NATIONAL CONFERENCE

Fostering Smarter Resilience in Energy Systems

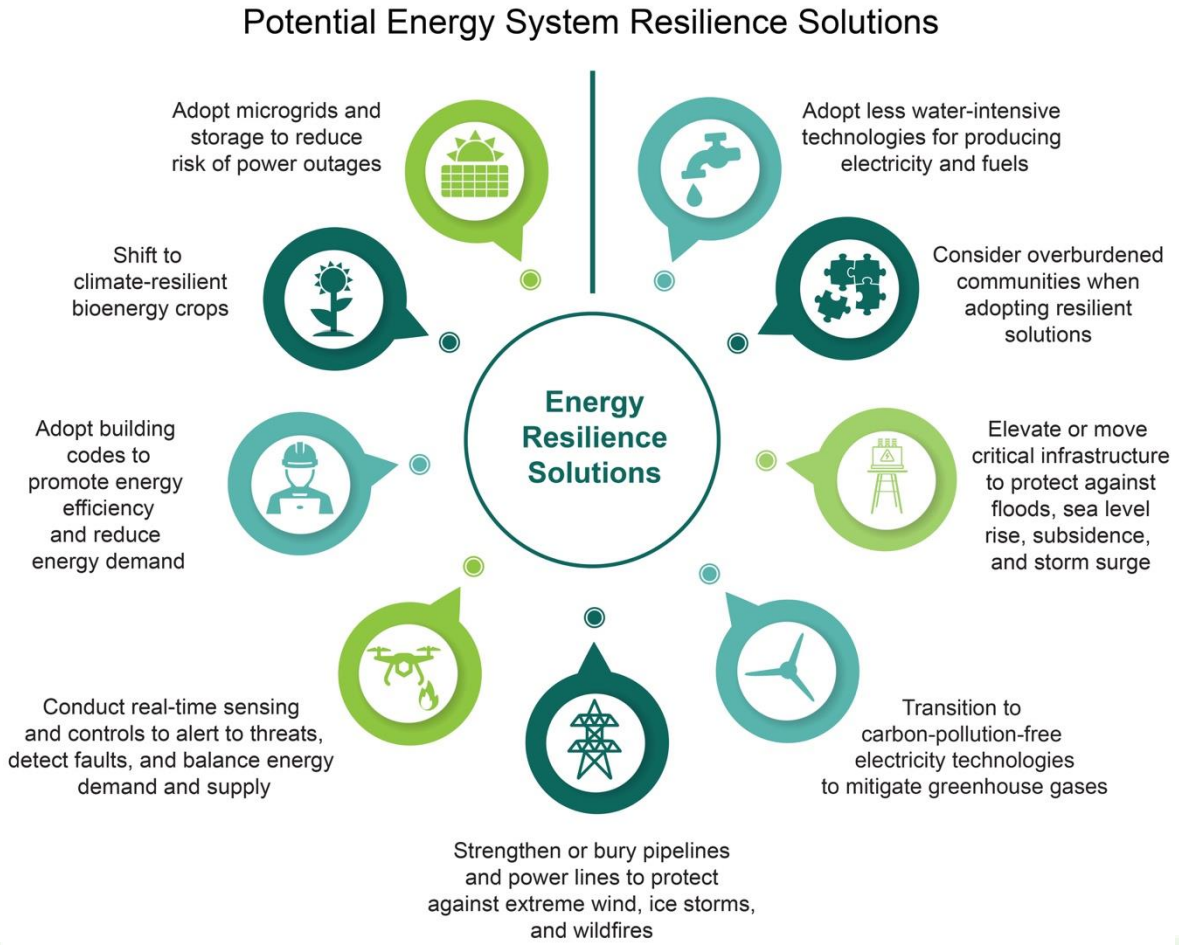
10-11 December 2024 • Chennai

Defining resilience, triggers and potential solutions

Resilience - “The capacity of the energy system and its components to cope with a hazardous event or trend, to respond in ways that maintain its essential functions, identity and structure as well as its capacity for adaptation, learning and transformation. It encompasses the following concepts: robustness, resourcefulness, recovery” – IEA

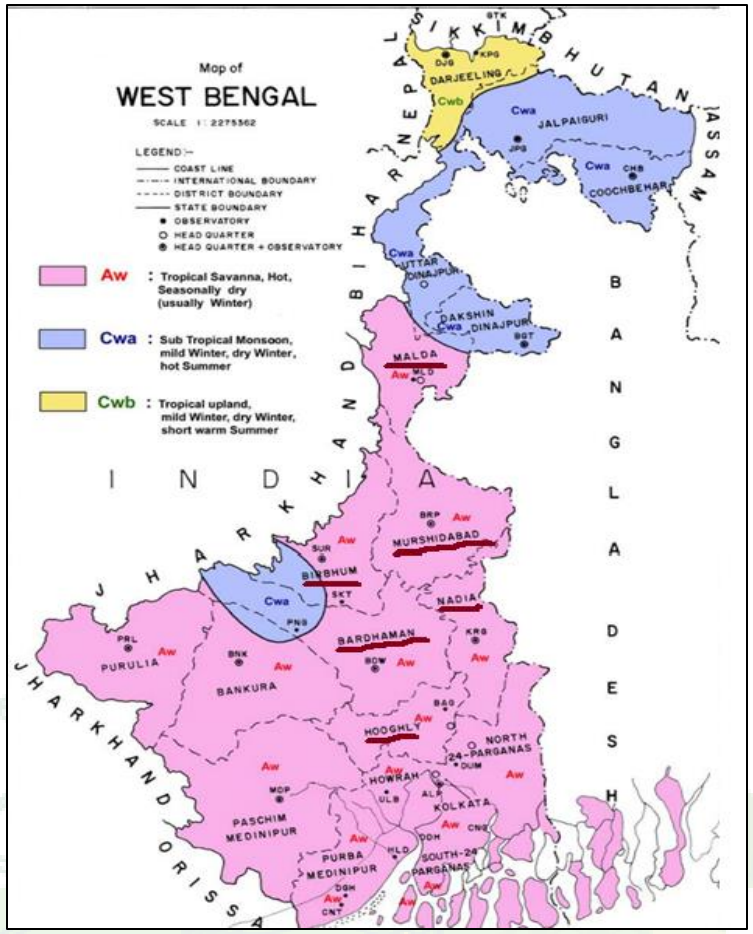
Triggers

- Energy security - Uninterrupted availability of energy sources at an affordable price
- Reliability - Extreme weather events are responsible for most of the disruptions in additional to other events like cyclone, floods etc.
- Restoration of services – Bring back services timely
- Vulnerabilities to cyberattacks – Threat of attacks which use in technology

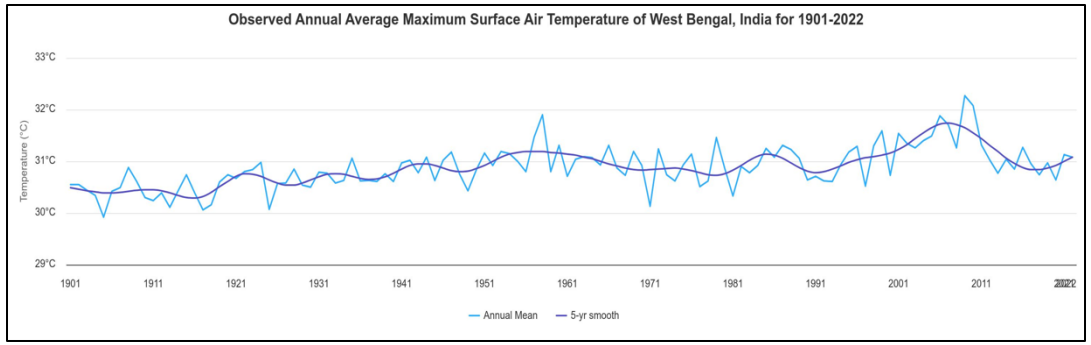


Building resilience in power distribution network – Case Study

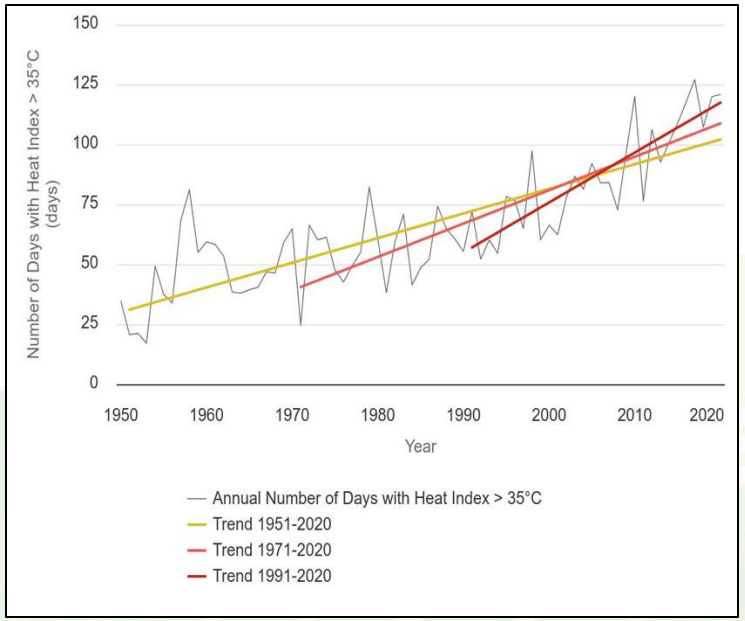
Climate zones in West Bengal



Annual Average Maximum Surface Air Temperature



Decadal shift in number days of Heat Index >35deg. C



The observed annual average maximum surface air temperature of the state between 1990s indicates a warming trend with almost 0.1^0C rise in decadal temperature. The mean temperature also shifted by 0.1^0C whereas the minimum temperature trend also increased by 0.5^0C

In past one decade (1990 – 2020), hotter days (>35^0C) have increased from 52 days to 112 days, indicating a significant shift of the norm towards more heatwaves

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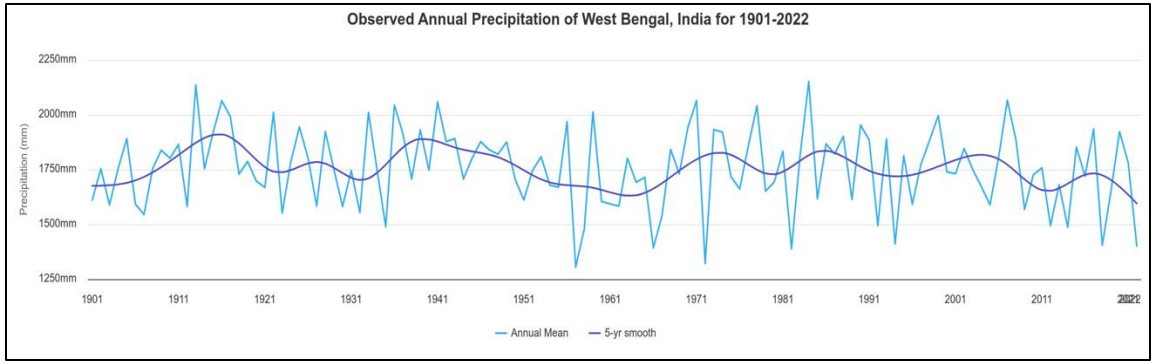
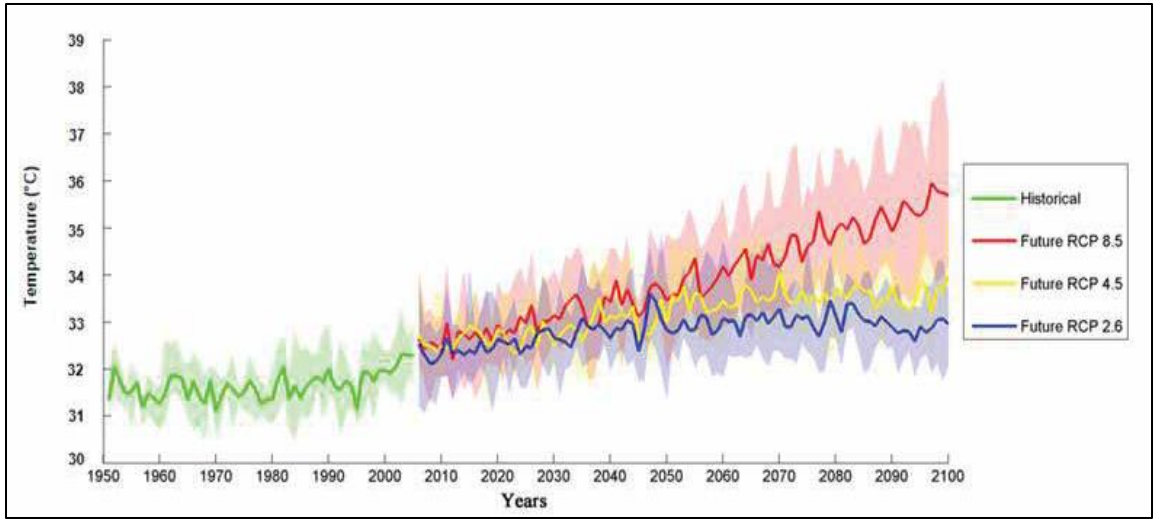
Rainfall Time-series between

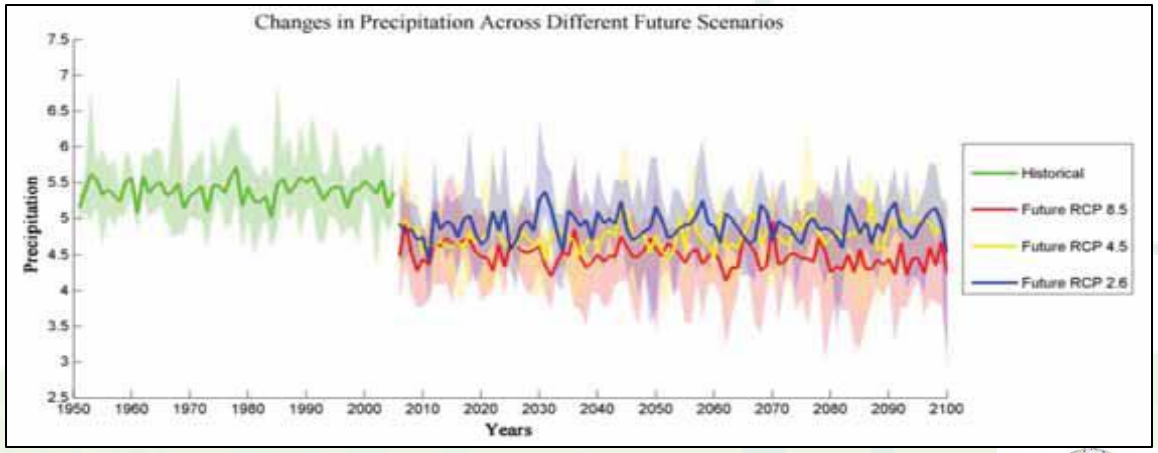


- The maximum number of rainy days in a year is about 51 to 86 days with most rain occurs during monsoon months 41 – 55 days, average rainfall is 400 mm in 24 hours.
- For the near future (2021-2030), the average maximum temperature is projected to rise by +1 to +1.04 ^{o}C with respect to baseline (1961-1990).
- Mean annual precipitation projections indicate that the maximum rainfall may increase by 1 mm per day.
- *Long term projection for the state significant rising trends in the frequency and magnitude of extreme rain events and a significant decreasing trend in the frequency of moderate events.*

Projected average annual maximum temperature trends



Projected changes annual precipitation intensity



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Climate-induced Hazard Profile

	Hooghly	Bardhhaman East	Bardhhaman West	Birbhum	Nadia	Murshidabad	Malda
River flood	High	High	High	High	High	High	High
Urban Flooding	Low	Low	Low	Medium	Medium	Low	Low
Landslide	Low	Low	Low	Low	Low	Low	Low
Cyclone	High	Medium	Medium	Medium	Medium	Medium	Medium
Water Scarcity	Medium	Medium	Medium	Medium	Medium	Medium	High
Extreme Temp./ Heat	High	High	High	High	High	High	High
Wildfire	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Earthquake	Medium	Medium	Medium	Medium	Medium	Medium	Medium

Enhancing efficiency and building climate resilience in distribution network (loan by ADB)

- **West Bengal** distribution strengthening program targets developing climate resilient distribution infrastructure in 7 most flood venerable districts of the state through
  - Replacement of 11kV overhead lines with AB cables of higher cross section, optimizing span and strengthening the foundation of the supporting poles
  - GIS mapping and remote online monitoring system on the feeder for ease of operations, maintenance and restoration.

Impact and actions to develop a resilient energy system

Climate Change Events	Vulnerabilities to Transmission and Distribution Infrastructure
Increasing temperature & Heat waves	- Sagging of lines and in presence of tall trees, may lead to catching fire - Decreased conductivity in OH lines - Reduced carrying capacity of lines, capacitors and transformers - Increased losses in lines - Derating of transformers; –1% load per 1°C rise; - Overheating of capacitors and transformers - Sagged bare line encountering humans/livestock may lead to accidental death from electrocution.
Rainfall leading to increased flooding	Impact on substations - Loss of supply and drop in serviceability - Damage to the electricity poles from landslide triggered from heavy rainfall Level of Impact - varies based on local information – inundation could cause long-term power outage and electrocution
Thunderstorm/ Hailstorm	- Cable breakage - Up to 100% loss of local supply - Increase heat convection - Snapped bare line encountering humans/ livestock, may lead to accidental death.
Extreme rainfall events	Inundation of substations - Up to 100% loss of local supply Level of Impact - varies based on local information – inundation could cause long-term power outage and electrocution
Extreme wind speed (cyclonic)	- Cable breakage - Up to 100% loss of supply local - Increase heat convection - Snapped bare line encountering humans/livestock may lead to accidental death from electrocution.

- Resilience suggests images of stronger, bigger, and more expensive infrastructure which is perceived as expensive.
- Building resilience is dependent on the ‘soft’ aspects like skills and practices followed by the people operating the infrastructure.
- Programs should follow a phased approach where in institutional capacity to bring in efficiency must be built while the infrastructure is made available.

THANK YOU