ALTIOREM EXPERT GUIDE

Understanding climate finance for resilient infrastructure

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Table of Contents

Introduction

Climate change presents unparalleled challenges to the world through rising temperatures, shifting weather patterns, and increased frequency and severity of natural disasters. A country's infrastructure is usually directly affected – from telecom and digital connectivity, to roads, bridges, houses and supply chains -all suffer climate related damage which can take years and significant finances to rebuild. The resultant losses from weaker economic activity can extend into the billions, causing deeper problems from emerging markets. Without climate resilient infrastructure, communities are more vulnerable to the impacts of climate change, leading to economic losses, social disruption, and loss of life.

Climate finance refers to the financing of mitigation, adaptation and resilience strategies. In fact, all infrastructure should be viewed with a climate lens. However, the mobilisation of adequate climate finance has a lot of challenges, especially in developing countries where resources are limited, yet the need for resilient infrastructure is most urgent. This expert guide identifies the major debates in resilient infrastructure climate finance, including adaptation versus mitigation, innovations in financing tools, and country and project-level challenges. Teasing out these debates, the guide gives insight into how climate finance will be integral in fundamentally building a sustainable and resilient future. *

* This guide is for informational purposes only and does not constitute professional, financial, or investment advice.

Key insights

1. **The growing need for resilient infrastructure**: Climate change is increasing the frequency and severity of natural disasters, making resilient infrastructure essential to safeguard communities and economies.

2. **Balancing adaptation and mitigation**: Climate finance must address both adaptation (building infrastructure to withstand climate impacts) and mitigation (reducing emissions), with resilient infrastructure bridging both approaches.

3. **Innovative financing mechanisms**: Green bonds, blended finance, and climate insurance are crucial tools in mobilising private investment and reducing risks associated with climate-resilient infrastructure projects.

4. **The role of nature-based solutions (NbS)**: Integrating nature-based solutions, like mangrove restoration and floodplain management, enhances resilience while promoting biodiversity and sustainable development.

5. **The climate finance gap**: The current level of climate finance is insufficient to meet global needs, particularly in developing countries, where the vulnerability to climate change is most urgent.

6. **Public and private sector collaboration**: Governments, financial institutions, and private sector partners must collaborate to scale up investment in resilient infrastructure, leveraging public funding to attract private investment.

7. **Need for capacity building among financial institutions and project owners**: Strengthening the knowledge and skills of financial institutions and project owners is essential for effectively designing, financing, and implementing climate-resilient infrastructure projects.

8. **The economic benefits of resilience**: Investing in resilient infrastructure provides substantial economic returns, with estimates suggesting that every $1 spent on adaptation can yield $2 to $10 in avoided costs.

9. **High initial costs vs. long-term benefits**: Although resilient infrastructure requires significant upfront investment, the long-term benefits far outweigh the initial costs, reducing disaster recovery expenses and boosting productivity.

10. **Protection for vulnerable communities**: Climate-resilient infrastructure directly benefits the most vulnerable communities by providing essential services and reducing the risks posed by extreme weather events, thus improving social equity.

What is climate finance for resilient infrastructure?

Types of climate finance: Adaptive, mitigative and resilient

Adaptive climate finance supports projects that focus on building infrastructure that manages the immediate impacts of climate change, including flood defences and climate-resilient roads thereby reducing loss and damage.

Mitigative finance is directed at reducing emissions and dampening global climate events caused by fossil fuel burning through projects such as energy transitions to renewable energy development, energy efficiency improvements, and carbon capture.

Resilient infrastructure finance brings together both adaptation and mitigation strategies; it supports energy-efficient and flood-resistant transportation systems which have the potential to both lower emissions and sustain themselves against climatic risks.

Nature-based solutions (NbS) are a vital aspect of adaptive finance in the context of climate-resilient infrastructure. These solutions leverage natural ecosystems, such as forests, wetlands, and mangroves, to mitigate the impacts of climate change while promoting biodiversity and sustainable development. Adaptive finance mechanisms, like green bonds and impact investment funds, support large-scale forestry and replantation drives, which sequester carbon and provide economic benefits through sustainable forestry practices. By integrating NbS into infrastructure planning, adaptive finance helps create sustainable, cost-effective solutions that align with global climate goals.

To tackle the climate finance gap, the financial sector is creating tools to draw in private money and cut down investment risks.

- Green bonds support clean energy and environmental projects resilient to climate impacts.
- Climate insurance provides financial protection against climate-related losses, particularly in sectors like agriculture, reducing investment risks.
- Blended finance combines public and private funds to lower investment risks by offering concessional loans, grants, or guarantees from governments and development banks, making projects more attractive to private investors.
- Microfinance Banks (MFBs), Development Finance Institutions (DFIs) and climate funds (e.g., the Green Climate Fund, GCF) play a crucial role by providing technical assistance and financial options. MFBs extend microloans to communities, particularly in emerging economies, to invest in climate-resilient technologies like sustainable agriculture, renewable energy, and water management systems.

DFIs attract private capital for green infrastructure by offering blended finance schemes, credit enhancement, and de-risking instruments, including viability gap funding, first-loss provisions, and contingent or A/B loans. Together, MFBs, DFIs, and the GCF bridge the climate finance gap and promote sustainable, resilient growth.

The case for climate finance for resilient infrastructure

Increasing frequency and intensity of extreme weather events

Climate change is becoming more severe and widespread, with extreme weather events such as floods, droughts and heatwaves occurring more frequently and with greater intensity. These events pose significant risks to our current infrastructure, which is often not designed to withstand such events. Without designing buildings with energy-efficient features to adapt to changing temperature patterns or constructing roads with effective drainage system to tackle flooding, the economic and social costs of climate change are expected to rise dramatically, leading to widespread disruption and loss of life.

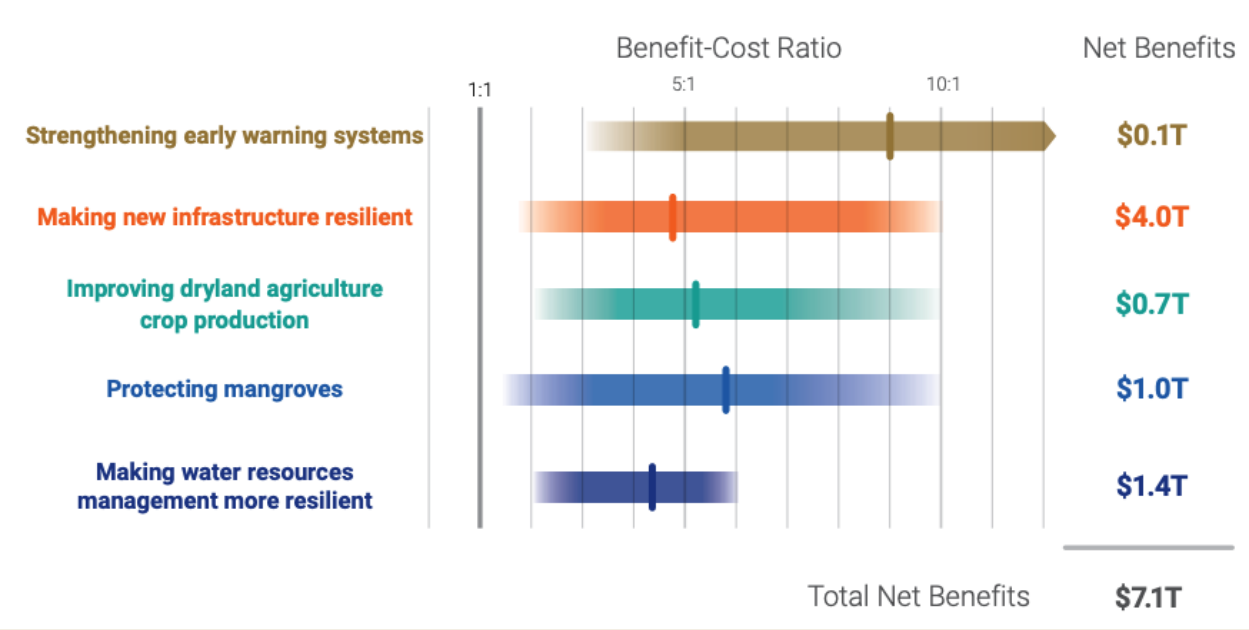
Contribution to Sustainable Development Goals (SDGs)

Investments in infrastructure will be instrumental in meeting the SDGs and achieving economic growth. Climate Action (SDG 13) plays a pivotal role in unlocking synergies across various goals. By supporting initiatives to enhance resilience such as renewable energy and climate resilient infrastructure, vulnerabilities to climate-related shocks like floods and droughts are reduced – helping to protect vulnerable populations from climate induced economic losses and promoting resilient agriculture and food securities, addressing SDG 1 (No Poverty) and SDG 2 (Zero Hunger). Additionally, through investments in water management systems, health risks associated with climate impacts are mitigated, addressing SDG 3 (Good Health and Well-Being) and SDG 6 (Clean Water and Sanitation). Climate finance accelerates the adoption of renewable energy and sustainable urban planning, supporting SDG 7 (Affordable and Clean Energy) and SDG 11 (Sustainable Cities and Communities). Furthermore, fostering global partnerships (SDG 17) and empowering vulnerable groups ensures inclusive, equitable progress across economic, social and environmental dimensions. The SDGs relating to infrastructure, sustainable cities and climate action depend heavily on climate finance. Without sufficient funding for climate change adaptation, these objectives would not advance as quickly.

Economic benefits

Investing in resilient infrastructure offers substantial economic benefits. According to the Global Commission on Adaptation, investing $1.8 trillion globally in five areas from 2020 to 2030 could generate $7.1 trillion in total net benefits. The benefit to cost ratio of such projects range between 2:1 to 10:1. These benefits include avoided losses, increased economic productivity and reduced disaster recovery costs.

Additionally, resilient infrastructure projects often create jobs and stimulate local economies, further contributing to sustainable development.



Source: Fig.1 'Benefits and Costs of Illustrative investments in Adaptation' *from* Global Commission on Adaptation (2019) **Adapt now: A global call for leadership on climate resilience** (*See original source for graph note).*

High cost of inaction

One of the key reasons adaptation planning is often delayed is the apparent 'cost savings'. Determining the costs of inactivity, however, is more difficult since it entails a lot of unknowns, including the scope and timing of catastrophic climate events, what is at risk, and the potential financial losses if those risks materialise. The World Economic Forum has estimated that for every $1 spent on adaptation action now, there is avoided costs of $2 – $10 in the future. Acting now can therefore be viewed as an investment for the future. The cost of inaction is quite substantial. These costs include not only direct damages to infrastructure but also broader economic impacts such as lost productivity, increased poverty and social instability.

Co-benefits of resilient infrastructure

Investment in resilient infrastructure offers numerous co-benefits aside from a direct economic return. This contributes to positive public health through access to clean water, sanitation and healthcare facilities, as well as reducing vulnerability to climatic hazards such as floods and heatwaves. With job generation not just at construction sites but also in renewable energy industries and technology industries, it supports more jobs and stimulates local economies. Resilient infrastructure therefore increases social equity by realising dependable transportation, energy and communication systems in underserved communities. This contributes to reduced disparities in access to primary services. Secondly, it contributes to mitigating climate impacts, benefiting particularly vulnerable populations who are most at risk from environmental hazards.

Protection of vulnerable communities

Resilient infrastructure is critical in protecting vulnerable people from climate change impacts by factoring in their level of preparedness against extreme weather and environmental changes. Climate-resilient

infrastructure, such as flood barriers, stormproof housing, and drought-resistant water systems, lowers the degree of damages contributed by rising sea levels, heatwaves, floods, and storms. The most helpless segments of communities usually settle within low-income or disaster-prone areas that have been worst hit by this impact of climate change. Resilient infrastructure offers protection to these communities with the provision of essential services like clean water, electricity, healthcare and transport whenever the events hit hard. This has gone a long way in reducing economic losses, saving lives, and fostering long-term stability.

Addressing the climate adaptation funding gap

The economic case for resilience is strong, and the need for resources is clear. Yet money is not flowing at the scale needed. Climate risk has been and continues to be ignored in most investment decisions. Therefore, to better finance the required adaptation actions, a revolution in finance is needed to mobilise funding into climate-resilient infrastructure. According to the Global Commission on Adaptation, the financing needs to focus on four major areas:

- Resilience needs to be built into financing decisions from the beginning and not considered as a climate finance add-on after other financing decisions have been made.
- Public sector needs to recognise its role as an essential provider and enabler of finance for adaptation actions for the foreseeable future.
- Private sector has a critical role to play, not only on its own account but to complement the public sector.
- There is a critical need for higher levels of international financial support for adaptation in developing countries. By creating infrastructure that can adapt to changing climate conditions, governments and organisations can attract private sector investments, leveraging public funding to close the adaptation funding gap.

Challenges and barriers of climate resilient infrastructure

"Despite the growing recognition of the importance of climate finance, several major hurdles hinder its effective deployment for resilient infrastructure projects." – Maheen Rahman

Lack of sufficient funding

Funding inadequacies is among the major hurdle faced in effective implementation of resilient infrastructure projects. It is important to note that significant amounts of money have been mobilised for climate mitigation, but not enough attention is paid to adaptation projects which promote building resilient infrastructure. This is partly because it is difficult to show the economic returns made from these projects, making them less viable options for investors.

Low ROI due to high cost

One of the significant challenges in developing climate-resilient infrastructure are the real and perceived high initial costs result in a lower return on investment (ROI) in the short term. The capital-intensive nature of climate-resilient projects — such as constructing flood-resistant buildings, reinforcing coastal zones, or implementing renewable energy systems — demands substantial upfront investments. These costs can deter private investors and governments due to the extended time frames required to realise financial returns. Additionally, uncertainties around climate impacts and regulatory changes can exacerbate the financial risk, further dampening enthusiasm for investment. While the long-term benefits of climate resilience are clear, the financial burden of high initial costs remains a critical barrier to scaling such infrastructure projects globally.

Problem of greenwashing

Essentially, greenwashing is false advertising. If a company is putting more time and resources into marketing its climate commitments than making changes to meet those commitments, it's greenwashing. Companies or organisations may claim that their infrastructure initiatives are eco-friendly or contribute to climate adaptation, while they offer minimal environmental benefits or even cause harm. As a result, greenwashing can lead to the misallocation of critical financial and policy support, slowing the adoption of genuinely sustainable and resilient infrastructure solutions, and ultimately delaying progress in addressing climate change.

Explore Altiorem's greenwashing resources.

Lack of global commitment

One of the significant hurdles in mobilising climate finance for resilient infrastructure is the lack of global commitment. Although instruments like the Paris Agreement have set ambitious targets on how much to reduce greenhouse gas (GHG) emissions or finance climate initiatives, their implementation is often disappointing. In fact, many developed countries did not fulfil their financial pledges made to support developing nations in constructing climate-resilient infrastructures. Furthermore, the absence of enforceable mechanisms to ensure that nations adhere to their climate finance pledges results in William varied contributions. Among emerging markets, this is especially obvious since needs for finance are at higher levels but still no worldwide commitment has been made hence these areas become more

vulnerable to climate change. Without unified and coherent global actions, the gap between available climate finance and the need for resilient infrastructure just keeps expanding, hindering progress.

Inadequate data on climate risks

Another big challenge in achieving climate resilient infrastructure is the lack of appropriate data on climate hazards. Infra investors and authorities are in effect facing a global data emergency, with grossly inadequate collating and processing of relevant data. Planning and designing resilient infrastructure projects are challenging in the absence of relevant data on the possible effects of climate change. Additionally, it is challenging to evaluate the risks involved with these initiatives and to entice private sector involvement due to the lack of data.

Lack of standardised methodologies

The absence of standardised methods to assess climate risks and measure resilience complicates comparisons and the effective implementation of infrastructure projects. Impact metrics are essential for adaptation finance, as adaptation costs don't reliably indicate benefits. For instance, the impact of a drought-resilient wastewater system varies greatly between drought-prone areas and regions with adequate rainfall, making cost-based impact estimates unreliable. Current methods aim to improve impact measurement but lack a focus on infrastructure, especially climate-resilient projects. This lack of standardisation also discourages private investment, as investors prefer projects with predictable outcomes.

Lack of understanding among investors

Another significant challenge in promoting climate-resilient infrastructure is the limited understanding among investors about the long-term benefits and financial returns of such investments. Many investors prioritise short-term gains and are reluctant to commit capital to climate-resilient projects, which often involve high upfront costs and longer payback periods. Without a clear understanding of how climate-resilient infrastructure can mitigate risks and deliver sustainable returns over time, investors may miss opportunities to contribute to projects that enhance societal resilience while addressing the growing climate crisis.

Policy and regulatory challenges

Effective policy should guide decision-makers across government and the private sector in adapting to climate change, while ensuring frameworks don't hinder adaptation efforts. However, unclear roles and responsibilities among stakeholders create uncertainty. Without robust policy and regulatory frameworks, it's challenging to foster an environment conducive to climate finance. Clear guidelines, incentives, and risk-sharing mechanisms are essential to attract investment in resilient infrastructure.

How to mobilise climate finance for resilient infrastructure

This section sets out a practical roadmap for scaling climate finance for resilient infrastructure. Unlike other Altiorem Expert Guides that focus on immediate organisational action, this guide addresses systemic stakeholders. Drawing on expert practice, it outlines practical actions, identifies barriers and enablers, and sets impact markers that reflect progress.

The framework draws on the COM-B behavioural model (Capability, Opportunity, Motivation – Behaviour), which helps explain what enables or blocks change. To keep the roadmap clear and easy to follow, barriers and enablers are summarised in a consolidated table at the end of this section, rather than listed under each step. Readers can refer to that table for an overview of the challenges and supportive factors aligned to each objective.

International bodies

Objective

Build global consensus and set common standards for resilient infrastructure.

Why it matters

Global standards ensure consistency, harmonise efforts, and encourage widespread adoption of resilience principles.

Practical actions

Develop international guidelines

- Create frameworks that integrate climate resilience into infrastructure projects across sectors and regions.
- Example: The OECD's Guidelines for Resilient Infrastructure provide a starting point for global alignment.

Promote global coordination

- Facilitate collaboration through platforms like the UNFCCC, Green Climate Fund (GCF), and UNDRR's Sendai Framework.
- Establish global task forces to align goals across nations.

Mandate climate risk assessments

- Require large-scale infrastructure projects to include climate risk analyses.
- Example: The World Bank's climate risk screening tools are widely adopted.

Impact markers

- Uptake of harmonised resilience guidelines by member states.
- Number of countries mandating climate risk assessments for infrastructure projects.

Multilateral Development Banks (MDBs) and Development Finance Institutions (DFIs)

Objective

Scale up financial support and catalyse private investment in resilient infrastructure.

Why it matters

MDBs and DFIs can de-risk investments, attract private capital, and fund projects in high-risk regions.

Practical actions

Expand concessional financing

- Increase concessional loans and grants for adaptation-focused projects, particularly in vulnerable regions.
- Example: The African Development Bank's Adaptation Benefit Mechanism.

Provide technical assistance

- Develop capacity-building programs to help governments and developers integrate resilience into planning.
- Example: The Global Facility for Disaster Reduction and Recovery (GFDRR).

Innovative financial instruments

- Design tools like resilience bonds or blended finance models.
- Example: The Caribbean Catastrophe Risk Insurance Facility (CCRIF) uses pooled risk models to lower costs.

Create regional platforms

- Pool resources across MDBs, DFIs, and governments to finance large-scale projects.
- Example: The Asian Infrastructure Investment Bank's platform.

Impact markers

- Volume of concessional finance committed to adaptation projects.
- Number of resilience bonds and blended finance facilities launched.
- Amount of private capital mobilised alongside MDB/DFI investment.

Governments

Objective

Create robust climate finance frameworks to attract investment in resilient infrastructure.

Why it matters

Governments can reduce financial risk and create an enabling environment for long-term resilience.

Practical actions

Establish national climate funds

- Develop funds focused on financing resilient infrastructure projects.
- Example: Bangladesh Climate Change Resilience Fund pools donor contributions.

Coordinate with international bodies

- Work with MDBs and the GCF to channel resources effectively.

Implement financial incentives

- Use tax credits, subsidies, and guarantees to reduce private sector risks.
- Example: India's Viability Gap Funding program supports PPPs in resilient projects.

Develop Public-Private Partnerships (PPPs)

- Facilitate co-investment by partnering with private firms.
- Provide training to public officials to structure effective agreements.
- Example: The UK's Thames Estuary 2100 project integrates public and private funding for flood resilience.

Impact markers

- Number of national climate funds established and operational.
- Uptake of PPP models in resilience projects.
- Private investment leveraged through fiscal incentives.

Regulatory bodies

Objective

Enforce mandatory resilience planning in infrastructure projects.

Why it matters

Regulatory enforcement ensures resilience planning becomes a standard part of infrastructure development.

Practical actions

Develop policies for climate risk assessments

- Require infrastructure projects to assess vulnerabilities to climate change.
- Example: Singapore mandates climate risk disclosures for large developments.

Align national policies with international standards

- Incorporate frameworks like the Sendai Framework into national guidelines.

Conduct compliance audits

- Establish monitoring programs to ensure adherence to resilience requirements.
- Publish public reports to enhance transparency.

Impact markers

- Proportion of new infrastructure projects incorporating mandatory climate risk assessments.
- Number of compliance audits conducted and reported annually.

Private sector

Objective

Integrate climate resilience into investment decision-making and ESG strategies.

Why it matters

Private capital is essential to bridge the funding gap for resilient infrastructure.

Practical actions

Perform climate risk assessments

- Use frameworks like TCFD to evaluate risks and opportunities in infrastructure projects.
- Example: The European Investment Bank uses detailed risk modelling.

Invest in resilience bonds

- Allocate portfolios toward financial instruments focused on resilience.
- Example: Zurich Insurance's investments in resilience-focused bonds.

Collaborate with public entities

- Use government guarantees to de-risk investments in adaptation projects.

Impact markers

- Growth in resilience-focused financial instruments in investor portfolios.
- Evidence of private sector uptake of government guarantees for resilience projects.

Infrastructure developers

Objective

Incorporate resilience planning into the project lifecycle.

Why it matters

Developers are the frontline implementers of resilient infrastructure projects.

Practical actions

Conduct vulnerability assessments

- Evaluate risks using tools like the CRIDA framework (Climate Risk Informed Decision Analysis).

Use adaptive designs

- Incorporate modular and flexible designs to withstand climate variability.
- Example: The Netherlands' Room for the River programme designs for increased flood capacity (mentioned in Case studies section).

Monitor and maintain infrastructure

- Use IoT and predictive analytics to track performance and identify maintenance needs.

Impact markers

- Number of infrastructure projects integrating adaptive design features.
- Monitoring and maintenance systems deployed across projects.
- Reduced incidence of climate-related infrastructure failures.

Barriers and enablers relative to each objective

Objective	Barriers	Enablers
Build global coordination through Nationally Determined Contributions (NDCs)	Fragmented international commitments	International agreements and peer pressure
	Lack of enforcement mechanisms	Technical and financial support for implementation
Increase interventions by Development Finance Institutions (DFIs) and Multilateral Development Banks (MDBs)	Limited capital flows to resilience projects	Concessional finance to de-risk private capital
	MDB risk aversion	Policy mandates prioritising resilient infrastructure
Establish in-country and global standards for resilient	Inconsistent definitions and benchmarks	Harmonisation of global standards

Case Studies

Coastal Embankment Improvement project (CEIP)

Coastal Embankment Improvement Project (CEIP) **2010 - present** **Focus area:** Disaster management **Country:** Bangladesh	**Problem:** Bangladesh's coastal regions are highly vulnerable to cyclones and flooding, affecting millions, especially women. **Solution:** The US$400 million CEIP upgraded 249 km of embankments, constructed 115 hydraulic structures, and improved water management systems to boost resilience. **Outcome:** 402,680 people (50% women) are better protected, agricultural productivity rose by 178.2%, and 141 water management groups ensure sustainability. Click to read more

Shams Power Solar Project

Shams Power Solar Project **2022** **Focus area:** Power **Country:** Pakistan	**Problem:** Pakistan faces energy shortages and high dependence on non-renewable energy sources. **Solution:** A US$11.3 million investment funded 21 megawatts (MW) of rooftop and ground-mounted solar plants to connect users to the grid. **Outcome:** The project contributes renewable energy to Pakistan's grid, reducing reliance on fossil fuels. Click to read more

Africa GreenCo Renewable Energy Guarantee Facility

Africa GreenCo Renewable Energy Guarantee Facility 2020-2022 **Focus area:** Renewable energy **Country:** Southern Africa	**Problem:** Southern Africa relies heavily on coal-based energy, contributing to climate change. **Solution:** US$27 million in guarantees helped secure investments in renewable energy projects across the region. **Outcome:** Increased renewable energy capacity, contributing to greater energy security in Southern Africa. Click to read more

Mangrove Restoration Pakistan

Mangrove Restoration in Pakistan 1986-2020 **Focus area:** Protecting local communities and disaster management **Country:** Pakistan	**Problem:** Coastal erosion and storms threaten Pakistan's coastlines, worsened by climate change. **Solution:** Pakistan restored mangrove forests, expanding coverage by threefold since 1986. **Outcome:** The restoration enhanced coastal protection, supported biodiversity, and provided carbon sequestration benefits. Click to read more

Room for the River Program

Room for the River Program
2013-2018

Focus area:
Flood management

Country:
The Netherlands

Problem: The Netherlands faces flood risks due to high water volumes during peak events.

Solution: The program created space for rivers to expand naturally by relocating dikes, lowering floodplains, and creating flood channels.

Outcome: Reduced flood risks and enhanced biodiversity by restoring natural landscapes.

Click to read more

Conclusion

Building climate-resilient infrastructure is essential for addressing the increasing threats posed by climate change. As extreme weather events become more frequent and intense, investing in infrastructure that can withstand these impacts is crucial for protecting vulnerable communities and supporting sustainable economic growth. This guide has highlighted the importance of climate finance, focusing on the need for both adaptation and mitigation strategies in infrastructure projects.

While challenges such as funding gaps, high initial costs, and a lack of data remain, innovative financial mechanisms like green bonds, blended finance, and climate insurance are helping bridge the gap. Governments, private sector actors, and international institutions must work together to scale up investment in resilient infrastructure, ensuring that it becomes a cornerstone of climate action.

The case studies presented demonstrate the real-world impact of resilient infrastructure investments, offering valuable lessons for future projects. By continuing to refine financial tools and policies, we can overcome existing barriers and create a future where infrastructure not only survives climate challenges but thrives in the face of them.

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