate resilience should be mainstreamed in public investment management systems generally, or specifically in engineering standards, for the development of all kinds of infrastructure. PPPs would be captured within this and held to the same standards as other infrastructure projects.

Some interviewees cautioned against integrating climate risk within Environmental Impact Assessments (EIAs) for infrastructure projects, as they noted that EIAs are often understood to focus on the impact of a project on the environment, while climate risk is about the impact of a changing environment on a project. There is also a danger that climate risk is assumed to have been addressed in EIAs when these cover greenhouse gas emissions that contribute to climate change. However, there is a growing body of guidance which promotes inclusion of climate risk within EIA, including the International Finance Corporation (IFC) Environmental and Social Performance Standards and Guidance,⁴⁶ which are widely applied to major projects in developing countries, and the European Union revised EIA Directive.⁴⁷

Climate risk assessment and mainstreaming of resilience by international development partners in infrastructure development

Development partners have published a robust body of literature on climate risk, resilience and infrastructure. The same is broadly true for PPPs. However, guidance from development partners on how to bring these two fields together, to increase the climate resilience of PPPs is scarce. The results of a review of MDBs and bilateral donors' guidance in these areas are summarized in Annex D.

One example of climate change being incorporated into PPPs is in Africa, where hydroelectric dams financed by IFC are designed according to expected streamflow in a changing climate, in line with IFC new policy to require consideration of climate risk.⁴⁸ Such assessments have been occasionally done at the level of specific contracts by different agencies, but not all multi-lateral development banks

(MDBs) mandate climate risk screening (see Annex B and Annex D for further details).

However, while the topics of PPPs and climate risk have barely begun to be discussed in concert, there are many tools available to infrastructure project developers and government officials to mainstream climate risk into infrastructure design and operation. Many of these have been published by international development partners, and can be used at the project level to assess risk and identify and evaluate adaptation measures. Though the implementation of these tools remains patchy, and none of them specifically focus on the intersection of climate risk and PPPs, they offer useful guidance towards improving climate resilience of infrastructure. For example, one tool intended for use on large infrastructure projects, whether or not they are financed by PPPs, is the European Commission's guidelines for integrating climate resilience into a conventional asset lifecycles. The Guidelines include a climate resilience toolkit with modules designed to complement the analyses routinely performed as part of infrastructure project development. The modules are applied at several stages in the project development process, and cover all stages of a project from business model development to design, construction and operation, through to decommissioning.

There are also related tools that support climate risk assessment and adaptation planning at the project level, including:

- **Probabilistic risk assessment:** useful for disaster risk modelling where data are available. One example is CAPRA, from the World Bank, which helps institutions with "integrating risk information into development policies and programs".⁴⁹
- **Uncertainty analysis:** data uncertainty arises due to fundamental limitations to measuring the world. There are various techniques for uncertainty analysis. One key method widely applied for climate risk assessments is the application of climate change scenarios. Other, non-climate (socio-economic) scenarios can also be used. These assist decision-makers by providing contextual information on the implications of uncertainties for decisions, and help structure analyses with different information sources.⁵⁰
- **Downscaling of global climate model output:** a data-intensive process that provides localized climate change projections which can be applied at the project level, using regional climate models or statistical approaches.ⁱ

ⁱ More related tools are available in *Climate adaptation: Risk, uncertainty and decision-making*, available at <http://www.ukcip.org.uk/wordpress/wp-content/PDFs/UKCIP-Risk-framework.pdf>

TABLE 5: Selected climate risk and resilience processes for application to infrastructure investments

Tool	Organization	Description	Year	Source
Climate Safeguards System (CSS)	African Development Bank	"creating tools to climate proof AfDB-financed investments, and to mainstream climate change adaptation into development"	2011	link
Climate Proofing Investment in the Transport Sector: Road Infrastructure Projects	Asian Development Bank	"aims to present a step-by-step methodological approach to assist project teams to incorporate climate change adaptation measures into transport sector investment projects"	2011	link
Guidelines for Climate Proofing Investment in the Energy Sector	Asian Development Bank	"This provides a step-by-step methodological approach to help project teams assess climate change adaptation measures into energy investment projects."	2013	link
Adapting to Climate Change: helping keysectors to adapt to climate change	UK Department for Environment, Food and Rural Affairs (Defra)	"to provide guidance about assessing the current and projected impacts of climate change in relation to the authorities' functions and preparing proposals and policies for adapting to climate change in the exercise of their functions" in energy, water, transport, and other sectors.	2012	link
Building resilience to climate change: investing in adaptation	European Bank for Reconstruction and Development	"climate resilience audits, which provide a basis to identify, propose and discuss with the client possible technical and investment solutions."	2015	link
Climate-ADAPT	European Commission	"variety of tools and methods which are helpful for adaptation" including uncertainty guidance, case studies, adaptation planning, and more.	2015	link
Guidelines for project managers: Making vulnerable investments climate resilient	European Commission DG Climate Action	"to help developers of physical assets and infrastructure incorporate resilience to current climate variability and future climate change within their projects."	2012	link
Integrating Climate Change Adaptation into Development Co-operation	Organization for Economic Co-operation and Development (OECD)	"policy guidance [that] outlines a number of priorities for governments and international donors for implementing adaptation activities"	2009	link
Climate & Disaster Risk Screening Tools: Energy, Water, and Roads	World Bank	for use by "development practitioners at an early stage of national level planning processes or project design....both the national/policy level tool and the project level tools provide a user-friendly step-by-step approach to understand potential risks to programs and investments."	2015	link
Hands-on Energy Adaptation (HEAT) Toolkit (part of ESMAP Energy and Climate Adaptation Initiative)	World Bank	"an online resource that is designed to lead you through an assessment of climate vulnerabilities and adaptation options in your country's energy sector and raise awareness among key stakeholders."	2010	link

These project-level climate risk assessment and adaptation tools are complemented by many different risk mitigation instruments which can be applied to infrastructure projects. Some key examples are described below.

Managing climate risk with risk mitigation instruments

The primary concern for infrastructure project funders is to ensure that the main commercial risks of the project under development are covered, regardless of the origin of the risk. The main risk factors include overall commercial viability, completion risks, environmental risks, operating risks, revenue risks, input supply risks, force majeure risks, mismatch of contracts, and sponsor support, and it is notable that changing climate risks can interplay with many of these. In the analysis of risks in a PPP, the standard approach is to take each risk and identify whether it is covered in the project contracts, identify what other mitigation there is for risks not covered contractually (for instance, through guarantees or insurance), and assess the impact of these risks on the project company.

Another fundamental aspect in establishing the credit worthiness of any PPP project is a detailed analysis of the security of its cash flow. Funding should be forthcoming only if the business model of the project or PPP is robust and the political risk situation in the project's location is stable. Commercial funders will require a project to protect its cash flow by taking out appropriate insurance to enable the project's debt service to continue in the event of unexpected events. Lenders' interests are twofold: first to ensure that they are satisfied with the scope of the proposed insurance cover (the risks covered, the exclusions, the amounts of cover and the deductibles) and, secondly, to ensure that their interests in the insurances are adequately protected. In addition to insurance against physical damage and third party liability, lenders may wish the project company to take out pollution insurance and delay in start-up and /or business interruption insurance. Many of these insurances are only available on an annual basis which introduces a risk around renewal for the project concerned and its funders. Any failure to renew an insurance policy could result in default under the terms of

the funding agreement. The costs of the various insurance cover can be high and would be borne by the project itself.

There are many available financial instruments for risk mitigation, though more can be done by MDBs to "improve the effectiveness of the instruments in support of climate related investment"⁵¹ and to extend their geographical scope. These financial instruments transfer certain defined risks from project financiers (lenders and equity investors) to creditworthy third parties (guarantors and insurers) that have higher capacity to accept such risks. The availability of appropriate risk mitigation instruments allows private sector lenders and investors to cover those risks that they are not willing to accept because they are considered as excessive or beyond their control.

Financial risk mitigation instruments are still being developed but can support addressing climate risk in PPP contracts as the industry grows and evolves.

In response to the growth in project finance and PPP structured projects around the world, the private financial services sector and MDBs have established a variety of risk mitigation instruments that range from insurance policies and guarantees aimed at enhancing creditworthiness of projects, to contract-based instruments targeting the volatility of commodities and currencies. These instruments help stabilize revenues, control costs, and manage cash reserves. Some of these instruments have application in managing climate risk, and may be available to developers and funders who wish to undertake projects in countries where the availability of insurance may be restricted or unavailable. In addition, experts have indicated that managing climate risks in a systematic manner could in-fact enhance country's creditworthiness through identification and mitigation of risks. Examples of these instruments include:

- **Index-based weather derivatives:** if, for example, precipitation falls below an agreed upon threshold, a rainfall index is used to project losses to a water-sensitive project, and a payout is made when production falls below historic averages.⁵²
- **Catastrophe risk deferred draw-down option (CatDDO):** a contingent credit line that provides immediate liquidity after a natural disaster, helping member countries respond and rebuild.⁵³
- **Sovereign insurance schemes:** vulnerable, small, and low-income countries may not have sufficiently broad or diversified portfolios of assets to ride out extreme disasters, and so increasingly pursue insurance-linked

**BOX 1: Example of a risk mitigation instrument used to protect against climate variability:
The Uruguay Weather Derivative**

Background: Uruguay's state-owned public electric company, Administración Nacional de Usinas y Trasmisiones Eléctricas (UTE) relies on hydropower to generate more than 80% of its energy needs. When rainfall and/or accumulated water reserves is low, UTE is forced to purchase alternative fuels (mostly oil and natural gas) to use as inputs for electricity production. When the price of oil is high, generation costs become very expensive, affecting UTE's bottom line, and creating problems for both consumers and the national budget.

Financing objectives: In 2012, water shortages meant the company needed to purchase other sources of energy. That year the cost of supplying demand for electricity reached a record \$1.4 billion, far exceeding the company's original projections of \$953 million. In order to cover the gap, UTE borrowed funds from the market, drew down the country's \$150 million Energy Stabilization Fund, and increased rates to consumers. UTE needed to manage these risks. In response to public attention on the World Bank's intermediation

of a weather derivative for Malawi, the Government of Uruguay asked the World Bank for technical support to hedge UTE's financial exposure to low rainfall and high oil prices.

World Bank (IBRD) financial solution: On December 18, 2013, the World Bank executed a \$450 million weather and oil price insurance transaction for UTE. The transaction insures the energy company for 18 months against drought and high oil prices. UTE's hydropower is dependent on water levels in two river systems in Uruguay and Brazil: the Rio Negro and the Rio Uruguay. To measure the extent of a drought and potential insurance payouts to the company, the transaction measures and collects daily rainfall data at 39 weather stations spread throughout the two river basins. If precipitation falls below the level set up as trigger of the contract, UTE will receive a payout of up to \$450 million based on the severity of the drought and oil price levels. If oil prices are high, the payout will be larger to offset the high cost of fuel purchases.

Note: For more information, see: http://treasury.worldbank.org/bdm/pdf/Case_Study/Uruguay_Weather_Derivative.pdf

securities schemes that pool natural catastrophe risks among similar neighbor countries, reducing premiums in countries by up to 50 percent.⁵⁴

- **Property catastrophe risk insurance:** covers private and public assets, including infrastructure, in markets with low insurance penetration from damages associated with extreme weather or natural disasters. This insurance from the World Bank has low premiums and covers 100 percent of the insured amount.⁵⁵
- **Partial risk guarantees:** these indemnity instruments shield private investors from the risk that governments are unable to fulfill their obligations under a contract. These guarantees only pay out when a default occurs due to specific risks listed in the agreement.⁵⁶

MIGA's political risk insurance instruments, in particular its Breach of Contract coverage, could also provide protections to private investors in the face of unforeseeable climatic events.

- **MIGA guarantees:** In the context of a PPP structure, MIGA is able to provide investors with political insurance coverage, that is, Transfer Restriction and Inconvertibility (TR), Expropriation, War and Civil Disturbance (WCD),ⁱⁱ and Breach of Contract. In particular, Breach of Contract coverage (BOC) is very relevant to PPPs in that it protects investors against losses arising from the government'sⁱⁱⁱ breach or repudiation of a contract with an investor (e.g., a concession or a power purchase agreement). BOC may be extended to the contractual obligations of state-owned enterprises in certain circumstances. In the event of an alleged breach or repudiation, the investor should invoke the dispute resolution mechanism (e.g., an arbitration) set out in the underlying contract. If, after

ⁱⁱ For description of the coverages of TR, Expropriation and WCD, please see: <http://www.miga.org/Pages/Investment%20Guarantees/Overview/TypesOfCoverage.aspx#toc1>

ⁱⁱⁱ For the definition of government of a host country, please see under "Host Government" contract of guarantee template: <http://www.miga.org/documents/disclosure/Contract%20of%20Guarantee%20for%20Equity%20Investments.pdf>

a specified period of time, the investor has been unable to obtain an award due to the government's interference with the dispute resolution mechanism (denial of recourse), or has obtained an award but the investor has not received payment under the award (non-payment of an award), MIGA would pay compensation. Under BoC and as is the case with force majeure clauses, MIGA may make a decision to cover certain provisions^{iv} in an agreement between an investor and the government that set forth the parties' rights and obligations in situations when unforeseeable, unavoidable, and external actions related to climatic events happen.

To date, however *"only a few types of risk instruments appear to have been used at a significant scale to support climate related projects."*⁵⁷ There is an increasing need to scale up the application of these financial instruments, particularly to support climate risk mitigation in PPP policy frameworks.

Challenges and responses

Despite the vast scientific knowledge base on climate change and problems that come with not considering climate risk, it appears that many government officials and PPP experts remain unaware that climate risk can be quantified and the uncertainty surrounding climate change is manageable. There is a growing need for resources like this Global Knowledge Product to be prepared and offered to this audience. When climate is not considered in a PPP, projects can fail. For instance, the contract for the Bujagali Hydropower Project in Uganda included a provision where the government guaranteed the revenue of the private partner, but this revenue was predicated on the idea that the variation in river flow would be consistent with past history. Hydrological fluctuations and climate risk were raised by critics of the project but dismissed in the planning and negotiations. However, soon after competition a multi-year regional drought significantly reduced river flow, and consequently the energy produced. The drought was so severe that the Ugandan government was unable to fulfil its contractual agreements in the PPP, and so had to go back to the company and renegotiate terms. Though the private partner was willing to come to a new, more feasible agreement under the extreme climatic conditions, this example demonstrates the impact that climate variability can have

^{iv} Note that MIGA has discretion to decide whether to cover certain clauses of an agreement or not.

on PPP contracts.⁵⁸ Ignoring climate risk as a potential constraint on the projected generation of power from the project led to higher costs and delays, as well as very public criticism from local and international organizations who raised the issue before an Independent Review Panel (IRM) convened by the Africa Development Bank (AfDB).⁵⁹ Their report acknowledged the validity of complaints that the AfDB project documents did not address climate change risks (although noting that studies had been done and were cited in the management response).^v However, the Panel concluded it could not make a finding of "non-compliance" because the Bank had no policy that required consideration of climate change but also because there was *"no commonly accepted prediction of a climate change risk of a magnitude that could have seriously affected the validity of the low and high hydrological scenarios on which the project feasibility analysis is based."*^{vi} There are other challenges in mainstreaming of climate risk and resilience. The literature review undertaken for this report indicates that, while some countries have included the need to accommodate climate change in major infrastructure projects, many have not yet achieved this, and climate resilience does not feature in any of the PPP policy frameworks analyzed (see Annex D). There are various reasons why this may be the case. For one, there are low levels of awareness regarding climate resilience, particularly in many developing countries. Furthermore, the need for localized and relatively short-term impact analysis is not always available or consistent across models, making it more difficult to accommodate climate change even when it is considered to be important. The actions set out in the following sections aim to address these issues.

Another challenge is that there is often the belief that incorporating resilience to climate change in major infrastructure projects will increase the overall cost of the project and the cost of services provided to the public. This may well not be the case. As already noted, the additional costs of making new infrastructure resilient typically amount to only a 1 to 2 per cent increase in overall project costs. Furthermore, there is significant and growing availability of concessionary finance for adaptation. The Climate Policy Initiative (CPI) estimated that investment in climate adaptation focused activities was on the order of \$25 billion annually (based mainly on 2013

^v An earlier Inspection Panel review of the same project by the World Bank does not include any discussion of climate risks.

^{vi} The Panel gave some indication of greater concern in a closing admonition: *"Nevertheless the unusually unfavorable hydrological conditions that prevailed in the 2000–2005 period and the increasing global evidence of climate change impacts on water resources should have led Management to devote special attention to investigating hydrological risks related to climate change and to reflecting the results of such assessment in the Project Appraisal."* (Id at 53–54).

data).⁶⁰ CPI explains this is a partial estimate that excludes project-level private adaptation interventions, as well as data from domestic public budgets. Some \$22 billion of the \$25 billion (88 percent) was identified as coming from development finance institutions, an increase of \$5 billion from the year before, and a similar share (89%) was invested in developing countries.

A more recent report focused on MDB private sector finance highlights how relatively limited private sector adaptation finance from MDBs can be highly leveraged to increase climate resilience of investments. It shows

how a total of \$270 million was spent in 2013–14 to improve the climate resilience of MDB investments totaling \$1.5 billion, while also making \$5.5 billion worth of development investments with adaptation components more resilient.⁶¹ In this report, private sector adaptation finance is defined as the component of MDB investment in the private sector that relates to making the investment more climate-resilient. Another \$33 million of co-financing from donors and \$4 million of technical assistance supported implementation of adaptation in investments.⁶² Most of this finance was invested in middle income countries.

There are several donor funds dedicated exclusively to adaptation, the largest at present being the Pilot Program for Climate Resilience with \$1.1 billion.⁶³ There are arguably several reasons for the dominance of adaptation finance being shown as supported by development finance institutions in developing countries. The first is simply that these institutions have agreed to a common definition of adaptation finance and reporting procedure, such that data are available.⁶⁴ A second is that private firms have no mandatory requirements^{vii} to identify or report investments in climate resilience and to do so requires typically difficult distinctions between natural variability and unexpected extremes.^{viii} Third, as in the IFC Muelles el Bosque study, when a private firm is made aware of private risk, the incremental investment required can be modest and may require no special financial support or reporting.⁶⁵

^{vii} However, many private organizations do report investments in response to climate resilience disclosure requests from organizations like CDP. Investor initiatives like CDP create pressure despite the lack of mandatory requirements.

^{viii} The MDBs require specific intent to respond to climate change for an investment to be classified as done for the purpose of adaptation. Otherwise a wide range of expenditures for disaster planning, water resource efficiency, etc. could be classified as adaptation.

Finally, it should be noted that much larger financial flows are expected for support of adaptation in developing countries with recent decisions by the UNFCCC regarding the design of the Green Climate Fund (GCF). The goal is to “mobilize” \$100 billion per year by 2020, and for roughly half of its funding to go towards adaptation, with half of that

going to small island states, least developed countries, and African states. How much of this will be available for private sector investments, and what types of financial instruments will be used, are among many issues to be decided.⁶⁶

There are other perceived barriers that can be addressed with guidance and leadership from international development partners. In order to attract blue-chip bidders and investors for PPP projects and to compete with the many other PPPs being promoted around the world, there may be the belief by governments that it is essential to keep the PPP procurement process and requirements as simple as possible. There may be a concern that by adding the complexity of meeting climate change requirements, the project will be less attractive. In addition, there is the fear among bidders that their bid will become more expensive, reducing their chances of winning. However, as the literature shows, not considering climate impacts on investments can cause more problems (as was the case for the Bujagali hydropower project) and pose higher costs. Governments may also believe that any increases in the price of essential utilities such as water or electricity to its consumers due to the accommodation of climate change resilience will be poorly received, with a possible political backlash. This would be unwelcome to any government and it would also be unwelcome to the private sector company involved, as it would be the main recipient of much of the criticism. To attract private investors, PPPs require stable government and reliable courts. Private investors look to these institutions to provide surety and reduce risk before they commit to making investments. Part of the efforts to strengthen the resilience of PPPs requires also addressing these essential institutional challenges. Solutions to these perceived challenges are addressed in the section below.

The UNFCCC plans to mobilize \$100 billion annually by 2020 for funding adaptation in developing countries.

—Schalatek, L. et al.

3 Key actions for international development partners, governments and the private sector to consider

Based on the findings of the literature review underpinning this report and the interviews conducted with MDB experts on climate resilience and PPPs, several top issues are identified for international development partners to work on together with governments and the private sector. These are summarized in Figure 4 and discussed below. As Figure 4 reveals, the emphasis is on upstream actions which help incorporating climate risk and resilience into policy frameworks.^{ix} In Figure 5, the same actions are shown for stakeholders operating at different levels.

^{ix} While (as the figure shows) some of the actions are relevant at several stages of the PPP lifecycle, they are more beneficial when undertaken early in the lifecycle.

FIGURE 4: Key actions for international development partners, governments and the private sector to build climate resilience in the PPP lifecycle



KEY ACTIONS FOR INTERNATIONAL DEVELOPMENT PARTNERS

1. Foster political will on climate resilience
2. Bolster climate risk and resilience in PPP technical assistance
3. Encourage emphasis on climate risk in public investment management frameworks
4. Strengthen client's capacity to make robust decisions in face of climate uncertainties
5. Leverage climate finance and financial risk mitigation instruments

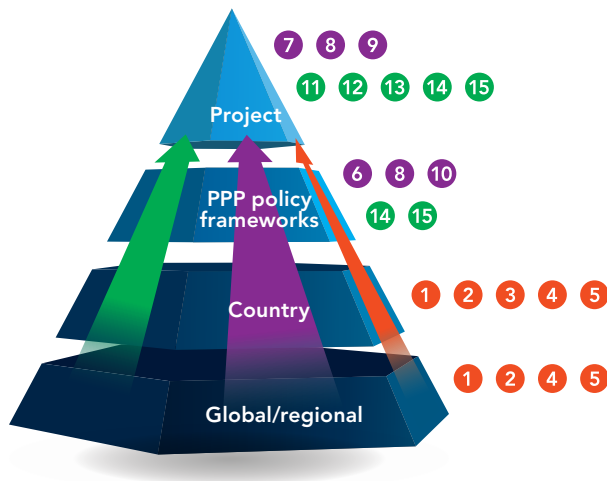
KEY ACTIONS FOR GOVERNMENTS

6. Introduce flexibility into existing PPP policy frameworks to enable integration of climate resilience
7. Incorporate climate resilience in project preparation and transaction structures
8. Level the playing field on climate risk and resilience in PPP procurement
9. Harness private sector adaptation expertise
10. Review language of PPP contracts

KEY ACTIONS FOR PRIVATE SECTOR PARTNERS

11. Project company: Incorporate climate resilience measures throughout project lifecycle
12. Lenders: Incorporate climate risk and resilience in lending criteria and loan covenants
13. Shareholders: Understand implications of climate change for investment performance
14. Insurers: Promote awareness of climate risk, incentivize resilience through insurance terms and advise on risk mitigation instruments
15. Professional advisors: Develop capacity on climate resilience

FIGURE 5: Key actions for stakeholders at different levels



1. International development partners should foster political will to incorporate climate resilience in multisector policy frameworks in client countries

PPPs only function when there is sufficient government support and interest to create an environment of confidence to attract private investors. This is particularly true when new conditions, like climate risk, are being introduced into PPP competition and negotiations. To date, progress on addressing climate risk in infrastructure is patchy at best, and has typically been at the project level, on an *ad hoc* basis. International development partners are well-situated to build political will in client countries by supporting awareness raising and capacity building on the necessity and benefits of incorporating climate risk and resilience into multisector PPP policy frameworks. This outreach needs to be continued and long-lasting, since mainstreaming new concepts into existing processes can take time. International development partners are also able to leverage interest by explaining how climate finance can support climate resilience investments (see below).

2. International development partners should bolster technical assistance to governments on integration of climate resilience into PPP policy development and infrastructure design standards

International development partners provide advice to governments on how to create an enabling environment conducive to private participation in infrastructure development. It is recommended that this assistance should include climate risk and adaptation, using elements from this report among other resources listed herein. Most international development partners have active work programs, processes

and expertise on climate risk and resilience, but the literature review and interviews with MDB experts for this report reveals that this experience is typically not being fed in to their technical assistance on PPPs. The multi-donor trust fund Public-Private Infrastructure Advisory Facility (PPIAF) provides numerous resources to PPP developers, including a section on climate change that discusses adaptation alongside mitigation.

To ensure infrastructure designs are climate-resilient, each country will require its own tailored set of design standards, informed by historical climate and best available forecasts of future climate change. However, identifying the most appropriate sources of climate change information and developing associated design standards are challenging processes for middle and lower income countries. International development partners have a natural role to help countries develop design standards for key economic infrastructure that are specific to national climate conditions and socio-economic context. This technical assistance would facilitate and strengthen PPP investment in client countries by establishing a knowledge base and reducing the added cost of addressing climate risk.

This program to develop and distribute country-specific design standards for application in PPPs across multiple sectors could be piloted initially in several countries to test its development and implementation. Ideally, the pilot countries would represent a wide geographic distribution (for example, one country each in Latin America, Africa, Central Asia, and a Pacific or Indian Ocean island nation). The pilots would also work best if they represented a variety of infrastructure sectors (ports, hydroelectric dams, water treatment facilities, etc.) facing different risks and requiring different data, as well as the inclusion of the respective industry groups. International development partners could finance the technical assistance, working in close coordination with client governments, and climate and engineering experts, while leveraging its existing vast climate resources⁶⁷ and freely available datasets on climate change from other data providers.^x After the pilot countries' climate-informed design standards are developed, the international development partners could take stock of the pilot program, identifying lessons learned and tweaking the model, and then expanding it.^{xi}

^x See, for example, http://www.ipcc.ch/publications_and_data/publications_and_data_other.shtml, <http://climexp.knmi.nl>, <http://www.climatewizard.org/> and <http://www.ncdc.noaa.gov/>

^{xi} A model for this could be along the lines of the popular Rockefeller Foundation's 100 Resilient Cities, an iterative, competitive program where cities around the world bid for funding and technical assistance from the Foundation to address climate risk in their cities. This kind of 'contest' is effective at building interest and winning attention, and could help the World Bank identify which countries are most interested in climate resilient PPPs.

3. International development partners should encourage governments to add specific emphasis of climate risk and adaptation in public investment management frameworks as early action on adaptation is cost-effective

This report focuses on understanding how climate risk can be mainstreamed into PPP policy frameworks. However, another critical part of upstream decision-making is the public investment management investment process.⁶⁸ This process begins when a country identifies and prioritizes a project, and then evaluates the viability of the investment against selected criteria. This initial phase is a crucial period where climate risk should initially be screened and discussed, regardless of what type of procurement mechanism is later employed. Later, during the procurement phase, climate risks could be allocated between partners if the infrastructure is selected for PPP financing. There is a need to explore this topic further with focused research.

PPPs are often pursued because in low resource situations, they can be the only way to finance projects. Given such economic limitations, adding climate risk could invite resistance from private sector investors wary of potential cost increases. However, infrastructural changes that address climate risk are typically cost-effective if implemented at the design stage instead of as retrofits, or when compared to the significant costs associated with damage from climate impacts to unprepared infrastructure. While it requires political leadership to allow for incremental adaptation costs, the costs are typically not large if they are picked up early in the project lifecycle. What is more, as the literature shows, the cost of financing adaptation measures at the early stages of an infrastructure project is small compared to other factors that can influence the future costs of building or repairing infrastructure.

4. International development partners should help to build capacity of government counterparts, investors and PPP experts on how to make robust decisions in the face of climate uncertainties

Investors have never had a better understanding of future climate and weather than they do now. Significant resources have been developed, notably through the work of the scientists contributing to the Intergovernmental Panel on Climate Change (IPCC), to provide policymakers and investors with data on future climate conditions, and information on how infrastructure can be affected, and associated adaptation actions. Likewise, proven tools exist to aid robust

decision-making^{xii} in the face of uncertainty, building on the science of climate change and historical climate data. This information, coupled with the many climate risk and adaptation processes and tools produced by international development partners (like those summarized in Table 5), helps investors to make better informed decisions.

However, few investors or governments are raising, much less addressing, climate risks to infrastructure. There is a need for International development partners to inform and educate government counterparts, investors and PPP experts about how to manage climate risk and uncertainty in multi-sector PPP policy frameworks and projects through the application of techniques such as robust decision-making (RDM). This can be achieved through workshops or other events that showcase how existing tools, data and information can be used during policy and project development.

5. International development partners should leverage climate finance and financial risk mitigation instruments to support PPP adaptation investments

International development partners need to have an understanding of the applicability and appropriateness of available climate finance and financial risk mitigation instruments that would suit a specific country or context. With this understanding, international development partners can leverage interest among government counterparts and the private sector. They can promote climate finance to seed projects, fund adaptation, and overcome financial barriers, for example using existing climate finance instruments like the Pilot Programme for Climate Resilience and the Green Climate Fund⁶⁹ and capacity building mechanisms like the Global Innovation Lab for Climate Finance.⁷⁰ Climate finance instruments are growing in scale, funding, and flexibility, and can enable investments in adaptation by providing financial incentives (concessional loans, grants) and technical assistance to help deliver resilience-building measures. Similarly, more can be done by international development partners to extend the geographical scope and scale of financial risk mitigation instruments to address climate risk in PPP contracts, such as index-based weather derivatives, catastrophe risk deferred draw-down options (CatDDO), sovereign insurance schemes and property catastrophe risk insurance.

^{xii} Robust decision-making (RDM) is an approach that seeks to minimize the potential for regret, by identifying resilience-building options that perform well over a wide range of plausible futures.

6. Governments can introduce flexibility into existing PPP policy frameworks to enable integration of climate resilience

PPP policy frameworks can include built-in principles or tools that are flexible and adaptable, and can be employed to address climate risk. For example, Australia's National PPP Guidelines include many tools for major infrastructure project procurement. While these do not explicitly account for climate change adaptation, they provide a principle-based framework for PPP projects, with the principles (or 'tools') being flexible and broad enough to facilitate inclusion of adaptation in procurement decisions. The tools are:

- Technical standards, which can be used to establish standards for infrastructure to ensure that it is designed, constructed and operated in a way that is climate change resilient. The technical requirements and specifications for major infrastructure projects are not fixed or prescribed. They can be performance—or output-based. This allows each particular project to specify measures to address climate change and the risk of extreme climate change events. For example, these measures may include mandating design safety or redundancy factors to build additional resilience in the infrastructure.
- In-built risk assessment, which provides an opportunity for climate change risks to be included.
- A modification regime, which allows the government to make modifications to the project throughout its term. This regime allows the government to react to developing climate science and modify or vary parts of the project to ensure the infrastructure is capable of adapting to evolving climate change risks.
- A 'fitness for purpose' warranty which requires the private party to ensure that the infrastructure is fit for the intended purpose specified or reasonably inferred from the project documents. If the project objectives are clearly specified, this warranty may be sufficiently broad to take into account climate change risks.

7. Governments should incorporate climate resilience in project preparation and transaction structures

The project preparation phase should consider how the project can be affected by current climate variability and climate change. This analysis can be undertaken as part of the project feasibility study, and should assess how climate risks can affect the technical, operational, environmental, social, financial and economic performance of the project. Based on the findings of this analysis, resilience-building

options should be identified and assessed, so that the investment program can include needed investments in climate resilience, together with associated technical assistance.

As the finance plan for the project is developed, co-financing can be sought for the climate resilience measures and actions identified in the investment program, using climate finance instruments.

8. Governments should level the playing field by requiring inclusion of climate risk and resilience in PPP procurement

Private investors face stiff competition from peers in procurement processes. This discourages taking on new costs of previously unquantified risks, since it would decrease the chances of a successful proposal. Given the magnitude and importance of addressing climate risk, and the preference for governments to award contracts to lowest bidders, governments can level the playing field by requiring all investors to include climate risk and resilience in their proposals. One way to do this for extreme events is by linking climate risk to insurance requirements. Governments can inform the process by providing design parameters, informed by the best available science on future climate (as available given time and resources), which infrastructure must be designed to accommodate. Extreme weather events that occur beyond the government-established threshold could then be considered as 'Acts of God', while events within the threshold would be recognized, quantified, and allocated climate risks. There is a clear role for the international development partners to encourage this action, as they are beginning to do, and to promote their extensive resources on climate resilience with governments.

9. Governments should harness private sector adaptation expertise

The advantages of PPPs include that they introduce the speed, efficiency, and innovation of the private sector into infrastructure projects traditionally managed by governments. Another advantage private sector involvement can offer is that many companies and advisory firms around the world are leading the way in introducing climate risk and resilience into the infrastructure they design, build and operate.

Given a level playing field in the procurement process, increasing numbers of private sector investors are well positioned to understand the importance of, and lead implementation of climate resilience measures in PPPs. MDBs and other development partners should work with private sector partners to articulate and advertise these strengths to governments. Overall, public-private cooperation around

climate resilience is crucial, as private companies often look to government for policy signals to direct adaptation.⁷¹

10. Governments should review the language of PPP contracts to build flexibility into contract management and to differentiate 'Acts of God' from climate change

Building flexibility into PPP contracts, to allow them to be modified over time, is a useful way to respond to uncertainties about future climate change. Contracts can be reviewed and modified in agreement between government and the private sector to take account of new knowledge about climate change and impacts on infrastructure performance, based on observed conditions and developments in scientific research. As already noted under Action 6, Australia's National PPP Guidelines include a modification regime.

Secondly, governments must work to redefine what is legally considered an 'Act of God.' Climate-related risks that were once seen as unknowable, extreme events are increasingly quantifiable and predictable, and must be accounted for as such in PPPs. For example, the extreme heatwave in Europe in 2003 led to tens of thousands of deaths and severe damage to infrastructure and other economic sectors. At the time, it was a 1 in 500 year event, and could thus be reasonably described as an Act of God. However, in a changing climate, the frequency of summers as hot as 2003 is increasing rapidly, and by 2040 a similar heatwave is expected to occur every other year. Infrastructure projects being commissioned now need to be built with these future climate conditions in mind and the associated risks need to be classified as climate risks, not as 'Acts of God'.

11. Project companies should develop and implement climate resilience measures throughout the project lifecycle

Project companies undertake a broad array of activities and analyses through the PPP project lifecycle where it can be important to consider climate risk and resilience. In the project planning and design stages, climate risk and resilience should be included in decisions about site selection, design, technology selection and financial and economic analysis. As the project moves into procurement and construction, project companies should ensure that the contractors selected to construct and operate the project appreciate the need for climate resilience to be incorporated, and understand their responsibilities to deliver on this. At this stage, the final specifications for climate resilience measures will be confirmed. Those that need to be adopted or allowed for during construction should be incorporated

into the final designs and should form a contractual obligation for project execution.

Once, the project is operating, to allow for flexible, adaptive management, regular monitoring should be undertaken of changes in climatic conditions, their effects on the environmental conditions facing the project, and of the performance of the project and its climate resilience measures. Regular monitoring will inform the operator and other project stakeholders if there is a need to modify the resilience-building measures or to change the PPP contract.

12. Lenders should require consideration of climate risk and resilience as lending criteria, and implementation of resilience measures through lending covenants

It is arguably in the interest of lenders to ensure that projects to which they lend have considered climate risks, as failure to do so can affect project financial performance and credit-worthiness. The relevant aspects for lenders include climate impacts on: market conditions and demand; project efficiency and productivity; operating, maintenance and insurance costs; capital investment requirements; and asset depreciation rates, among others.

An increasing number of private banks and investors subscribe to the Equator Principles, a risk management framework for financial institutions to address environmental and social risk. These refer to assessing the *"viability of Project operations in view of reasonably foreseeable changing weather patterns/climatic conditions, together with adaptation opportunities."*⁷² Project companies see this as a driver for considering climate risk.

Lenders can require project companies to demonstrate that climate risks have been assessed, and appropriate climate resilience measures have been integrated into projects as a condition of the loan, and that implementation of measures is assured through lending covenants.

13. Shareholders in project companies should ensure they understand the implications of climate change for investment performance

Equity investors face a similar range of climate impacts to those described above for lenders. In general, however, they may be more exposed to climate risks, which can affect shareholder value, returns on equity and exit strategies. Equity investments often have longer terms than debt, and are therefore likely to be more affected as climate risks intensify. Awareness of climate risks is growing among investors, and so it may become more difficult to exit successfully from investments that are not climate resilient. It is therefore in shareholders' interest to ensure that climate

risk and resilience are being properly addressed by the project company's management team, to minimize any adverse impacts on investment performance and capitalize on any opportunities.

14. Insurers should continue to promote awareness of climate risk, incentivize resilience-building actions and advise on novel risk mitigation instruments

The insurance industry has been vocal in the international climate change policy arena for several decades, expressing its concerns that, without strong action, there will be major shifts in risk landscapes worldwide and threats to human and economic wellbeing. In the context of providing insurance for PPP infrastructure projects, insurers can emphasize to project sponsors the importance they attach to climate risk and resilience. They can use their risk expertise and quantitative models to advise project companies on climate risk assessment and management. They can also incentivize action by project companies, by offering more favorable insurance terms (lower premiums, less onerous exclusion clauses) to project companies who can demonstrate they have undertaken assessment of climate risk and

incorporated resilience-building measures into infrastructure projects. Finally, as the range of risk mitigation instruments available on the market grows, insurers can advise project companies and governments on the novel products they could use to better manage risks.

15. Professional advisors should develop capacity to address climate resilience in their support to PPPs

In addition to lenders and insurers, other professional organizations are involved in advising on many aspects of infrastructure PPPs, from the policy, transactional and legal issues, through to management of PPP projects throughout their lifecycle. As knowledge about climate change and its impacts grows, it is increasingly incumbent on these professionals to ensure they are incorporating advice on climate risk in their service offerings. This is beginning to be recognized among leading advisory firms, but the practice is far from widespread. Professional bodies have a role to play in ensuring capacity development among their members, in line with emerging good practice.

Annexes

Annex A: Interview questions

The semi-structured interviews were based on the following list of questions, which was adapted according to each interviewee's area of expertise

Standard Questions

- How are risks associated with extreme or variable weather currently managed in PPP law or policy, contracts and/or regulatory policy?
- Where do you think the current gaps are?
- What are the policy, legal, and/or regulatory practices on the risk sharing related to long term resilience of PPP contracts?
- Who is assuming the risk now and do the parties know it?
- What countries (developed or developing) do you know integrate climate risk into their policy, regulatory and investment framework governing PPPs?
- Can you share any examples of a PPP infrastructure policy and/or contract that addressed climate risk? What worked well and what needed improvement?
- What role do you see MDBs having in integrating climate risk into PPPs?
- What do you see as the major challenges in mainstreaming climate resilience in PFI and PPP for large infrastructure projects in developing countries?
- What resources on climate risk/PPP do you recommend we review?

Additional questions for PPP experts

- What policy signals are required from the Public Sector to mainstream resilience risks into PPPs? How can the current regulatory principles (economic and service quality) be modified to integrate climate variability as a key risk in PPPs?
- Discuss the relationship between force majeure and extreme weather events, and who holds this risk
- Are the insurable risks covered within traditional PPPs sufficiently capturing the climate resilience risks? What would you recommend to change?

- Private sector banks and investors are increasingly cautious, pursuing mostly straightforward funding opportunities, and do not want to take on unquantifiable risk. Discuss the current allocation of highly uncertain risks among parties. Discuss if it is the place of governments to take on uncertain climate risk. If so, discuss if projects with recognized climate risk still be attractive to investors.
- Are there sufficient market instruments available to mitigate resilience risks (e.g., weather index)? What role can MDBs play in developing innovative risk mitigation instruments to manage resilience risks?
- Can you suggest how best to reallocate climate risks between public and private sector counterparties when structuring infrastructure PPPs?

Additional questions for climate adaptation experts

- What are the tools and processes that your institution adopts to manage climate resilience risks?
- Are your task leaders (including sector experts) are aware of impact on climate resilience risks on infrastructure planning and investments?
- Discuss the availability and quality of climate data for assessing climate risk in PPPs. Which data does your institution use?
- Discuss whether to distinguish consideration of historic climate (a standard consideration in any hydropower or other climate sensitive project) from consideration of expected climate change.
- What are the major challenges in integrating climate resilience in the water, transport and energy PPP projects in developing countries?
- What types of support does the public sector (i.e., Government) need to integrate resilience in multi-sector investment planning and prioritization?
- Any other issue that you would like us to focus on this knowledge product?

Annex B: Interview summaries

Aziz Haydarov, Infrastructure Economist, Asian Development Bank (ADB)

Summary of main points: Climate resilience-specific due diligence during preparation of solicited PPP projects or during processing of unsolicited proposals is yet to be properly introduced in the Southeast Asian developing countries. It is perceived that it may be more important to focus first on mainstreaming climate resilience in the early stages of the public investment management cycle. Once mainstreamed in infrastructure planning and investment programming, this will positively influence specific downstream projects. There is insufficient guidance or tools on how to do this for PPPs, and such resources would be welcome. A good starting point would be to review international best practices on mainstreaming of climate resilience in infrastructure investments generally, and from this determine how specific resources for PPPs can be developed. A helpful stand-alone topic would be providing country-specific information on mainstreaming climate resilience in construction standards. One approach to avoid is linking environmental impact assessments with climate resilience, which confuses cause and effect relationships. A better home for mainstreaming climate resilience may be in the socio-economic analysis that accompanies infrastructure assessments, where additional costs and benefits are accounted.

Timothy Afful-Koomson, Principal Green Growth Officer, Compliance and Safeguards Division, Results and Quality Department, African Development Bank (AfDB)

Summary of main points: The African Development Bank (AfDB) developed the climate safeguard system (CSS) to help reduce negative environmental and social impacts of projects and to improve the resilience of project activities by carrying out upstream risk assessments in project design and implementing measures that mitigate identified vulnerabilities. A few countries, including South Africa, are leading the way on the continent in incorporating climate risk into PPPs by including provisions and policy at the regulatory level. AfDB already sees how climate impacts can lead to materials costs for transportation and energy infrastructure, reducing the resilience and increasing the

cost of development. Because of these impacts, some AfDB projects already manage climate risk using the Climate Safeguards System (CSS). CSS can be used for many sectors, and all project proposals at AfDB are passed through this CSS system as part of normal due diligence processes. Projects with identified climate risks are further analyzed and recommendations are made to increase their resilience.

Craig Davies, Senior Manager, Climate Change Adaptation, European Bank for Reconstruction and Development (EBRD)

Summary of main points: EBRD began working on climate change adaptation in 2009, and in 2011 put in place a systematic screening approach to identify climate-sensitive projects at an early stage of development, so that appropriate climate resilience measures can be integrated into investment design. In parallel, climate change impacts analysis and the identification of climate resilience priorities have been mainstreamed into all of EBRD's country and sector strategies. Since then, adaptation finance has become a significant area of EBRD's climate finance operations, with 89 adaptation projects signed since 2011, delivering €550 million in adaptation finance and a total investment volume of €2 billion. EBRD's focus is on practical investments that build the climate resilience of critical economic sectors, including essential infrastructure such as water supplies, power generation and transmission, transport, irrigation and buildings. While climate risk is screened for PPPs as with other investments, PPPs work best when countries have strong policy frameworks governing their implementation. However, not all EBRD client countries have full developed legal frameworks for PPPs. To address this, EBRD has a dedicated and long-standing Legal Transition Team comprised of lawyers specialized in PPP law, which has engaged in some 20 countries to adapt the legal basis to improve PPP readiness. While PPPs have faced difficulties across the region, there are a number of countries, such as Turkey, Kazakhstan, Belarus, and Egypt, which are now developing their PPP sector with EBRD support. Where PPPs are developed, it is crucial that the definition of force majeure be refined in its relation to climate risk.

David Richard Bloomgarden, Private Sector Development Specialist for PPPs in Infrastructure and Basic Services, Inter-American Development Bank (IDB)

Summary of main points: IDB places a high priority on assessing the impacts of climate change on investments. In regards to PPPs, mainstreaming climate risk in the structuring of a PPP is limited by challenges around addressing climate uncertainty. Normally the private sector in a PPP will get insurance to cover risks or manage a risk directly where they have the capacity to mitigate the risk through their technical expertise. The ability of any PPP to manage climate change risks will be affected to some degree by uncertainty in scientific knowledge to accurately assess the probability of an extreme weather event occurring and obtain insurance coverage. For this reason, severe climate risks are typically unallocated and fall to public partners in PPPs under existing force majeure clauses. The multilateral development banks are working to address climate change through upstream policies that push for increasing resilience in all projects, not just PPPs. As knowledge about climate change develops governments and their partners in the international development community should continue to support integrating climate risk in PPPs by facilitating awareness raising, technical support for project development, and research and knowledge sharing.

Emmanuel Nyirinkindi, Manager, Infrastructure Advisory Services—Africa Region, International Finance Corporation (IFC)

Summary of main points: IFC knows that climate impacts are real and already being felt. IFC has examples of material impacts on PPP-financed projects, for example hydroelectric dams that provide less energy than forecast due to diminished streamflow, as well as extreme, unexpected flood damage to IFC-financed toll roads. These risks are not typically allocated in IFC-negotiated PPP contracts. Ideally, climate risks should be allocated to the party in a PPP best able to bear them. This is challenging in developing countries though, where both public and private partners want to put climate risk, which is perceived as highly uncertain and hard to manage, on the other party. Insurance is pursued as a solution to managing climate risk, but this is also complicated and expensive, and not a guaranteed solution. Without explicitly allocating climate risk, IFC client governments are the parties typically assuming climate risk. Though this is often known to governments, they do not know all the implications of the risk or what the costs could be. There is a role for MDBs to build awareness and capacity among client governments, as well as to provide concessionary funding to support adaptation costs.

Annex C: Country case studies on incorporation of climate risk and resilience into infrastructure policy frameworks

United Kingdom

UK climate change adaptation policy: The UK Climate Change Act (2008)

The 2008 UK Climate Change Act⁷³ sets out a government-led approach to make progress on adaptation in England. It also committed the UK to reducing its greenhouse gas emissions. The legislation had four key components for adaptation:

1. A UK Climate Change Risk Assessment (CCRA) to be prepared by the UK Government and updated every five years. The first CCRA was presented to the UK Parliament in 2012. A second CCRA is due to be presented in 2017.
2. A National Adaptation Programme (NAP) to be prepared by the UK Government. The aim of the NAP is to set objectives and outline the actions that will be taken to prepare for the impacts of climate change. The first NAP was published in 2013. Infrastructure is one of six thematic chapters in the NAP. For infrastructure, the NAP aims to:
 - strengthen the adaptive capacity of the energy, transport and water sectors through improving the regulatory framework and asset management;
 - improve understanding of the climatic vulnerabilities of local infrastructure, and of infrastructure interdependencies, in order to identify actions needed.
3. An Adaptation Reporting Power (ARP), which gives the Department for Environment and Rural Affairs' (Defra's) Secretary of State the power to require organizations who provide critical public services to report on climate risks and associated adaptation actions. A first round of ARP reports was published in 2012. In the first round, 91 key infrastructure providers and regulators in the water, energy and transport sectors were requested to report. The second round of reporting is taking place in 2015.
4. The establishment of an Adaptation Sub-Committee (ASC) to the Committee on Climate Change (CCC). The

ASC has statutory roles in advising the UK and devolved governments on climate risks and reporting to the UK Parliament on progress being made by the NAP.

UK policy framework for infrastructure adaptation and resilience

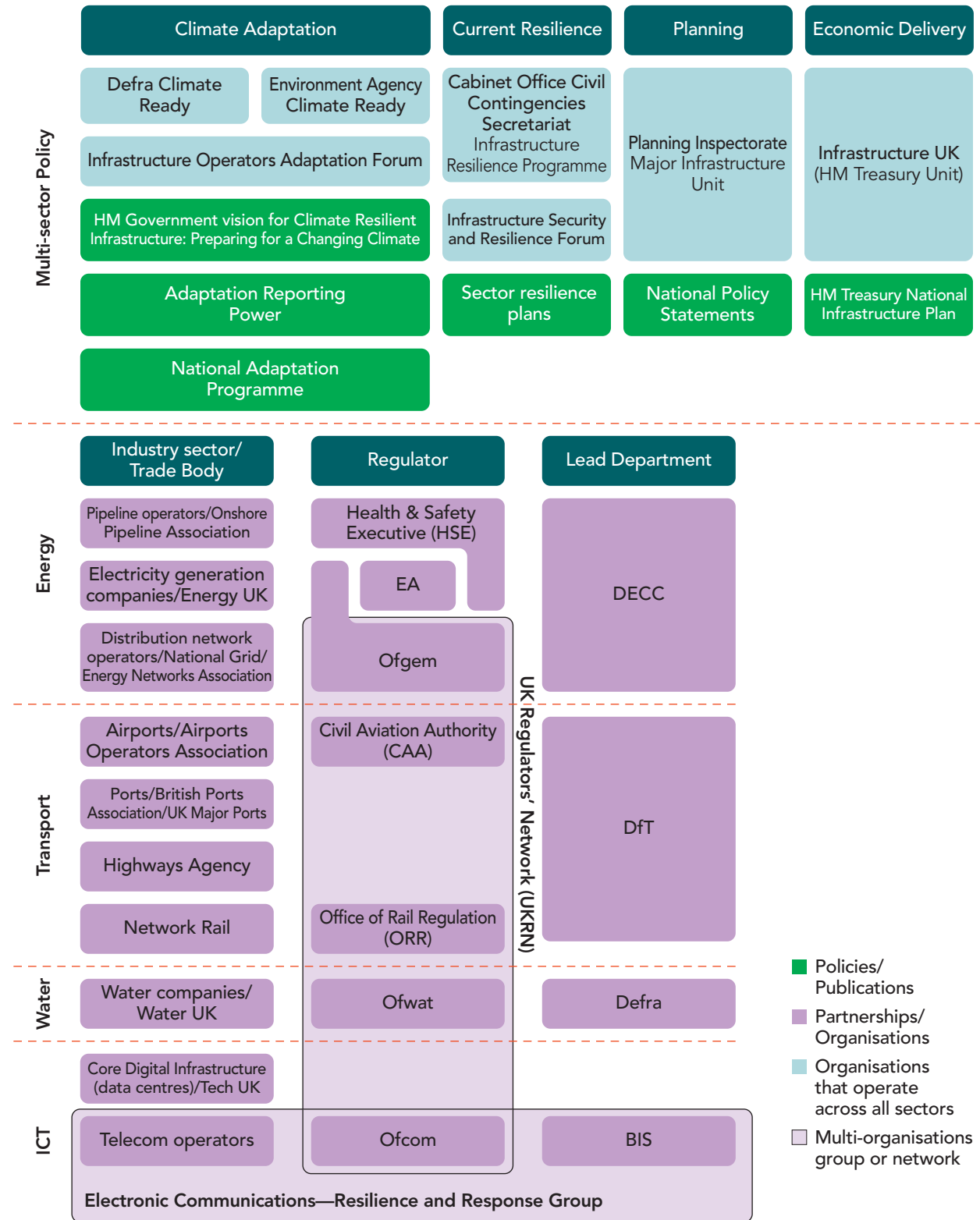
A broad range of stakeholders from the UK Government, industry and regulators are involved in assessing climate risks and resilience planning for infrastructure (see Figure 6). Government policy on infrastructure adaptation is coordinated by Defra, working with the relevant lead government departments.

The Government policy on infrastructure adaptation was published in 2011,⁷⁴ entitled the *"Government Vision and Action Plan for a Climate-Resilient Infrastructure"*. This outlines the main issues for the transport, energy, water and Information and Communications Technology (ICT) sectors and sets out the Government's policy on ensuring those sectors are 'resilient to today's natural hazards and prepared for the future changing climate'. It sets out how Government can help facilitate progress through:

- access to climate information, disclosure of risk and evidence;
- improving understanding of the risk of cascade failures;
- monitoring progress on adaptation of infrastructure;
- embedding climate risks and resilience in regulatory frameworks; and
- the planning system for nationally significant infrastructure.

The policy promotes the strength of existing links between the National Adaptation Programme and efforts to improve the resilience of the UK's most important infrastructure to present-day natural hazards, such as the Critical Infrastructure Resilience Programme and Sector Resilience Plans (SRPs), so as to encourage proportionate

FIGURE 6: Governance structure of infrastructure resilience in England.



Source: Committee on Climate Change, 2014.⁷⁹

levels of investment in the UK's infrastructure.⁷⁵ The Critical Infrastructure Resilience Programme⁷⁶ was established within the Cabinet Office Civil Contingencies Secretariat following the Pitt Review into serious flooding which affected the UK in 2007. Lead government departments are required to produce annual Sector Resilience Plans, setting out the resilience of the UK's most important infrastructure to the relevant risks identified in the National Risk Assessment. The individual plans are classified, but the Cabinet Office produces a summary overall sector resilience plan for critical infrastructure which is publicly available.⁷⁷ In the National Security Strategy, the Cabinet Office identified natural hazards as one of the top risks to the UK's national infrastructure.

Following the Government policy on infrastructure adaptation, the National Adaptation Programme⁷⁸ contains policy objectives and specific actions on infrastructure resilience. It describes actions for the Government, industry and regulators that can be broadly categorized as:

- infrastructure operators to implement the actions set out in their reports under the Adaptation Reporting Power;
- lead departments to factor in climate change when developing or implementing policy;
- encouraging coordination and joint working;
- continuing existing resilience-building initiatives and research programs; and
- setting out new research to inform infrastructure resilience.

UK policy on infrastructure delivery

The National Infrastructure Plan

The 2010 National Infrastructure Plan describes the overall approach to delivering national infrastructure.⁸⁰ It is updated annually and includes a section on infrastructure delivery, known as the 'pipeline'. The pipeline is a forward-looking assessment of potential public and private investment in infrastructure to 2020 and beyond, for large infrastructure projects with a capital value of at least £50 million. The 2013 Plan identified a pipeline of 650 planned infrastructure projects and programs worth £375 billion over the next decade, of which 45 percent are already under construction.⁸¹ Most of the investment is planned in the energy (£218 billion) and transport (£121 billion) sectors. It recognizes climate change mitigation and adaptation as one of the five major drivers that will have a long-term impact on the UK's infrastructure.

Infrastructure UK

Infrastructure UK is a unit within the Treasury that works on the UK's long-term infrastructure priorities, secures private

sector investment and prepares the National Infrastructure Plan. Its role is to provide a stronger focus to the UK's long-term infrastructure priorities, encourage cost efficiency, and facilitate private sector investment.

National Policy Statements

Decisions on nationally significant infrastructure projects are guided by a National Policy Statement (NPS) specific to each infrastructure sector, and the 2008 Planning Act requires Ministers to consider mitigation and adaptation to climate change when drafting NPSs. These are produced by the relevant lead government department and provide the framework within which Examining Inspectors consider a planning proposal.

There are twelve designated or proposed NPSs.⁸² To date, the Government has produced sector-based NPSs covering energy,^{xiii} transport,^{xiv} and waste^{xv} infrastructure. Most of the NPSs, with the exception of the Nuclear NPS, are not spatial on the basis that it is for the market to decide, in line with Government policies, where to site new infrastructure to meet demand.

In accordance with the 2008 Planning Act, all published NPSs state that applicants must consider the impacts of climate change when planning the location, design, construction, operation and decommissioning of new infrastructure. The NPSs set out the adaptation and climate resilience issues that should be considered by applicants and by the Examining Inspectors, but they do not provide detailed guidance on approaches that applicants should take to account for the range of future climate projections. They do, however, require applicants to provide evidence regarding:

- how the latest climate projections have been applied, with the applicant being required to apply the projections associated with the high greenhouse gas emissions scenario for infrastructure with safety-critical elements; and
- whether the proposal could be seriously affected by more severe changes in climate beyond those presented in the latest climate projections, taking into account the latest credible scientific evidence.
- Inclusion of climate change risks in recent applications for major infrastructure projects

In line with the NPS, climate change appears to have been accounted for in recent applications for major

^{xiii} There are six designated NPS for energy: an overarching Energy NPS and sector-specific NPSs on Renewable Energy, Fossil Fuels, Oil and Gas Supply and Storage, and Electricity Networks and Nuclear Power.

^{xiv} A Ports and a National Networks NPS have been designated.

^{xv} Hazardous Waste and Waste Water Treatment NPSs have been designated.

infrastructure projects. From 2010 (when the new planning regime established by the 2008 Planning Act began) to May 2015, there had been 107 applications for Nationally Significant Infrastructure Projects (NSIPs).⁸³ Of these, 36 applications had been through the whole process to decision. An analysis for the Adaptation Sub-Committee in 2014 revealed that Nationally Significant Infrastructure Projects that had been through the planning process had undertaken detailed flood risk assessments that accounted for current and future flood risk from rivers and the sea.⁸⁴ In most cases, surface water flood risk had also been assessed, although it was less clear how applicants had accounted for projected increases in heavy rainfall events. However, the risks associated with coastal erosion were not always explicitly assessed for coastal project applications.

Australia

Australian climate change adaptation policy

The Council of Australian Governments (COAG) requested the development of a National Adaptation Framework in 2006 as part of its Plan of Collaborative Action on Climate Change, and agreed to the Framework in April 2007.⁸⁵ The Framework outlines the agenda of collaboration between Australian governments to address demands from business and the community for targeted information on climate change impacts, and to fill critical knowledge gaps which inhibit effective adaptation. A key focus of the Framework is to support decision-makers understand and incorporate climate change into policy and operational decisions at all scales and across all vulnerable sectors.

The Framework provides guidance on actions by jurisdictions to generate the information and tools needed by decision-makers to adapt to climate change impacts. It set out actions specifically for infrastructure including:

- Identify and address knowledge gaps including synthesis of existing information.
- All jurisdictions evaluate and share information about the extent to which planning and development systems promote decisions that increase resilience to the impacts of climate change and discourage decisions that increase vulnerability, and consider changes where appropriate. The Local Government and Planning Ministers' Council would coordinate a national report based on these assessments.
- Analysis and revision of planning systems including revision and development of codes, standards and guides to increase resilience to climate change including:
 - assessing vulnerability and revising guides for all hazards (floods, bushfires, cyclones and coastal inundation);
 - revision of storm water and sewage guidelines.
- (d) Identify and address the impact of climate change on major infrastructure including:
 - identifying priority infrastructure assets;
 - analyzing the impact of climate change on electricity, transport, communications, water and other key infrastructure and develop adaptation strategies.
- (f) Establish a program to support local government in adapting to climate change, including a toolkit.

Following the National Adaptation Framework, in 2010, the Australian Government set out its vision for adapting to the impacts of climate change and proposes practical steps to realize this vision in its Position Paper, *'Adapting to climate change in Australia'*.⁸⁶ This paper identifies initial national priorities for adaptation action, among which infrastructure is one of six themes.

In terms of regulatory reforms, it states that:

"As a fundamental guiding principle, adaptation considerations and responses will be embedded within existing policy and institutional frameworks. This is because, in most instances, climate change is likely to exacerbate existing risks and therefore can be dealt with most efficiently through existing institutions and frameworks. Reforms will be applied on a sectoral/portfolio basis to ensure future planning and policy development within the Commonwealth anticipates climate change impacts."

It also states that climate change will be embedded in new policy reforms:

"The process of embedding climate change in new policy reform will involve explicitly identifying climate change risks and ensuring appropriate account of their implications is taken in policy development and program delivery. In doing this, it will also need to allocate climate change risks to those best placed to manage them and promote active management of risks by those parties."

Infrastructure Australia

Infrastructure Australia is an independent statutory body that is the key source of research and advice for governments, industry and the community on nationally significant infrastructure needs.⁸⁷ It leads reform on key issues including means of financing, delivering and operating infrastructure and how to better plan and utilize infrastructure networks. Infrastructure Australia has responsibility to strategically audit Australia's nationally significant infrastructure, and develop

15 year rolling Infrastructure Plans that specify national and state level priorities.

Its annual report⁸⁸ to the Council of Australian Governments (COAG) for 2012 outlines its goal to improve strategic planning for infrastructure and notes that, to achieve this goal, infrastructure decision-makers need to factor climate change into long-term strategic planning.^{xvi} It states that jurisdictions should plan for infrastructure that:

- has the capacity to be more resilient against intense, frequent storm events, extended droughts, increased temperatures, variable precipitation patterns and sea level rise inundation;
- provides more reliable regional transport networks to prepare for and recover from natural disasters;
- protects coastal urban areas from rising sea levels and storm surges; and
- does not need regular retrofitting and is not based on short-term solutions, thereby ‘future proofing’ infrastructure and economies for future generations.

The role of regulation in adaptation of Australian infrastructure

A report published by the Department of Climate Change and Energy Efficiency in 2011 describes the role of regulation in adaptation of Australian infrastructure.⁸⁹ It examines the existing regulatory frameworks for infrastructure, to determine whether and how they create barriers to adaptation or facilitate effective adaptation. It covers the regulation of pricing, performance and reliability of essential services provided by physical infrastructure, particularly, electricity, water, transport, communications and waste.

It also reviews the regulatory context for contractual arrangements for major infrastructure projects, including public private partnerships. In Australia, major infrastructure projects are typically procured using PPPs, (examples include the Victorian Desalination Plant PPP Project and the Gold Coast Rapid Transit PPP Project), Relationship Contracting and Traditional Procurement (all non-PPP and non-relationship contracting such as consultancy agreements, construction contracts, design and construct contracts, engineer procure and construct contracts, supply and install contracts and operation and maintenance agreements.) The report estimates that, between 2000 and 2009, PPPs represented approximately 5 to 10 percent of total estimated infrastructure spend.

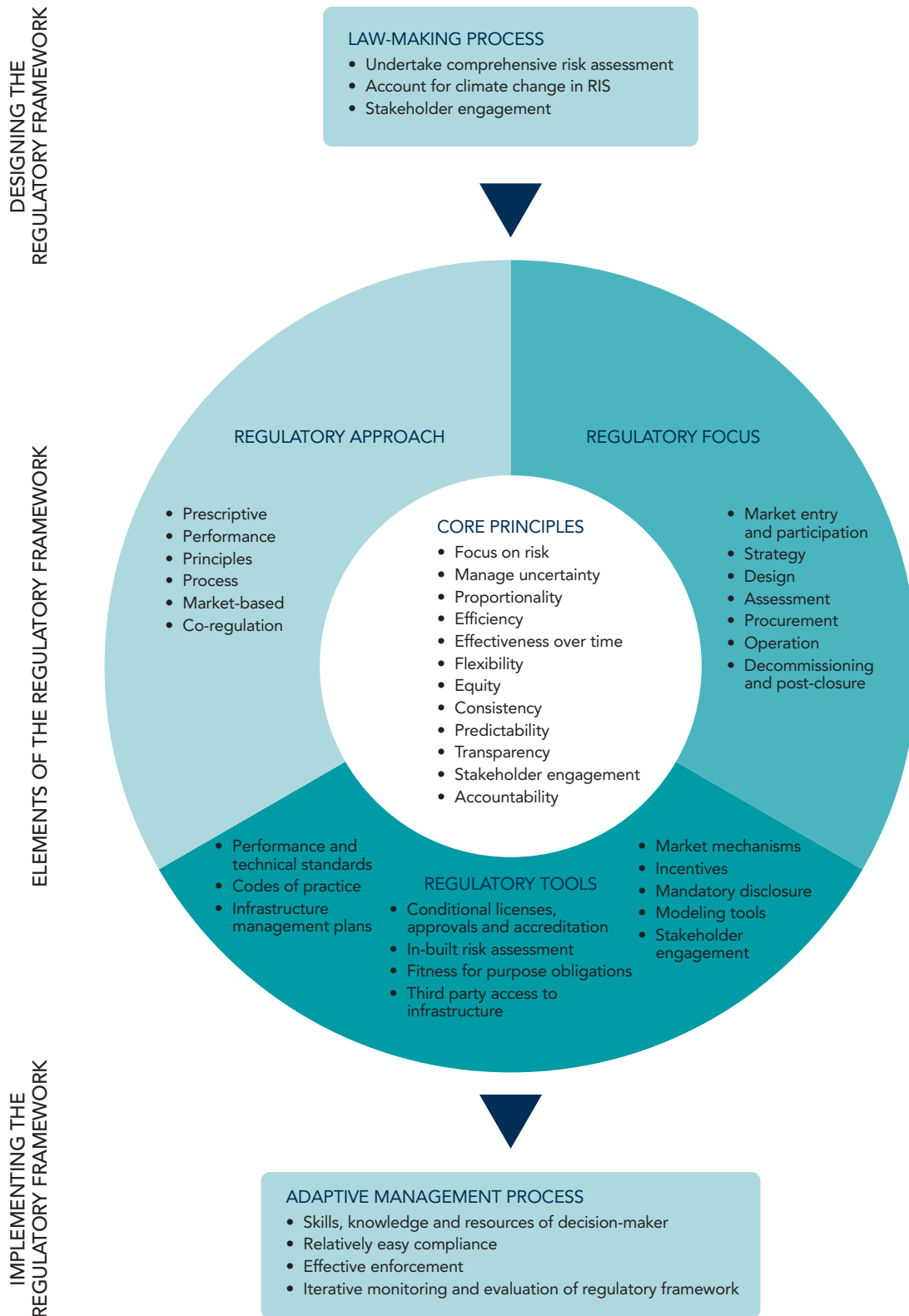
For major infrastructure project procurement, the report discusses Australia’s National PPP Guidelines. While these do not explicitly account for climate change adaptation, the report notes that they provide a principle-based framework for PPP projects, with the principles (or ‘tools’) being flexible and broad enough to facilitate inclusion of adaptation in procurement decisions. The tools are:

- Technical Standards, which can be used to establish standards for infrastructure to ensure that it is designed, constructed and operated in a way that is climate change resilient. The technical requirements and specifications for major infrastructure projects are not fixed or prescribed. They can be performance or output based. This allows each particular project to specify measures to address climate change and the risk of extreme climate change events. For example, these measures may include mandating design safety or redundancy factors to build additional resilience in the infrastructure.
- In-built Risk Assessment, which provides an opportunity for climate change risks to be included in existing regimes for risk assessment
- A Modification Regime, which allows the government to make modifications to the project throughout its term. This regime allows the government to react to developing climate science and modify or vary parts of the project to ensure the infrastructure is capable of adapting to evolving climate change risks.
- A ‘Fitness for purpose’ warranty which requires the private party to ensure that the infrastructure is fit for the intended purpose specified or reasonably inferred from the project documents. If the project objectives are clearly specified, this warranty may be sufficiently broad to take into account climate change risks.

The report proposes a set of core principles that should underpin any framework for infrastructure adaptation, to account for the wide range of infrastructure types, associated regulatory frameworks and array of potential climate change impacts facing infrastructure. These core principles can guide the way in which regulatory frameworks are designed, implemented and applied in practice. They must also be combined with a law-making process and implementation mechanisms that effectively account for the impact of climate change. This framework is summarized in Figure 7.

^{xvi} Annual reports to the COAG for 2013 and 2014 were not available online as of May 19, 2015.

FIGURE 7: Elements of a potential regulatory framework for adaptation of infrastructure.



Source: Department of Climate Change and Energy Efficiency, 2011.⁹⁰

Note: It should be noted that this is not a reflection of current Australian Government policy.

Annex D: Detailed results of literature review

Overview

Desktop literature reviews were undertaken covering the following three areas:

1. A sample of national policy frameworks for PPP / PFI to investigate coverage of climate risks and resilience in these,
2. National policy frameworks for adaptation in the same sample of countries,
3. Climate resilience and PPP initiatives by development partners.

The results of the reviews are presented below.

PPP policy and legislation in low to middle-income countries

The PPP desktop review searched for published information on mainstreaming climate resilience into infrastructure planning (regardless of governance structure) at the sector, multi-sector and regional scale. As part of this, particular attention was focused on if and how existing PPP/PFI frameworks, policies and laws integrate climate resilience, and in particular, in countries which are more climatically vulnerable and with potentially low adaptive capacity. The first step was to develop a shortlist of 10-12 low and middle-income countries for targeted research by:

- identifying the top countries (by scale of investment) implementing PPP projects in the water, power and transport sectors. This was undertaken through reviewing sector updates on the Private Participation in Infrastructure (PPI) Project Database;⁹¹ and
- identifying countries that are implementing infrastructure projects through the Pilot Programme for Climate Resilience (PPCR) that were either wholly or partially adaptation projects, and under PPP contracts. This was undertaken by searching the Climate Investment Funds' "Country Plans & Projects" database.⁹²

The PPI database allowed for the development of a shortlist of 10 countries which were commonly in the top 5 or 6 world countries for PPP investment in one or more of water, energy or transport sector projects. To improve geographic coverage, Albania and Bulgaria were added to the list to cover two Europe and Central Asia (ECA) countries; each was within the top 5 for PPP projects in the transport sector in 2013. Of the countries shortlisted in the PPI database, only India was listed in the PPCR "Country Plans & Projects" database as having an adaptation project. The list was further expanded to include two climatically vulnerable island states, Jamaica and Trinidad & Tobago, who are known to be active in PPP projects.^{93,94} The final shortlist of 16 countries is presented in Table 6.

The country shortlist was initially applied to internet searches for country-level PPP policy, legislation (Acts, Laws, Regulations etc.) or framework documents. In some cases, documents in English were unavailable, in which case simple online translations were undertaken and expert judgment applied in interpreting the translated text and extracting relevant information.

The documents, or other related reference sources if none could be found, were reviewed for evidence of whether a changing climate or adaptation had been explicitly included. This involved searching for "climate", "weather", "resilience", "adaptation", "extreme" or "severe events" within the documentation.

Early findings resulted in a modification of the approach, since there was little or no evidence appearing in country legal / policy documents that adaptation or resilience had been explicitly included, even in recently-dated legislative documents. The modification to the approach was to also include in the review references to risk in general, and to search for statements or legal requirements where the need for adaptation or resilience could be implied, or act as a primary measure for requiring inclusion in PPP Keywords such as "risk", "force majeure" and "Act(s) of God" were used to locate and determine how general and extreme event risks were legislated or recommended to be managed / shared between contracting parties. References in legislative documents that agreements between parties consider project risks and define ownership/risk allocation was a common,

TABLE 6: Shortlist of countries included in literature review

Country	PPP Project Type	Criterion
Albania	Energy, Transport, Water	In top 6 PPI project countries
Bangladesh	Energy, Transport, Water	Climatically vulnerable developing state
Brazil	Energy, Transport, Water	In top 6 PPI project countries, 2013
Bulgaria	Transport	In top 5 PPI project countries, Europe and Central Asia (ECA), 2013
Chile	Energy	In top 6 PPI project countries
China	Energy, Transport, Water	In top 6 PPI project countries
Honduras	Energy, Transport, Water	In top 6 PPI project countries
India	Energy, Transport, Water	In top 6 PPI project countries
Indonesia	Water	In top 6 PPI project countries
Jamaica	Energy, Transport, Water	Climatically vulnerable developing state
Mexico	Water	In top 6 PPI project countries
Nepal	Energy, Transport, Water	Climatically vulnerable developing state
Nigeria	Transport	In top 6 PPI project countries
South Africa	Energy	In top 6 PPI project countries
Trinidad & Tobago	Energy, Transport, Water	Climatically vulnerable developing state
Turkey	Energy	In top 6 PPI project countries

but not unanimous, practice in the countries reviewed. (In South Africa's Preferential Procurement Policy Framework Act (2000),⁹⁵ there was no mention of risk in any context.)

The full review of country-specific legislative documents demonstrated that none had clauses specifying that PPP agreements should take into account, or build resilience to, a changing risk landscape (e.g. a changing climate).

Findings from the shortlisted low—to middle-income countries are summarized below.

Albania, in its Law on Concessions,⁹⁶ refers to a concession agreement providing for requirements and conditions where the concessionaire "Assumes all or substantial part of risks related to such economic activity". The contracts are also required to have in place procedures for the "review and approval of engineering designs, construction plans and specifications by the contracting authority...which should ensure the application of best practice, developing the market through sensible risks allocation". According to an EBRD review of commercial laws in Albania,⁹⁷ Albania's Law on Concessions is described as "one of the few laws in the [East and Central Asia] region that includes in its definition the transfer of risk to the concessionaire and the remuneration considerations".

In their legislative or policy documents, **Bangladesh**,⁹⁸ **Brazil**,⁹⁹ **Honduras**,¹⁰⁰ **Indonesia**,¹⁰¹ **Mexico**,¹⁰² **Trinidad & Tobago**¹⁰³ and **Turkey**¹⁰⁴ made some reference to risk sharing,

allocation or maintaining balance of risks between partners. However, they did not go further in defining the types of risks that should be allocated or shared. **China**,¹⁰⁵ **Nepal**¹⁰⁶ and **Nigeria**¹⁰⁷ made no specific references to sharing or allocation of risks.

Compared to the other countries reviewed, both **Bulgaria** and **India** have produced legislation¹⁰⁸ and policy¹⁰⁹ respectively which provides greater detail in the definition of risk and management responsibilities. Bulgaria legislates:

- the private partner always taking on the construction risk and at least either availability risk or the demand risk for the service:
 - availability risk is defined as "the probability of occurrence of an event, fact or circumstance which has an impact on the serviceability of the facility and/or on the volume and quality of the service", in accordance with the contractually agreed terms and conditions;
 - service demand risk is defined as "the market risk arising from an event, fact or circumstance which has an impact on the demand for the service";
 - construction risk is defined as "the probability of occurrence of an event, fact or circumstance which have an impact on the contractually agreed amount of investment costs of works and the deadline for commissioning of the facility".

- the economic balance of the PPP to be determined upon conclusion of a PPP contract, and constitutes the “equilibrium between the benefits for the parties and the allocation of risks between them”. The economic balance of the PPP determined in the contract has to be maintained for the entire duration of the term of the contract.

i There is a clear direction in Bulgaria's legislation to ensure that probabilities or frequency of events are assessed. However, with no reference to a changing climate, there is a risk that event probabilities will continue to be based on a historic climate and therefore the underlying assumptions on which the contracted risks are shared and managed will no longer be robust in a non-stationary, future climate.

In its Draft National Public Private Partnership Policy of 2011, India clearly defines management of risks between the partners, whereby:

- the Government would identify different types and degree of risks during the project life cycle, appropriate mitigation measures, optimally allocate the project risks, rather than maximize their transfer to the private sector and allocate risks, taking into account stakeholder concerns, to the entity that best suited to manage them;
- in the normal course, the public sector would not retain the risk that the private sector has better ability to bear, but that risks that the public sector is more competent to mitigate/bear, such as availability of unencumbered land and regulatory clearance would be retained by the public sector;
- the allocation of risk are to be enshrined in the contract document and under normal circumstances cannot be modified after the award of the project. Contractual documentation is required to provide adequate protection to lenders against non-commercial risks related to force majeure, regulatory changes and contract termination;
- the Government, where required, sets out mechanisms for periodic review and reallocation of the risks that could not be transferred;
- in cases where there are other options for asset location, bidders would be allowed to propose alternatives and take responsibility for acquiring the site. Here, there is a preference, but not outright requirement, to pass the risk associated with ground conditions, geology and other factors on to the private sector partner.

Despite the comparatively recent publication date and detailed definitions and risk allocations of India's Draft National PPP Policy, there is no mention of a changing risk landscape.

i It is noteworthy that India's Draft National PPP Policy contains a statement related to monitoring, review and reallocation of risks during the project. This implicitly provides a means of adapting risk allocations in the face of a changing risk landscape due to climate change.

It was common, but not in all cases, for the countries reviewed to legislate that PPP contracts include provisions for, and allocation of, force majeure/unforeseen risks.

i Force majeure is a risk that can, in theory, encompass extreme climatic events. However, the types of events, frequency and intensity that comprise force majeure are commonly not defined in legislative documents, instead, more likely transferring the onus of definitions and in some cases allocation of these types of risk to the PPP contract development stages. An example contract from the World Bank's PPPIRC website made reference to force majeure as including events “materially worse than those encountered...at the relevant time of year during the twenty (20) years prior”. This provides a useful mechanism for taking into account events that may be of a greater magnitude compared to a historic baseline, as expected under climate change.

Bulgaria, Chile and Mexico were explicit in their legislation that the public sector took the burden of force majeure risk,^{110,111,112} although again, the type and scale of contributing events remained undefined at this stage. In the case of Chile, an online translation of its 1996 Ley de Concesiones (Law on Concessions) suggested that completion of works was at the sole risk of the concessionaire regardless of accidents, force majeure or any other disruptive causes, but that damages suffered from force majeure would be compensated, as long as this was stated in the agreement. Therefore, in this case, force majeure did not provide an outright exit clause for termination of the works or contract. Comparing this to Bulgaria, Article 306 of its Commerce Act brings into play “duration” of a force majeure event as an exit clause for PPP contracts, whereby if either party “... loses its interest in the performance, [they] shall be entitled to terminate the contract”. However, the length of duration which allows contracted parties to exit remains undefined within the Act itself.

China's Public Bidding Law of 1999 still remains relevant to the structuring of PPPs in China.¹¹³ Although the legislation does not state which entity takes the burden of force majeure risk, a research study¹¹⁴ surveying PPP stakeholders in China and Hong Kong indicated that in practice, at the contract stage the public sector preferred to share force majeure risk, but tended to primarily allocate weather risk wholly to the private sector, or to a much lesser degree, share it. (In Hong Kong, the research stated that there was a greater tendency to share weather risk, attributed to Hong Kong often being affected by severe weather (tropical cyclones etc.) and therefore more expectation on the public sector to share this high risk).

In its PPP policy,¹¹⁵ the Government of **Jamaica** makes reference to the Planning Institute of Jamaica's (PIOJ) growth inducement strategy for the short and medium term. Within the general framework, the PIOJ detailed the need for prioritization of the Government's focus in three areas, including climate change & disaster risk reduction. The strategy¹¹⁶ mentions interventions in infrastructure development for works to include new standards to adapt to climate change. The implications of this are cited as improved business continuity during hazard events as well as presenting an opportunity for PPP.

The Caribbean Development Bank refers to climate change as being part of the business case for PPPs in the region.¹¹⁷ In recognition of the geographical location and topography of Caribbean countries resulting in their infrastructure being vulnerable to climate change, benefits of PPPs are seen to include increased climate resilience. The report concludes that PPPs can bring the *"innovation, incentives and experience needed to build resilient infrastructure projects"*. The report also states that because capital will only be recovered if the asset is operating, *"private investors will carefully assess the climate change risk and identify innovative and proven approaches to manage"*.

Following the review of legislative documents, reviews were also undertaken on wider PPP literature and reference sources related to "force majeure".

An OECD/EU SIGMA assessment of Turkey's public administration reform¹¹⁸ indicated that there are risks to Turkey's state budget in PPP operations which have not been clearly identified. The assessment focused on operation and maintenance having a tendency *"to become more risky and costly over time"* with revenue streams being even more unpredictable and variable (examples of changes in risk and causes of cost overruns were not detailed). The assessment noted that at the same time, Build-Operate-Transfer (BOT) contracts which govern many of Turkey's current PPP operations have force majeure clauses which

imply that the contractor/operator can discharge themselves of responsibility arising from unforeseen problems (with corresponding cost overruns). The implication is that the public sector remains responsible for the costs incurred, backed by state budget. This was also considered the case when there is no explicit state guarantee and when, as a consequence, the Turkish Treasury has not had an opportunity to review draft contracts and therefore remained unaware of the Government's liabilities. SIGMA concluded that the current approach *"does not ensure efficient, cost-effective and financially sustainable PPP operation, and not all fiscal risks are recognized and mitigated"*.

The World Bank PPPIRC website describes force majeure provisions as varying depending on jurisdictions and the project and provides some real case samples of clauses, however source countries were not stated by PPPIRC.¹¹⁹ In the example agreements, force majeure has been defined in the following ways:

- Example 1: *"an event beyond the control of the Authority and the Operator, which prevents a Party from complying with any of its obligations..."*, covering, among others:
 - act of God (such as, but not limited to, fires, explosions, earthquakes, drought, tidal waves and floods);
- Example 2: force majeure is the occurrence of:
 - *"... exceptional adverse weather conditions in excess of those required to be designed for...which are materially worse than those encountered...at the relevant time of year during the twenty (20) years prior...;*
 - *tempest, earthquake or any other natural disaster of overwhelming proportions...;*
 - *discontinuation of electricity supply, not covered by the agreement concluded with the [utility company]; or*
 - *other unforeseeable circumstances beyond the control of the Parties against which it would have been unreasonable for the affected party to take precautions and which the affected party cannot avoid..."*
- Example 3: *"...any circumstance not within the reasonable control of the Party affected...cannot be... prevented, avoided or removed...and...materially and adversely affects the ability of the Party to perform its obligations, and such Party has taken all reasonable precautions, due care and reasonable alternative measures in order to avoid the effect..."* Instances of force majeure which are covered include:
 - fire, chemical or radioactive contamination or ionizing radiation, earthquakes, lightning, cyclones,

hurricanes, floods, droughts or such other extreme weather or environmental conditions, unanticipated geological or ground conditions, epidemic, famine, plague or other natural calamities and acts of God;

- explosion, accident, breakage of a plant or equipment, structural collapse, or chemical contamination (other than resulting from an act of war, terrorism or sabotage), caused by a person not being the affected Party or one of its contractors or subcontractors or any of their respective employees or agents.

i It can be implied from Example 2 above that future extreme events resulting from a changing climate could be inferred through its reference to events which are “materially worse than those encountered...at the relevant time of year during the twenty (20) years prior”. Examples 2 and 3 also provide examples of events that can be triggered or stressed by a changing climate, for example, discontinuation of electricity supply, explosion, accident, breakage of plant or equipment, structural collapse, chemical contamination etc, all of which are potential consequences of extreme weather events.

Adaptation frameworks of low and middle income countries

This section includes more detailed information on adaptation frameworks for 14 of the 16 the countries listed in Table 7, demonstrating where and how adaptation is incorporated into their national policy. The information is drawn from a recent study by the Grantham Research Institute on Climate Change and the Environment.

PPP policy and legislation in some higher-income countries

In civil law countries, concession laws are often introduced to enable PPP projects and to define the type of services that could be procured. Specific PPP laws have been introduced in Belgium, Italy, Poland, Portugal and Spain, among others. These laws can focus on specific sectors (e.g. highways) or may be cross-sectoral. However, specific PPP laws are not always a necessary condition; legal frameworks can be implemented by changing existing legal provisions which may have an impact on PPP projects.¹²¹

The UK developed its pioneer Private Finance Initiative (PFI) model with no PPP law in place. To address concerns expressed on behalf of funders, specific legislation was

introduced related to health service bodies and local authorities entering into PPP contracts. In 2012 the UK Government published a draft guidance document, “Standardisation of PF2 Contracts”¹²² building on its latest policy for delivery of infrastructure and services through PPPs. The latest policy, “A New Approach to Public Private Partnerships” introduces PF2, the UK Government’s successor to PFI. The main objectives of the guidance include:

- building on “A New Approach To Public Private Partnerships” by setting out the approach to be taken on structuring PF2 contracts and allocating risks between the public and private sector;
- providing detailed drafting provisions for incorporation into PF2 contracts;
- filling in gaps in contract standardization; and
- reducing the time and costs of procurement by enabling all parties to agree a range of areas that can follow a standard approach, without extended negotiations.

The guidance recognizes there will be circumstances where the private sector contractor should fairly be relieved from liability for failure to commence or provide a service. The guidance also recognizes that a balance must be struck between encouraging the Contractor to manage the risk and protect the public sector partner from non-performance. It defines three types of supervening events:

- Compensation events:^{xvii} defined as “breaches by the public sector partner of any of its contracted obligations or warranties and where the contractor should be compensated”;
- Relief events: defined as “events considered best managed by the private sector contractor (although not necessarily in its control) and for which the contractor bears the financial risk and where no rights of termination should arise”. These can include:
 - fire, explosion, lightning, storm, tempest, flood, bursting or overflowing of water tanks, apparatus or pipes, ionizing radiation (where it does not constitute a Force Majeure event), earthquakes, riot and civil commotion;
 - failure by any statutory undertaker, utility company, local authority or other like body to carry out works or provide services;

^{xvii} The guidance indicates that the distinction between Compensation Events and Relief Events is sometimes expressed as being the difference between the contractor being given ‘time and money’ and ‘time’ only to manage the outcome of an event.

TABLE 7: Country adaptation frameworks for the countries listed in Table 6.¹²⁰

Country	Adaptation Framework
Bangladesh	Although no formal framework is in place, the Bangladesh government's Vision 2021 document to reduce poverty and progress towards a middle-income economy forms a key adaptation planning document for the country. Vision 2021 requires all efforts to protect Bangladesh from the adverse effects of climate change. The "Outline Perspective Plan (OPP) of Bangladesh 2010–2021: Making Vision 2021 A Reality" outlines the medium-term objectives and longer-term goals, and includes analysis of climate change management strategies. The plan emphasizes climate change adaptation through participation of local communities and the private sector.
Brazil	Brazil's 2008 National Plan on Climate Change identifies a number of adaptation interventions to combat desertification and promote management of water resources. It aims increase institutional, managerial, and legislative adaptation capacity as well as promoting direct action for addressing impacts, risks and vulnerabilities. The 2009 National Policy on Climate Change (NPCC) identifies specific sectors and locations in need of adaptation, proposes short—and long-term strategies and established the National Climate Change Fund (FNMC) to provide financial support to adaptation and mitigation activities.
Bulgaria	Bulgaria is progressing towards a National Adaptation Strategy beginning with the finalization of a national climate change risk and vulnerability assessment Framework in 2014. The main objective of the Framework is to assess the risk of climate change-related natural disasters, covering a number of sectors including water, energy, transport, construction and infrastructure.
Chile	Chile's National Climate Change Adaptation Plan, adopted in 2014, provides the overall framework for adaptation activities across different sectors and administrative levels. The Plan is grouped under four main themes: scientific research; communication and environmental education; institutional strengthening; and disaster risk reduction. The Plan calls for development or update of sectoral adaptation plans, some of which have been already developed following the requirements of the National Climate Change Action Plan 2008–2012. Infrastructure and energy sector Plans are under development.
China	In 2013, China's National Development and Reform Commission (NDRC) published the country's National Strategy for Climate Change Adaptation. The strategy is embedded within the 12th Five Year Plan laying guidelines and principles for climate change adaptation and sets specific adaptation goals.
India	India adopted its National Action Plan on Climate Change (NAPCC) in 2008, and outlines existing and future policies and programs for mitigation, adaptation and knowledge management. State governments are preparing state-specific Action Plans, draw on the National Action Plan and operationalizing measures in mitigation and adaptation.
Indonesia	Indonesia's National Action Plan on Climate Change Adaptation (RAN-API) was produced in 2012 by. The plan does not have a formal legal basis, but is an important input into the development of the Government Annual Plan as well as the National Medium-Term Development Plan. It provides adaptation programs and activities for the short-term (2014), medium (2015–2019) and long-term (2020–2025)
Jamaica	None
Mexico	Mexico adopted its 10-20-40 National Climate Change Strategy in 2013. Following from the 2012 General Law on Climate Change, the Strategy outlines actions to be implemented until 2040. It sets out the main focal areas regarding cross-sectorial climate policy, adaptation to climate change and reduction of GHG emissions, presented as "eight axes of action".
Nepal	The 2011 Climate Change Policy supports the National Adaptation Program of Action (NAPA) and National Framework on Local Adaptation Plans for Action (LAPAs). Other projects complement these national-level initiatives, such as projects focused on capacity building such as the National Capacity Needs Self-Assessment Project (20–7 - 2009).
Nigeria	The National Adaptation Strategy and Plan of Action on Climate Change for Nigeria (NASPA-CNN) outlines responses to climate change in key areas such as water resources, energy and transportation. In 2012, the adoption of a National Climate Change Policy and Response Strategy (NCCP-RS) was approved, aiming to provide a framework for responding to impacts of climate change.

- any accidental loss or damage [to the development or any roads servicing it];
- any failure or shortage of power, fuel or transport.
- Force Majeure events: defined as "limited set of events which arise through no fault of either party, which are best managed by the contractor (although not in its control) and in respect of which rights of termination can arise". Defined events include:

- nuclear, chemical or biological contamination unless the source or the cause of the contamination is the result of the actions of or breach by the Contractor or its subcontractor.

i UK PPP guidance is tightly defined in relation to weather events, clearly placing the burden of primary weather and climate-related impacts and risks on the private sector contractor under the definition of Relief Events. However, it is also reasonable to assume that large scale secondary climate impacts, for example an event resulting in nuclear, chemical or biological contamination, would then cover the contractor under Force Majeure. There is no further definition in UK guidance on the geographic scale or magnitude of climate related events which could devastate wider areas and place at risk a project's delivery of services, even if the project itself is not directly and immediately impacted.

i A study for a regional climate change partnership in the UK¹²³ looked at facilitating and influencing the inclusion of climate change adaptation into a schools building program in the late 2000s. At the time, PFI mechanisms were increasingly being used to deliver the new schools and a growing number of organizations were critical of the program, with poor and ill-considered design being cited as a major problem. The following climate change risks to school PFI contracts were identified, and remain equally applicable to other types of infrastructure projects:

Income: concession payment reductions when performance and availability criteria are not met

Capital costs: extreme weather interruptions during construction

Additional capital requirements: to meet unplanned asset failure/asset replacement during the concession period

Operating costs: cost increases to meet changing customer needs and expectations, additional maintenance and repairs and asset failures

Financing costs: falling credit ratings and market confidence together with unplanned additional capital requirements may increase financing costs.

Additional finance: required to meet unplanned asset replacement and refurbishment

Increasing insurance premiums: with more restrictive exclusion clauses in response to flooding incidents.

New Zealand's PPP Program is coordinated by the Treasury. Although there have been few PPPs in New Zealand, the Treasury states that there are generally no legal barriers to entering into PPPs except for the Crown being prohibited from entering into any prison management contracts, PPPs

being prohibited for water and wastewater services and some procedural restrictions on road PPPs.¹²⁴

The Treasury has published a guidance document providing an overview of the contractual framework for standard PPP agreements.¹²⁵ The guidance is clear in its recognition that the potential costs to all parties of early termination means that agreements require "*clear delineation of risks*". The guidance also states that the procuring entity, as part of due diligence, should ensure that any subcontracts adequately pass risk from the Contractor to the relevant sub-contractor, recognizing that the contractor "*...will have limited ability...to actually manage these risks itself*". The guidance itself refrains from detailing how risks should be allocated, instead referring to a Base Agreement providing coverage of areas of risk allocation (see Section 0).

In its guidance, the Treasury refers to force majeure in the context of the "Operational Phase" of a project, where one of the key matters that should be considered is "*'reactive' management (such as following a natural disaster or other force majeure event)*". It is interesting to note that force majeure is not listed as a key matter in the guidance under "Design and Construction Phase".

i Climate change and extreme weather events are risks at all stages of a project, from developing the business and income model, to site selection, construction and operation and through to decommissioning activities. To adequately manage risks and allocations, PPP contracts should consider how climate change and force majeure events may impact all stages of a project lifecycle.

Standard/generic PPP contract templates created by governments

The Bangladesh Public Private Partnership Office's website provides draft PPP model agreements. A review of the highways model agreement¹²⁶ shows that it extends the risk sharing definition touched upon in Bangladesh's PPP policy.¹²⁷ Operations and maintenance standards clauses in the model agreement require the concessionaire to pay for maintenance repairs, renewals and replacement whether "*due to use and operations or due to deterioration of materials and /or parts*". The concessionaire is also obliged, unless otherwise agreed, to rectify or remedy loss or damage to the project occurring from "*any cause whatsoever*". The concessionaire is not, however, considered in breach of its obligations in the event of force majeure, but is required to keep all unaffected parts of the project operable if safe to do so.

Although the Bangladesh highways model agreement begins to provide more detail on risk sharing and obligations, it stops short of defining or providing examples of the type and scale of events that constitute force majeure. It is also interesting to note the maintenance obligation on the concessionaire to remedy “*deterioration of materials and/or parts*”, the frequency and associated costs of which may be impacted by a changing climate.

i Changes in the frequency and intensity of events are likely to impact on future infrastructure maintenance and repair requirements if climate-related design thresholds are encroached upon, or exceeded, more often and with greater magnitude. The Bangladesh highways model agreement indirectly places the risk of additional and unforeseen repair and maintenance costs (which could result from a changing climate) on the private sector.

New Zealand’s Treasury has published a set of Base Agreement ‘model terms’ as an overarching framework within which project specific material can be integrated.¹²⁸ Under the term “Extension Event”, the Base Agreement groups together uninsurable, force majeure, unforeseeable contamination and “...any [other] insured event or occurrence giving rise to physical loss, destruction of or damage to the Facility from any cause”. These types of events allow the contractor, provided they give the correct notice, to apply for “...relief from the consequences of failing to comply with certain terms...” of the contract. In the event that parties do not agree an extension event has occurred, they are required to resolve the matter through dispute resolution procedures. The Base Agreement’s definition of force majeure as an Extension Event includes the following:

- cyclone, tornado, earthquake, natural disaster, landslide, tsunami, flood, volcanic eruption, mudslide or explosion or fire caused by the aforementioned;
- epidemics or pandemics which prevent delivery of services;
- ionizing radiation, contamination by radioactivity, nuclear, chemical or biological contamination.

Uninsurable Events are defined as:

- a force majeure event that is, at the time of occurrence, uninsurable; or
- a force majeure event that continues to subsist following expiry of coverage under the contractor’s works insurance and/or business interruption insurance.

Where Uninsurable Events materially affect a contractor’s performance obligations, the contracted parties are required to use “...reasonable endeavors to agree... arrangements with the other party that...avoid or mitigate the effect of the Contractor’s inability to perform...”. If parties are unable to agree, termination proceedings can begin subject to, among others, the following conditions and timescales:

- “... an Uninsurable Event that has resulted in destruction of the Majority of the Facility, 20 Business Days after the date of that Event; or
- in any other case, 40 Business Days after the date of that Event...”.

Therefore, in the case of New Zealand’s model PPP terms, a force majeure event in itself does not allow for an outright termination of the agreement, instead, reliance is placed on whether the contractor is covered by insurance during the period in which they suffer damages.

i The U.S. insurance industry is taking an adaptive approach to the impacts of increasing wind damage from hurricanes, lobbying for improved building codes as suitable technology and risk management products come on the market (such as better hurricane shutters and wind resistant glass). In some instances individual insurance companies have required individuals to build with these materials in order to qualify for coverage.

Also referred to as form of adaptation, some insurers began withdrawing from high-risk coastal locations in Florida. This was seen as being in part due to regulators preventing insurers from raising premiums to reflect the increasing risk and hampering the market’s ability to send price signals to educate consumers on the vulnerability of assets on exposed coastlines. The American International Group (AIG) is no longer writing new property policies in some parts of the Gulf Coast and another company, MetLife, stated that it would require extra inspections and storm shutters for new customers living within five miles of the sea before issuing cover.

While this form of adaptation is seen to protect insurance companies, it creates a shift in risk burden away from insurance companies and onto asset owners.¹²⁹

Climate resilience and PPP initiatives by development partners

The development partner literature review aimed to identify current initiatives led by the World Bank Group, Multilateral Development Banks (MDBs), Regional Development Banks

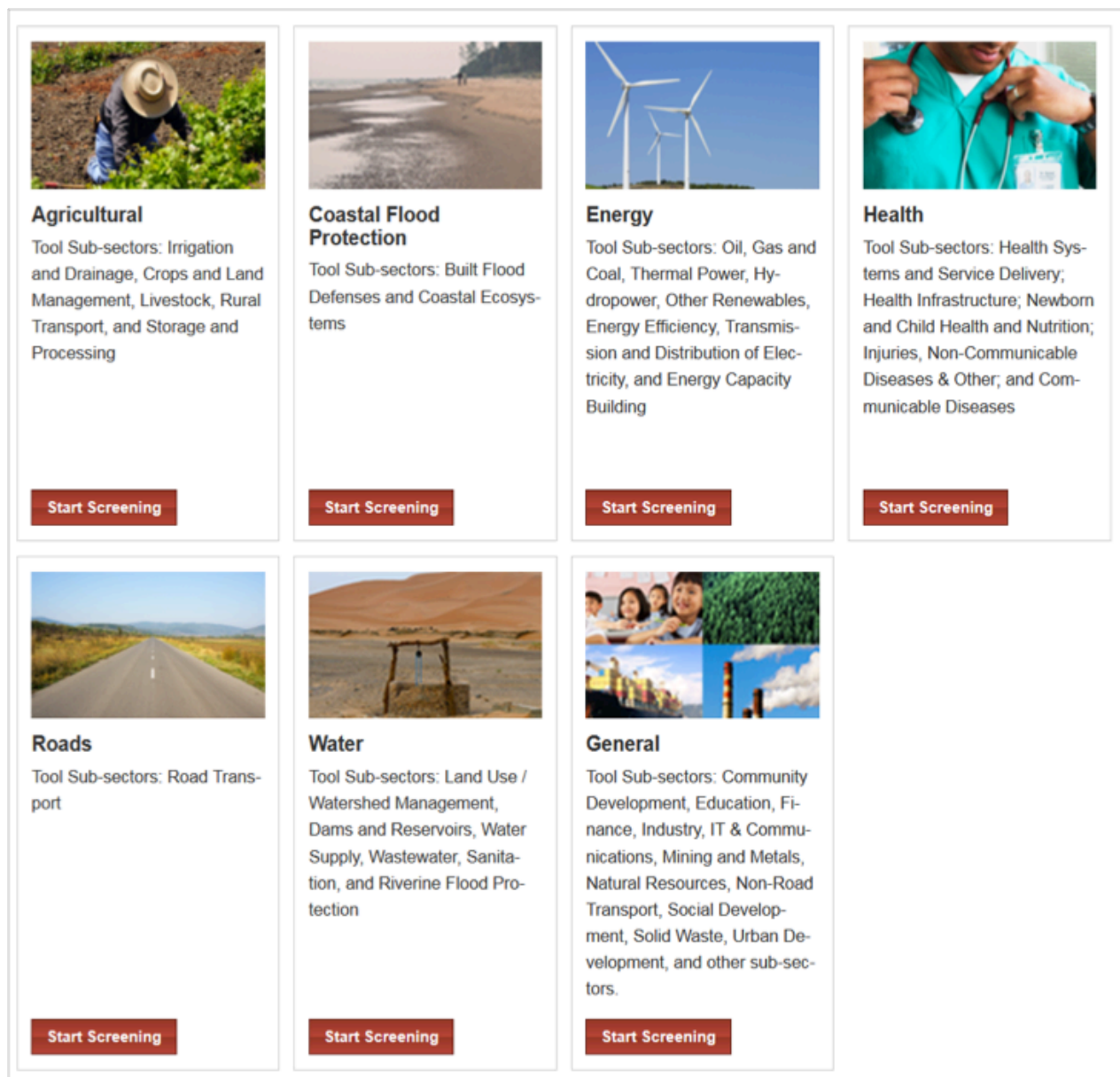
(RDBs) and bilateral donors on mainstreaming climate resilience in sector, multi-sector and regional infrastructure planning. They provide a snapshot of the current state of global knowledge on experience in these areas, identifies gaps and challenges, and lay the foundation for further analysis and recommendations.

For individual MDBs and Bilateral Donors a number of key search terms were used to find references to their

work on climate change adaptation (or resilience), PPPs and where the two topics overlap.

The review found that the body of literature is reasonably mature for climate risk and infrastructure at the global scale and for individual MDBs and bilateral donors. The same is true for PPPs in the general sense. However specific information on the use of PPPs to improve climate resilience is scarce—often the focus is on low carbon PPPs.

FIGURE 8: World Bank Climate and Disaster Risk Screening Tools at the project level.



World Bank

The World Bank’s efforts on climate change focuses on five key areas:

1. Building low-carbon, climate resilient cities;
2. Moving forward on climate smart agriculture and nurturing forest landscapes;
3. Accelerating energy efficiency and investment in renewable energy, including hydropower;
4. Supporting work on ending fossil fuel subsidies; and
5. Developing carbon pricing to get prices right for emissions.

In 2014, the World Bank Group provided \$11.9 billion in financing for 224 climate projects in over 77 countries, including \$8.79 billion from the World Bank (IBRD/IDA), \$2.48 billion from IFC, and \$603 million from the Multilateral Investment Guarantee Agency (MIGA).¹³⁰ As such, the International Bank for Reconstruction and Development (IBRD) and International Development Association (IDA) provide the main conduits for financing the World Bank’s work on climate change.

The IDA, which is the Bank’s fund for the poorest, is particularly focused on ensuring climate resilient growth and as of July 2014, all country planning strategies and investments funded by the IDA must consider climate and disaster risks and address them as appropriate.¹³¹ IDA Country Partnership Frameworks are now incorporating climate and disaster risk considerations, and new IDA operations are screened for

short—and long-term climate change and disaster risks, and resilience measures are integrated as appropriate.

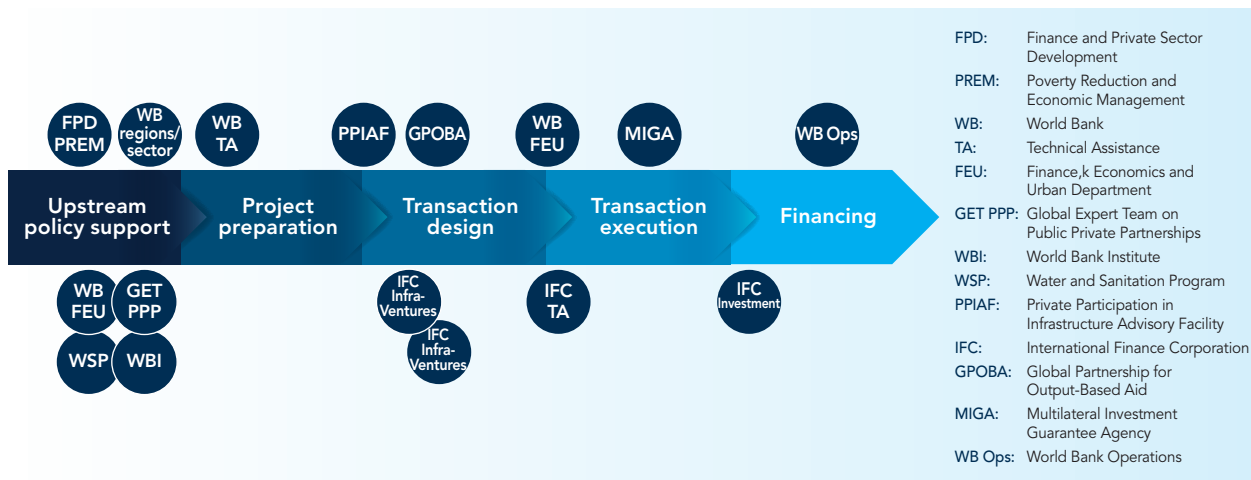
To support development practitioners to consider climate risk to their programs and investments, the World Bank provides a suite of “Climate and Disaster Risk Screening Tools”.¹³² The tools are divided into:

1. National / Policy level, which target national plans, sector-wide strategies, and development policy and institutional strengthening and reforms; and
2. Project level, which targets a range of sectors (as shown in Figure 8).

Both the national/policy level tool and the project level tools provide a user-friendly step-by-step approach to understand potential risks to programs and investments.

With regards to PPPs in infrastructure, the World Bank Group’s role is described in their latest “Infrastructure Strategy (2012–2015)”,¹³⁴ which outlines a joint action plan with the IFC is to scale-up the PPP project pipeline. The Bank recognizes that this will require a concerted effort by all Bank, IFC, and MIGA PPP-related units to develop the enabling environment to attract the private sector and a pipeline of PPP projects in 6 focus countries, with existing resources (budget, trust funds and expertise) strategically re-aligned.¹³⁵ Up until this point, the World Bank Group acknowledges that mobilizing PPP projects has been difficult due to a lack of incentives to pursue typically costly, risky and time-intensive projects and the complex organizational structure (Figure 9), with approximately 20 units and groups contributing one way or the other to the PPP agenda.¹³⁶

FIGURE 9: World Bank Group involvement in PPPs.



Source: World Bank, 2011.¹³⁷

The Public Private Partnership in Infrastructure Resource Centre (PPIRC)¹³⁸ is a World Bank initiative. It includes a website database of items of legislation and regulation from countries relating to PPP. It is supported by the Public Private Infrastructure Advisory Facility (PPIAF) and African Legal Support Facility (ALSF), which in turn is hosted by the African Development Bank and FOMIN—a multilateral investment fund administered by the Inter-American Development Bank (IDB) group. The PPIAF¹³⁹ is also supported by the World Bank and appears to have a similar function to PPIRC. It specializes in facilitating an enabling environment for successful PPPs in infrastructure.

PPIRC has a section on their website that “focuses on PPP projects that address the threat of climate change by incorporating features aimed at the mitigation of greenhouse gas emissions and at adaptations to climate change impacts”.¹⁴⁰ While there is some guidance on low carbon projects, there appears to be an absence of examples of how climate adaptation could be incorporated into PPP.

Likewise, technical assistance is eligible for funding by PPIAF specifically to, “assist government officials in planning and prioritizing projects, incorporate specific climate change responses into project designs, regulate project implementation after contract closure, and find subsidy funding to pay for costs.”

In 2010 PPIAF assisted the Government of Malawi¹⁴¹ with a study on the options for private sector investment in a large irrigation project. While the aims of the project are to improve access to irrigation and mitigate the impact of current climate variability, there was no clear assessment in the study about how the irrigation project might perform in the future as the climate changes. A similar conclusion can be drawn from an earlier study in Ethiopia.¹⁴²

In 2011, studies in Ghana,¹⁴³ Mozambique¹⁴⁴ and Ethiopia¹⁴⁵ looked at the climate resilience of planned transport infrastructure investments. As a result, recommendations were made to modify plans for ongoing maintenance of the roads. The PPP context of the projects was not highlighted in the study and so it is unclear how the division of responsibility for improving climate resilience and allocation of risk is made.

In 2014 PPIAF developed a “Caribbean Infrastructure PPP roadmap”. The roadmap suggests that PPPs can bring innovation, incentives and experience needed to build resilient infrastructure projects. The argument is that private investors will insist that climate-related risk be adequately assessed and mitigated in innovative ways. This would of course only be the case if the private sector bears the risks associated with climate-related events.¹⁴⁶

International Finance Corporation (IFC)

In 2010, the IFC created the Climate Business Department (CBG) as a new department and collaborative platform to coordinate, catalyze and optimize all climate business activities within IFC on the investment and advisory side.¹⁴⁷ To help its clients understand and respond to the risks of climate change, IFC is developing best practices in assessing private sector risk and adaptation strategies.

The IFC is involved in innovative work in ensuring infrastructure developments are resilient to climate change. “Climate Risk and Financial Institutions”,¹⁴⁸ is a publication that assesses climate-related risks material to financial institutions, including commercial banks, institutional investors, and international financial institutions. The IFC concluded that climate change is a material risk for financial institutions, particularly those investing in long-lived infrastructure assets. The IFC has carried out a Climate Risk Pilot Program which produced case studies to demonstrate practical approaches to climate risk and adaptation. The idea is that these will lead to more general tools for addressing risks for investments.

The IFC is also at the forefront of providing advisory services for effective PPPs. In IFC, structuring a PPP transaction is a specific business of IFC Advisory Services (with appropriate fee compensation from clients).¹⁴⁹ In order to communicate and learn from past experiences, they have documented a range of PPPs across multiple sectors.¹⁵⁰ One of the key lessons learned is that “politics is (and always will be) the main cause of death for PPP transactions”.

The IFC has stated that it is important to consider the role of PPPs in addressing adaptation. PPPs, with possible 25-year (or longer) concessions, have the opportunity to provide a structure for addressing medium—and longer-term issues. It has been suggested that continued progress in the climate arena and the maturing of climate-related regulatory frameworks will eventually change the way PPPs are constructed.¹⁵¹ However, there remain few details on what these changes will look like in practical terms.

Asian Development Bank (ADB)

In 2010, ADB issued their climate change strategy, titled “*Addressing Climate Change in Asia and the Pacific: Priorities for Action*”. This strategy includes a number of strategic priorities to promote “an Asia and Pacific region that is more resilient to the adverse impacts of climate change and will contribute to the global reduction of GHG emissions by helping the region follow a low-carbon path for economic growth and poverty reduction.”¹⁵² These priorities are:

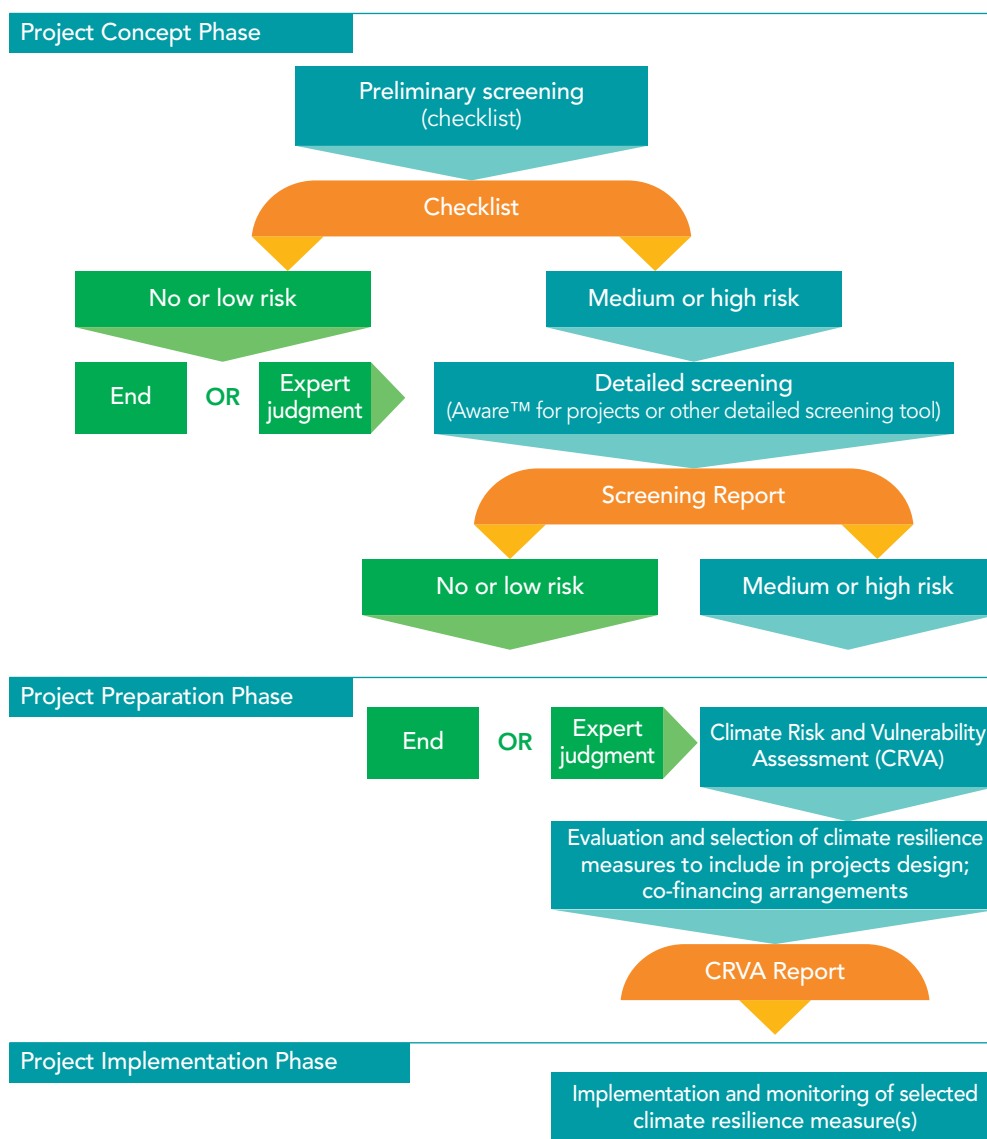
1. Expanding the Use of Clean Energy;
2. Encouraging Sustainable Transport and Urban Development;
3. Managing Land Use and Forests for Carbon Sequestration;
4. Promoting Climate-Resilient Development; and
5. Strengthening Policies, Governance, and Capacities.

Between 2009 and 2011, ADB's climate change-related interventions spanned more than 110 projects, involving an

investment of about \$10 billion.¹⁵³ During the same period, ADB also provided more than \$245 million in technical assistance to improve knowledge and capacities, support policy and institutional development, and ensure the feasibility of investments related to climate change.¹⁵⁴

To ensure that development investment in Asia and the Pacific deliver the socio-economic benefits under a changing climate, the ADB has assigned a high priority to embedding climate resilience into development projects. The key process for achieving this is their Climate Risk Management Framework¹⁵⁵ (Figure 10), which aims to reduce risks resulting from climate change to investment projects across the

FIGURE 10: ADB's Climate Risk Management Framework for assessing risks to projects.



Source: ADB, 2014.¹⁶¹

region. As a first step, there is a systematic risk screening process. Those projects deemed at risk during this stage go forward for further assessment, using climate risk and vulnerability assessments. Adaptation options are therefore evaluated for those projects deemed significantly in need of such action. The end-point of this process is the integration of climate risk reduction measures into project design.

In addition to this generic risk management framework, ADB has also developed a number of sector-specific “climate proofing” guidelines, including for the transport,¹⁵⁶ energy¹⁵⁷ and agriculture¹⁵⁸ sectors. ADB has also recently intensified efforts to increase climate resilience in urban development through the Urban Climate Change Resilience Trust Fund (established in December 2013).¹⁵⁹

In tandem with ADBs efforts to mainstreaming climate resilience, they are increasingly seeing the importance of mobilizing private sector finance. This includes initiatives such as the Canadian Climate Fund for the Private Sector in Asia (established in March 2013) and the Climate Public-Private Partnership Fund, to provide commercial investors with investment products that can bring scale and at the same time have a meaningful impact on the market.¹⁶⁰ To date, ADBs activities around PPP and climate change have tended to focus on mitigation, for example in India’s flagship solar energy program, the Jawaharlal Nehru National Solar Mission (JNNSM). The PPP literature at ADB does not mention climate change specifically and the guidelines for climate resilience, in turn, make no reference to PPP. While there is activity in both areas, there appears to be

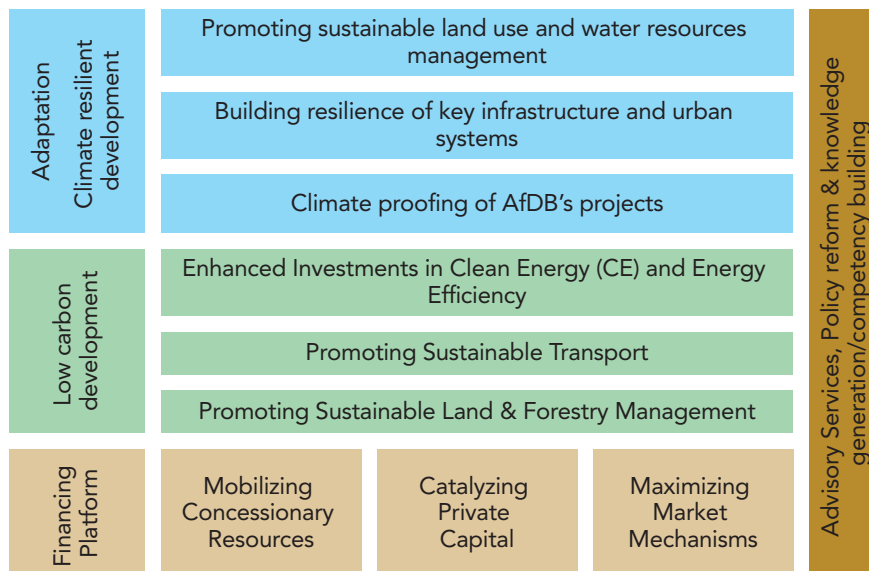
a disconnect between how PPP can be used to enhance climate resilience specifically.

African Development Bank (AfDB)

AfDB designed a “Climate Change Action Plan (CCAP) for 2011–2015” to support its Regional Member Countries adapt to climate change and mitigate its effects while supporting the Bank’s focus on infrastructure development and regional operation.¹⁶² The CCAP is organized around three pillars—Low Carbon Development, Climate Resilient Development and Funding Platform—to help African countries strengthen their capacity to respond to climate change and to mobilize resources from existing and proposed sources of climate finance, the private sector, and market mechanisms (Figure 11).

Underpinning AfDB’s CCAP is the Bank’s “Climate Risk Management and Adaptation (CRMA) strategy”.¹⁶⁴ Part of the strategy is to climate proof the bank’s infrastructure investments. In order to make this happen, bank staff apply due-diligence and climate risk management procedures at all stages of the project cycle. This is to be carried out for all types of infrastructure across multiple sectors such as roads, energy and agriculture. The African Development Bank has also been active in encouraging the implementation of PPP to stimulate infrastructure development across the continent. Their “Capacity Development Strategy” identifies the Bank’s focus on strengthening the capacity in its RMCs and regional institutions, including Regional

FIGURE 11: African Development Bank climate change program.



Source: AfDB, 2011.¹⁶³

Economic Communities (RECs), by designing essential policies for infrastructure development and by creating legal and regulatory frameworks for public-private partnerships, among other objectives.¹⁶⁵ In 2014, the bank expressed an interest in actively identifying potential PPP port projects.¹⁶⁶ In Nigeria, there have been efforts by the bank to build capacity with respect to PPP generally, including the establishment of an “advisory hub” in Abuja.^{167,168} Funds have been made available by the bank to promote an enabling environment for PPP and carry out other advisory services and studies.¹⁶⁹

There is at least one documented example of PPP being implemented by the bank (in partnership with the Global Environment Facility—GEF) to develop a series of renewable energy investments i.e. climate mitigation projects, in West, Central, and East Africa.¹⁷⁰ However, there does not yet appear to be an explicit link between PPP and improving the climate resilience of infrastructure projects.

European Bank for Reconstruction and Development (EBRD)

EBRD’s climate change adaptation operations cover a wide range of sectors, including water supplies, power generation, coastal infrastructure, irrigation, buildings and water-intensive industries such as agribusiness and mining. The EBRD systematically integrates comprehensive climate risk assessments and adaptation measures in their investment operations, looking across the whole project development

process (Figure 12). Since 2006, the EBRD has provided €580 million to 92 adaptation projects in 27 countries.¹⁷¹

EBRD also works closely with international climate finance mechanisms such as the Climate Investment Funds (CIF), Global Environment Facility (GEF) and Green Climate Fund (GCF), in order to channel their resources into practical infrastructure projects that are resilient to variable and extreme weather.

The EBRD has been promoting better standards and practices in PPP for 20 years. This has been primarily achieved through the bank’s Legal Transition Program (LTP).¹⁷³ The program has enabled the EBRD to assist governments committed to bringing their PPP regimes in line with better standards through four types of activities:

1. Assessment of PPP frameworks, laws and practices in its countries of operations;
2. Providing technical assistance to EBRD countries to bring their PPP regimes in line with international standards and best practice;
3. Identification and promotion of sound practices in PPP; and
4. Outreach and awareness rising in the form of publications and conferences.

An example of EBRD and GEF collaborating on a climate-related PPP is in establishing a financing facility to serve

FIGURE 12: EBRD’s approach to integrating climate risk and adaptation measures within their project development process.



Egypt, Jordan, Morocco and Tunisia. The program aimed to support the emergence of a market for energy efficiency that would not otherwise develop.¹⁷⁴ While there is more limited experience of using PPP approaches in climate resilience investments, in part because some climate-vulnerable countries may lack appropriate regulatory frameworks, there is some evidence that they may be feasible in certain EBRD countries of operations. For example, EBRD is developing investments in port infrastructure upgrades in Morocco, which take into account climate change projections and integrate resilience measures. A sovereign loan will be used for the construction of port infrastructure such as breakwaters, quays and dredging equipment, which will subsequently be used by private concessionaires for commercial port operations.¹⁷⁵

Inter-American Development Bank (IDB)

In 2011, IDB published their “Integrated Strategy for Climate Change Adaptation and Mitigation and for sustainable and Renewable Energy (CCS)”¹⁷⁶ and “Climate Change Action Plan (2012–2015)”¹⁷⁷ which promotes the development and use of a range of public and private sector financial and non-financial instruments to enhance the region’s institutional, technical, and financial capacity to address climate change. It also provides guidance for the Bank’s dialogue on regional and national climate policy agendas with governments, civil society, and the private sector. The IDB’s response to climate change focuses on the following sectors:

1. Land use and forestry;
2. Agriculture and livestock;
3. Energy efficiency;
4. Sustainable urban transport;
5. Water resource management and sanitation; and
6. Renewable energy.

IDB had a target that by 2015, 25 percent of total Bank lending will support operations in climate change, environmental sustainability, and sustainable energy, as stipulated by the IDB’s 2010 Ninth General Capital Increase.¹⁷⁸

FOMIN (Fondo Multilateral de Inversiones Miembro de Banco Interamericano de Desarrollo)—a multilateral investment fund administered by the IDB group—have recently published an evaluation of the environment for public-private partnerships in Latin America and the Caribbean.¹⁷⁹ Country level support has been implemented by IDB in Colombia to facilitate and encourage private participation

to promote improvements in service delivery and quality of infrastructure, through technical, institutional and regulatory strengthening.¹⁸⁰

While IDB has developed a robust approach to integrating climate resilience into infrastructure planning,¹⁸¹ the existing example PPP climate projects relate to ‘low-carbon’ initiatives with no indication on how or whether climate resilience was integrated.¹⁸²

United States Agency for International Development (USAID)

USAID’s “Global Climate Change and Development Strategy”¹⁸³ sets out principles, objectives and priorities for USAID climate change assistance from 2012 through 2016. The overarching strategic objective is to help developing countries speed their transition to climate resilient, low emission, sustainable economic growth.

In 2014, USAID published “A framework for understanding and addressing climate change”.¹⁸⁴ It suggests that climate-resilient development is about adding considerations of climate variability and climate change to development decision-making in order to ensure that progress toward development goals now includes consideration of climate impacts. The framework is relevant to the full range of infrastructure investments and covers five stages; scope, assess, design, implement and manage and evaluate and adjust (Figure 13).

USAID also plays a key role in improving access to climate services globally by supporting the Climate Services Partnership (CSP). CSP matches decision-makers with useful information on climate, weather and vulnerability in order that robust adaptation strategies can be developed.

USAID has been co-financing a significant number of PPPs over the last few decades. It is estimated that USAID has engaged with around 1,600 PPPs since 2000. As a result, of an estimated \$3.8 billion invested by USAID between 2001–2014, a further \$10.3 billion was raised by ‘non-AID entities’, producing an average ratio of approximately 1 to 3.7. Global Development Alliances (GDAs) are USAID’s favored model for public-private partnerships. There are a number of tools and publications produced by USAID in order to facilitate the process of building such partnerships. There are for example, sector specific guides covering energy, health, water and extractives, among others.

The energy and water guides both make direct reference to the use of PPP to fund adaptation activities. The guidance suggests that USAID would be able to leverage internal and third party expertise and offer access to ‘toolkits’ that address the impacts of global climate change and the

FIGURE 13: USAID's Climate-resilient development framework.

Source: USAID, 2014.¹⁸⁵

possibilities for mitigation and adaptation. This is consistent with USAID's climate change adaptation plan, which itself does not make an explicit link to PPP as a tool to facilitate climate resilience.

United Kingdom Department for International Development (DFID) & UK government

Climate change adaption is a strategic priority for DFID. Through funding of a number of international development program and research, DFID is increasing the knowledge and evidence available on climate change and helping people take action, particularly in agriculture, cities and infrastructure, water resources and disaster risk reduction.

In partnership with the ADB and IFC, the UK government (DFID, the Department for Climate Change (DECC) and the

Department for Food and Rural Affairs (Defra)) has invested in the Climate Public Private Partnership (CP3). CP3 consists of two commercially run private equity funds which aim to "mobilize new sources of finance, such as pension funds, in to low carbon, climate-friendly projects." The expectation is that equity investment made by the CP3 funds will be matched by equity and debt from private sources at a ratio of 30:1. One of the key outcome indicators of the CP3 funds is an increase in the overall size of annual private sector investment in adaptation. By demonstrating a workable PPP, the CP3 Platform will set a replicable precedent for cooperation between private and public sectors in climate finance. Grant technical assistance is also available which helps "remove risks of first mover disadvantage and other market failures".

DFID directly funds the “Climate and Development Knowledge Network” (CDKN), which operate in over 40 countries to help public, private and non-governmental decision-makers to develop new policies, introduce new technologies and get funding. CDKN focuses on four strategic themes:

1. Climate compatible development strategies and plans;
2. Improving developing countries’ access to climate finance;
3. Strengthening resilience through climate-related disaster risk management; and
4. Supporting climate negotiators from the least developed and most vulnerable countries.

During 2013–14, CDKN has overseen 164 projects, and over the 4 years the Network has been running, total expenditure has been approximately £57 million.

In 2013, CDKN funded some research on private sector engagement in disaster risk management and climate resilience.¹⁸⁶ The project analyzed over 100 examples of innovative public-private partnership and private sector initiatives. The resulting report “Resilience in Action: Lessons from Public-Private Collaborations around the World”¹⁸⁷ distills lessons learned from this analysis and showcases nine innovative, successful case studies. These case studies show how innovative collaborations can make communities, economies, and businesses more resilient to existing and emerging threats. They demonstrate how a wide array of players are involved in resilience-building activities, including government entities ranging from local authorities to international development organizations, and businesses of all sizes from micro-enterprises to multinationals. The collaborations span the full spectrum of sectors and industries most critical for building resilience: agriculture, housing, information and communication technology, health, fishing and aquaculture, transportation, tourism, water, financial services, waste and energy. Through this research six success factors were identified as key considerations for policy-makers seeking to drive greater resilience through public-private collaborations:

1. Build on a foundation of local engagement and trust;
2. Start small and local, but position for scale and replicability;

3. Integrate skill building to maximize community ownership;
4. Build adaptive capacity by strengthening businesses and livelihoods;
5. Create partnerships along—or across—value chains; and
6. Find innovative alternatives to traditional infrastructure.¹⁸⁸
7. Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ) & German government

GIZ implements the climate policy commitment of the German Government and other donors, translating it into practical interventions. GIZ provides advisory services in adapting to climate change, climate financing and mitigating greenhouse gas emissions. Through GIZ’s climate change adaptation program, they support governmental and non-governmental actors in accessing and using climate—relevant information, in conducting climate risk and vulnerability analyses, in identifying, prioritizing and implementing appropriate adaptation measures,¹⁸⁹ and in establishing systems to specifically monitor and evaluate adaptation measures. GIZ also works with partner countries that are interested in systematically incorporating climate risks in their planning and decision-making processes, e.g. within the framework of their national adaptation plans (NAPs).

Under their climate financing program, GIZ acknowledges that public funding alone is not enough to realize the needs of international infrastructure development. GIZ offers a range of support services for companies on tools and processes for cooperation with the private sector and there are some case-study examples of PPPs to support climate change adaptation in the tea and coffee sectors in Kenya¹⁹⁰ and olive industry in Tunisia.¹⁹¹

The German Federal Ministry for Economic Cooperation and Development (BMZ) administers the ‘develoPPP.de’ program which “fosters cooperation between the private sector and development policy for the mutual benefit of both parties”.¹⁹² Since 1999 BMZ has launched more than 1,500 cooperation arrangements of this type in over 70 developing countries and emerging economies and climate change is highlighted as a focal point.

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