CSTEP
CENTER FOR STUDY OF SCIENCE, TECHNOLOGY & POLICY

# Building Resilience in Power Sector

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Contributors: Indu K Murthy, Kritika Adesh Gadpayle, Vidya S, Pratima Bisen

Editor: Sreerekha Pillai

Designer: Bhawna Welturkar

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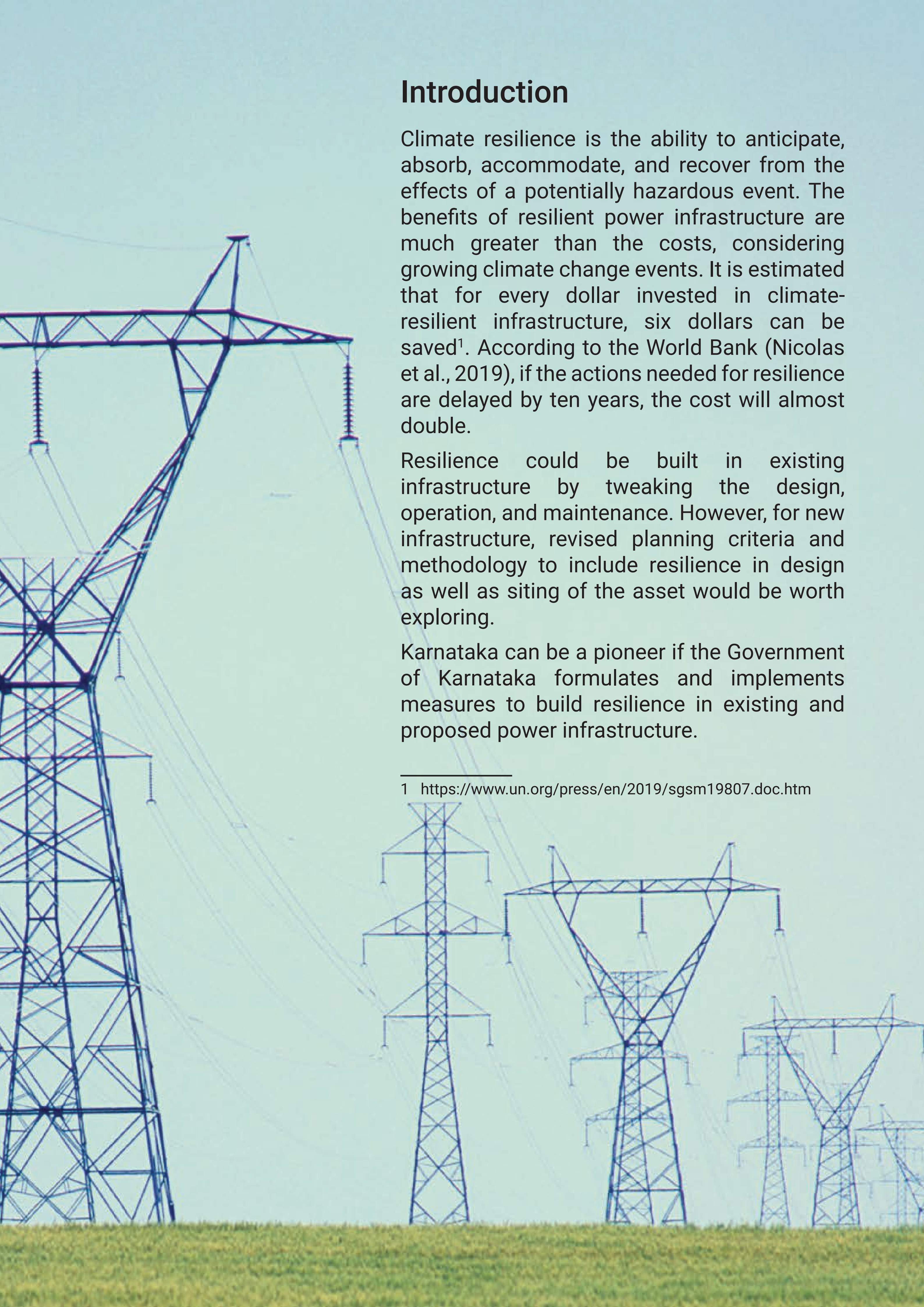
**Center for Study of Science, Technology and Policy**

| **Bengaluru** | **Noida** |
|---|---|
| 18, 10th Cross, Mayura Street<br>Papanna Layout, Nagashettyhalli<br>RMV II Stage, Bengaluru 560094<br>Karnataka (India) | 1st Floor, Tower-A<br>Smartworks Corporate Park<br>Sector 125, Noida 201303<br>Uttar Pradesh (India) |



# Introduction

Climate resilience is the ability to anticipate, absorb, accommodate, and recover from the effects of a potentially hazardous event. The benefits of resilient power infrastructure are much greater than the costs, considering growing climate change events. It is estimated that for every dollar invested in climate-resilient infrastructure, six dollars can be saved[1]. According to the World Bank (Nicolas et al., 2019), if the actions needed for resilience are delayed by ten years, the cost will almost double.

Resilience could be built in existing infrastructure by tweaking the design, operation, and maintenance. However, for new infrastructure, revised planning criteria and methodology to include resilience in design as well as siting of the asset would be worth exploring.

Karnataka can be a pioneer if the Government of Karnataka formulates and implements measures to build resilience in existing and proposed power infrastructure.

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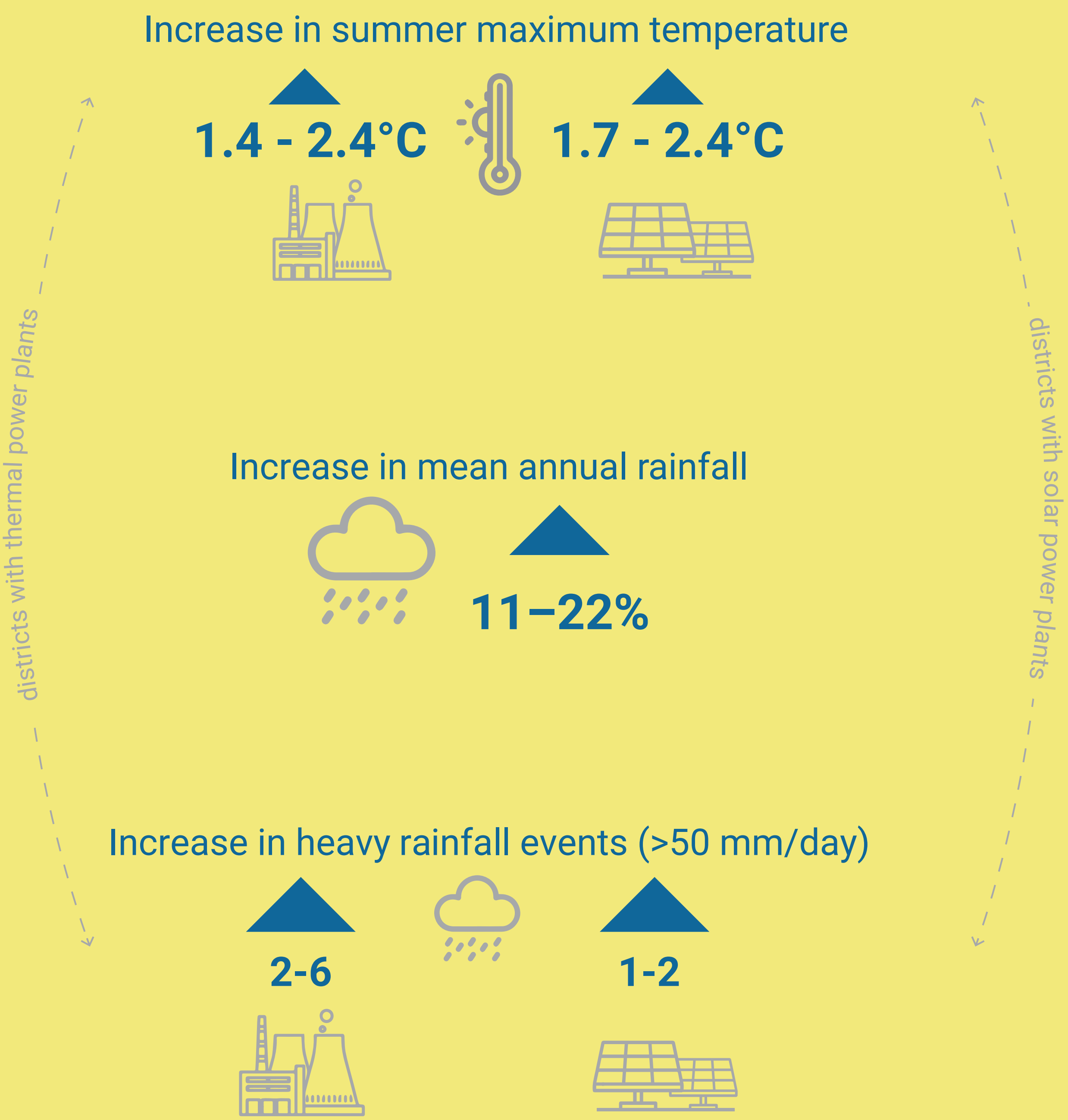
1 https://www.un.org/press/en/2019/sgsm19807.doc.htm

## Key Insights From CSTEP Study

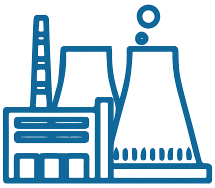
A study by Center for Study of Science, Technology and Policy (CSTEP) to assess climate risks to power infrastructure in Karnataka reveals that climate is projected to change in all the districts of the state during the 2030s (2021-2050) under a high-emission representative concentration pathway (RCP) 8.5 scenario (a scenario of the Intergovernmental Panel on Climate Change). The study found that districts with thermal and solar power plants will be subject to climate change as illustrated below.



# Climate Risks to Power Infrastructure

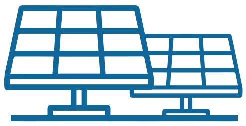
Climate risk is a function of the type, extent, and likelihood of a hazard, and vulnerability. A composite scoring method was adopted considering changes in summer maximum temperature and heavy rainfall events, along with the vulnerability criteria to categorise plants.

### Thermal Power Plants



Thermal power plants in Bijapur are at 'medium-high' risk; Raichur and Bellary plants, 'medium' risk, and the Udupi plant, 'very low' risk.

### Solar Power Plants



Solar power plants in all the eight districts fall in the 'low-medium' risk category.

### Increase in temperature and the related water shortage could cause

**0.4–0.7%**

likely reduction in thermal efficiency and reduced transmission efficiency because of additional resistance and increased conductor sag

**0.3–0.5%**

likely reduction in solar efficiency and material damage

### Increase in intensity and frequency of heavy rainfall events could cause

**Reduced boiler efficiency**

because of increased moisture content of coal and delay in coal supply as Karnataka thermal plants rely on interstate coal supply

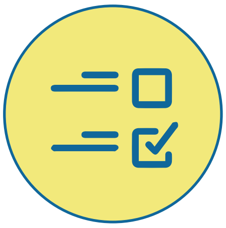
**30%**

likely reduction in solar efficiency due to dark rain clouds, and material damage

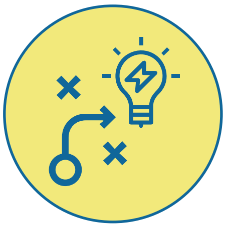
# Climate-proofing Existing Power Infrastructure

## How it Works?

Develop a Resilience Index considering climate change projections, infrastructure location, design, and past data on performance under extreme climate conditions



Survey periodically and review power infrastructure based on the Resilience Index



Create climate-proofing strategies for those infrastructure segments that do not meet the Minimum Acceptable Standard

Draft a Retrofit Code and impose legal liability on infrastructure that do not conform to the Minimum Acceptable Standard

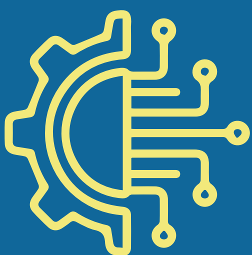
Adopt green infrastructure by pursuing a hybrid approach incorporating grey and green infrastructure models

# Adaptation Strategies for New Power Infrastructure

Develop a comprehensive data collection, integration, and dissemination network

Introduce climate insurance

Fund risk-assessment tools

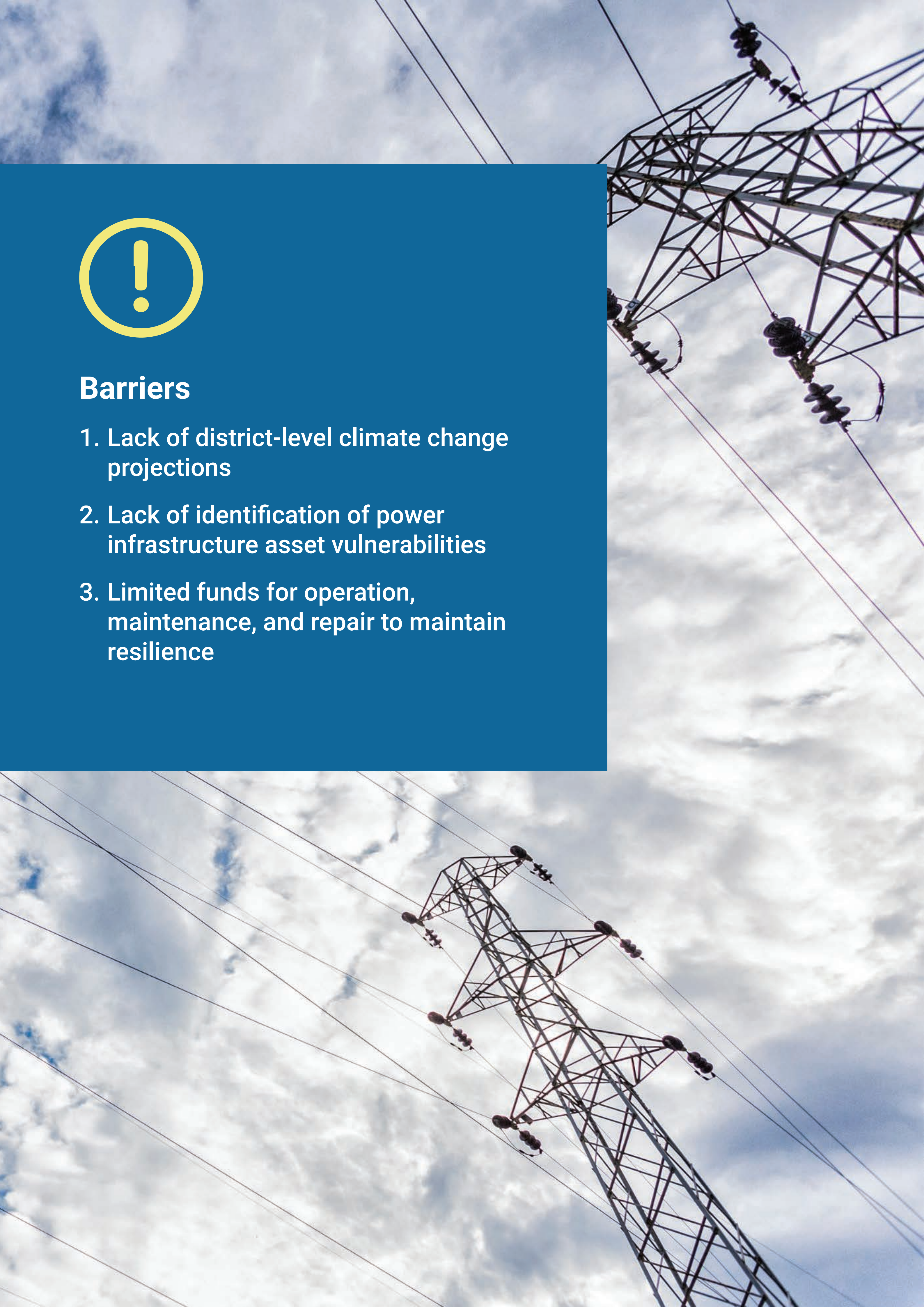


Establish a technological consortium to promote innovation, research, and development of technologies to achieve climate resilience

Legislation to build climate-resilient infrastructure in coastal regions, and a hybrid approach in high-risk non-coastal regions.

## Benefits

1. Reliable access to electricity supply
2. Lower maintenance and repair costs of power infrastructure
3. Lower life-cycle cost of power plants



## Barriers

1. Lack of district-level climate change projections
2. Lack of identification of power infrastructure asset vulnerabilities
3. Limited funds for operation, maintenance, and repair to maintain resilience

# Annexure

## Global Practices

### Appropriate climate information services

Many countries around the world are actively pursuing resilience measures. In the United Kingdom, once during every Parliament's tenure, a National Infrastructure Assessment[2] is conducted for assessing and outlining long-term needs for resilience building in existing and proposed infrastructure.

In Argentina, advance warning to climate hazards has helped avoid damage and loss, particularly in high-risk areas, where the government-developed website SIMARCC provides climate risk maps under different scenarios, to help plan better for and reduce climate vulnerabilities.

Peru's Disaster Management Centre carried out an assessment of hazards and vulnerabilities at the local level (UNDRR, 2015).

### Adjustment of Design Criteria

Technological interventions such as hardening of transmission and distribution infrastructure in New Zealand and grid upgradation in Tonga have demonstrated the potential to reduce damage and losses. Estimates show that the $6 million spent in New Zealand[3] to harden transmission and distribution infrastructure resulted in $30–50 million reduction in direct asset replacement costs. Similarly, in Tonga[3], which is highly exposed to cyclones, grid upgradation brought down the damage to 4.7%, compared to 45.9% damage in portions that were not upgraded. Thermal power plants have switched to air and dry cooling or recirculating systems from water cooling systems to cope with high temperature and water shortage (PGCIL, 2015).

2 https://www.apm.org.uk/media/18686/national-infrastructure-briefing-lr-pages.pdf
3 https://openknowledge.worldbank.org/bitstream/handle/10986/31910/Stronger-Power-Improving-Power-Sector-Resilience-to-Natural-Hazards.pdf?sequence=1&isAllowed=y

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1. Nicolas, C., J. Rentschler, A. Potter van Loon, S. Oguah, A. Schweikert, M. Deinert, E. Koks, C. Arderne, D. Cubas, J. Li, E. Ichikawa. 2019. “Stronger Power : Improving Power Sector Resilience to Natural Hazards.” Sector note for LIFELINES: The Resilient Infrastructure Opportunity, World Bank, Washington, DC.

2. Power Grid Corporation of India Limited (PGCIL). (2015). Building Climate Change Resilience for Electricity Infrastructure.

3. UNDRR (2015), Review of Peru Interim Report: Working Paper on Public Investment Planning and Financing Strategy for Disaster Risk Reduction, United Nations Office for Disaster Risk Reduction (UNDRR), Geneva, https://www.undrr.org/publication/unisdr-working-papers-public-investment-planning-and-financing-strategy-disaster-risk-1.

CENTER FOR STUDY OF SCIENCE, TECHNOLOGY & POLICY

**Bengaluru**
No, 12-14 & 18-19, 10th Cross, Mayur Street, Papanna Layout,
Nagashettyhalli (RMV II Stage), Bengaluru-560094
Karnataka, India

**Noida**
1st Floor, Tower-A, Smartworks Corporate Park, Sector-125,
Noida-201303, Uttar Pradesh, India

www.cstep.in

+91-8066902500

cpe@cstep.in

@cstep_India