Overview climate proofing approach of infrastructure investments

Investment cycle steps	Description of the investment activities		Climate Risk Management			
			Scoping for climate proofing	**Risk Assessment**	**Risk Treatment**	**M&E**
Investment planning at the basin level	**Diagnostic analysis/baseline survey of the basin key figures:** Definition of system boundaries, collection and analysis of data/information, identification & prioritization of the transboundary problems, determination of the environmental and socio-economic impacts, analysis of the immediate, underlying, and root causes, Development of thematic reports		<u>Relevance of climate proofing:</u> Climate change and variability adds to the definition, characterization, and prioritization of transboundary problems in the basin, including the environmental and socio-economic impacts. <u>Key question:</u> How is climate and change characterized at a basin level and how does climate change potentially add to the identified problems and challenges in the basin?	<u>Risk assessment purpose:</u> Identify climate trends in the specific catchment or sub-catchment, including historic and future estimates of changes in key variables and hydrology (rough comparison of water availability compared to demand) and define levels of risk for the identified problems / challenges in the basin. <u>Approach</u> GCMs and RCMs (Global and Regional Climate Models) for the basin and sub-basin in the near and far future (30 years, 60 years, etc.) to be developed for identified key climate variables that are relevant for key sectors and prioritized problems / challenges. Risks are ranked using a defined scale.	Define how climate change needs to be considered for the Catchment Planning Process Use the results and mainstream them into the Basin Development planning process or other related investment planning process at the national level.	Review the updates on the GCMs, RCMs and Remote sensing Data on the Catchment
	Basin Development Plan (BDP): Rough proposal of infrastructure projects Basin development plan strategies, strategic objectives for investments, proposal of projects, water supply analysis and scenarios, rough cost estimates, overall risk assessment (multiple stressors) in the basin that affects proposed projects		<u>Relevance of climate proofing:</u> Climate can have significant impacts on water supply in a river basin, or sub-catchment. River basin plans must incorporate climate considerations to propose the most viable mix and types of infrastructures to ensure the sustainable energy and water supply. <u>Key questions:</u> • Do current investment policies, plans and regulation increase the risk of climate change impacts on the physical structure and the service expected by hydropower, irrigation, and water supply? • Are the types of infrastructure projects proposed and their anticipated services being potentially impacted by climate change? • What types of infrastructure at the basin level are needed that at best provide efficiently and	<u>Risk assessment purpose:</u> Laying open the observed and future climate risks in the basin with respect to reliable energy and water supply. <u>Approach</u> • Analysis of types and causes for past climate impacts on existing physical structure of water infrastructures, and past service reliability performances, e.g., in same basin or similar configured basins. • Water supply scenarios in the basin and sub-basin and identify risks that the anticipated service of the proposed structures will meet the demand, considering the best operational practices of these infrastructures.	Identify, propose, and select measures to develop climate resilient BDPs or national plans and policies where types of projects are proposed that provide the intended service during their anticipated lifecycle and define climate change induced operational requirements at a basin level (dam cascades and implications etc.). Mainstream and use the results into the entire BDP and especially into risk Assessment chapter of the BDP and modify BDP as appropriate on strategic objectives, proposal of recommendations for action and define how climate change needs to be considered for the project identification and preparation phase	Develop a monitoring system of climate risks in the respective basin, closely monitor climate impacts such as the documentation of experienced damage and service reliability performances of the infrastructure projects implemented for periods of planning cycles

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			effectively reliable energy, water supply and irrigation under climate change conditions?	• Roughly estimating risk of service performance failing reaching project goals such as expected demand, supply of the services being provided, or Net present value (NPV) or Internal rate of return (EIRR).		
Project identification	**Pre-feasibility studies:** Studies (reconnaissance) of alternative locations for a project to be realized are being carried out to narrow down the most viable options *(e.g.,* 5 locations shrinking to 2*).* In this process IESEs (Initial environmental and social examination) are being carried out for each alternative location. The environmental and social appraisal will assess whether the project is capable of being implemented in accordance with the ESP and the PRs and include the assessment of the potential financial, legal, and reputational risks as well as identify potential environmental or social opportunities. The appraisal will be appropriate to the nature and scale of the project, commensurate with the level of environmental and social impacts and issues.		Relevance of climate proofing: Next to an IESE study, that roughly estimates the social and environmental consequences of a project at a certain location, also climate change can be a decisive factor for influencing compliance with requirements for project feasibility (design, costs, service reliability)? Key questions: • How do the climate risks at proposed alternative project sites compare with regard to financial feasibility & service reliability?	Risk assessment purpose: A comparative climate impact assessment on specific alternative project sites in the sub-basins allows factoring in climate considerations in project site specific financial feasibility & service reliability. Approach: • Simple but comprehensive climate risk matrixes that ranks climate risk across multiple locations and explores the best and least performing project sites under conditions of climate change (e.g., Net present value or Internal rate of return). • Incorporate site specific climate impacts into the assessment scheme to estimate hazard potentials. Elaborate on context specific hazards triggered by hydrometeorological events such as Sub-Catchment Probable Maximum Flood (PMF) estimation, landslides, sedimentation, heat stress etc.	Select most appropriate project site with best NBV and EIRR considering climate change as an additional factor; and conduct resilience framing for the project (type of dam, necessary operational features, etc.) to ensure the resilience framing for the project preparation phase.	Monitor & re-assess whether key criteria for the investment are valid or need to be changed due to changing climate conditions

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Project preparation	**Feasibility studies and detailed design:** • Economic and finance Analysis (EFA) and Environmental and Social Impact Assessments (ESIA) for remaining candidate projects are being executed to determine their viability and select the best performing project and location. • During the detailed design, the information from the feasibility study stage is extended and supplemented to provide detailed final plans and specifications from which tenders can be invited and construction contracts awarded.		Relevance of climate proofing: Economic viability, service reliability and climate resilient design parameters and operations must be assured during the entire life cycle of the project. Key questions: • How and to what degree are to be developed infrastructure assets (and their components) and their operational procedures potentially under risk of climate change? • How does a climate resilient design have to look like?	Risk assessment purpose: Detailed risk assessment (climate stress test or PIEVC Protocol) that informs the overall feasibility and design of the project, including service reliability and structural architecture and design. Approach: • Single location detailed simulation of changes in service provision under future climate conditions (e.g., discharge, floods and floods return periods, evaporation, sediment loads, slope stability, etc.). • Risk assessment of specific structural and operational components and services of the identified project, other than comparing risks and opportunities for alternative projects and project sites.	Identify and select measures for the climate resilient budgeting, design, operation and maintenance of the infrastructure investment Mainstream selected measures Into the budgeting, design, operation and maintenance of the infrastructure investment	Re-Assess whether identified measures have been proofed successful and viable
Resource Mobilization	In the Resource Mobilization phase, projects are seeking funding and approval. This typically calls for high levels of detail. Funders and regulators want to have a precise understanding of the project. Fortunately, the design is complete and high levels of data detail are available.		Relevance of climate proofing: For mobilizing funding and negotiating insurance schemes, nowadays climate proofing is a requirement. The project planners, designers and future operations must proof that the financial proposal is resilient. As such it should be possible to establish the probability of the project not meeting a given financial criteria within a given time horizon. Climate proofing may require additional capital investments (depending on the adaptation or mitigation measures that are adopted. Key questions: How financial/economic metrics fare under different climate scenarios?	Risk assessment purpose: Demonstrating the financial performance of the project and quantify residual risks under different climate scenarios and make transparent the nature and costs of different types of adaptation measures proposed in the design. Approach • Use results of the climate stress test and update risk matrix documenting which risks have been identified and treated within the chosen climate scenario and financing strategy. •	Climate resilient insurance policy covering climate risks (monetary loss) identified and contracted.	Re-Assess whether policies contracted cover current & future climate risks

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Construction	The Implementation and Construction phase of the project generally requires high levels of detail. At this stage, the project is tendering, construction is underway, and manuals and guidance are being prepared.		Is climate change impacting the "business continuity" of constructing the infrastructure. How are construction site specific set-ups vulnerable to extreme events?	Monitoring climate hazards as a so- called early warning system is required to prevent damage in the course of construction period. No new risk assessments are expected at this stage except if major design modifications and site management practices become necessary, e.g., because the period between the feasibility study and the construction was significantly big (e.g. 10 years or more) and new findings on climate change impacts had been identified. In this case the type of risk assessment described in project preparation applies.	Development of standard operating procedures (SOPs) for the construction site with regard to warning and immediate response options to protection of assets and people in case of climate related extreme events. approaches to mitigating runoff from and sedimentation because of cleared ground may require different climate analyses than what would have been conducted to inform project design and, later, operations. In such cases, the new designs may have to be checked for their resilience using the approach defined under the project preparation stage. Implementation of SOPs for the construction site with regard to warning and immediate response options to protection of assets and people in case of climate related extreme events	Re-Assess performance of these SOPs
Operation & Maintenance	The operation stage commences once a project is commissioned. The Operation and Maintenance phase covers four key activities: (1) the operation of the project; (2) maintenance; (3) refurbishment, and (4) ultimately the end of useful life and retirement of the project		Is the performance of the infrastructure potentially under risk due to climate-related hazards? The long lifespan of certain assets means that climate hazards and the exposure to those hazards can change. Several types of climate proofing during operation, monitoring and maintenance exist, such as physical structure, health and safety policies, asset monitoring and maintenance systems in place	Continuous performance and vulnerability assessment (physical design, operations) under conditions of climate change (similar to risk assessment in project development phase)	In case changes in risks are identified, identification and selection of measures to increase the resilience of the project Implementation of operation-related measures to increase the resilience of the project	In case changes in risks are identified, provide feedback into the entire investment cycle where appropriate