

IEEE WG SES-DC

Resilience Task Force

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What is resilience?

“...is the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions...” (as defined in Presidential Policy

Direction 21 (PPD-21)

“...is the capacity of individuals, communities, institutions, businesses, and systems to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience...” (as

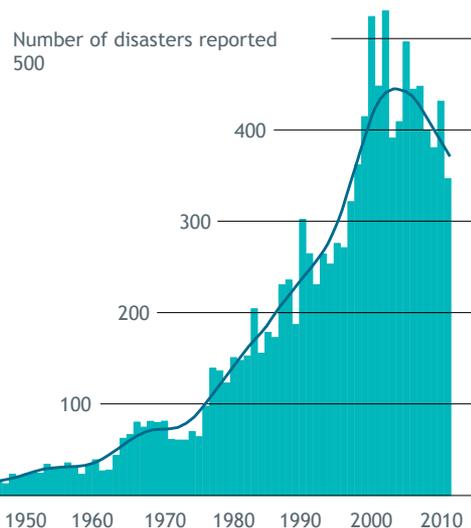
defined in the 100RC Resilience Framework)



Between 2000 and 2012, natural disasters – including weather, health and seismic events – caused \$1.7 trillion (£1.1 trillion) globally in damages.

This figure includes direct impacts on infrastructure, communities and the environment, together with reductions in business profitability and economic growth in affected regions.

United Nations International Strategy for Disaster Reduction, 2012



Frequency of reported natural disasters, 1900-2011 (source: EM-DAT)

\$1 billion (£646 million) is the cost to New York City of a day without power.

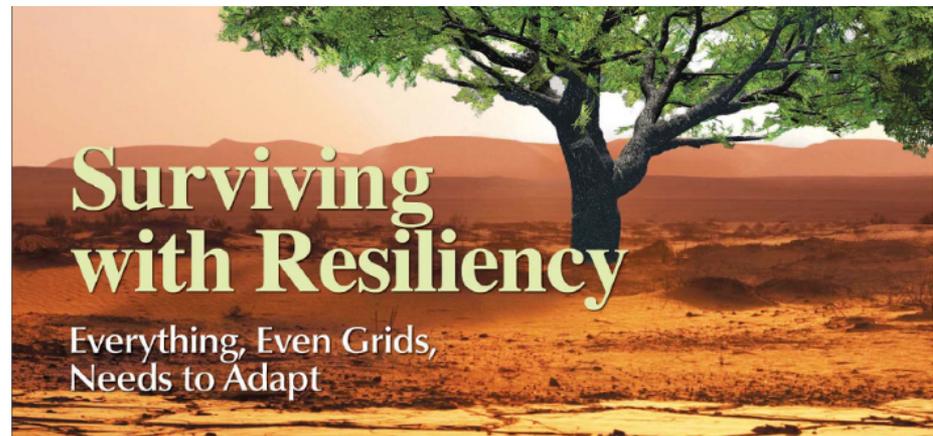
Michael R. Bloomberg

The 2012 India blackouts affected 640 people and represented US\$108 million in losses for companies

The Confederation of Indian Industry

Resilience and the power grid

- The design of the grid is currently centred around reliability, security and adequacy of supply.
- Planning for high probability, low impact events.
- Risk management is not resilience as it is focused on preventing or mitigating the loss of assets due to specific events.
- Resilience on the other hand focuses on enhancing the performance of the system and supporting its adaptation in the face of multiple hazards. It refers to a dynamic process.



The main impact of **climate change** on power supply is caused by extreme weather events which usually results in damage to the infrastructure and interruption of supply.

Approaches to designing a resilient grid would include:

- **Robust and weather proof infrastructure**: a power infrastructure which is capable of withstanding strong winds, intense rainfall, higher temperatures, etc. Possible solutions include hydrophobic coating or simply undergrounding or elevation of essential equipment.
- **Advanced distribution network monitoring, control and automation**: this is in line with the smart grid approach of being able to have a complete appreciation of the state of the network and perform automatic preventive or post-event restorative actions.
- **On-site distributed generation**

And plenty more...

Do we need more work on this topic?

Resilience in emerging economies

- Does this approach focused on weather related/natural events and technology solutions apply in emerging economies?
- Chronic stresses and man-made events are not considered.
- Approach very utility focused



[Claudio Núñez](#) - originally posted to [Flickr](#)

In Concepción we had two earthquakes: the 8.8 one and the social earthquake – looting, arson...I think the last one affected our soul most violently.”
Mayor of Concepción, Chile

Acute Shocks

Flooding

Severe storms

Terrorism

Earthquake

Wildfires

Sandstorms

Extreme cold

Hazardous materials accident

Disease outbreak

Riot/civil unrest

Infrastructure/building failure

Heat wave



Chronic Stresses

Lack of social cohesion

Poverty/inequity

Lack of affordable housing

Poor air quality

High unemployment

Homelessness

Changing demographics

Aging Infrastructure

Shifting macroeconomic trends

Water Scarcity

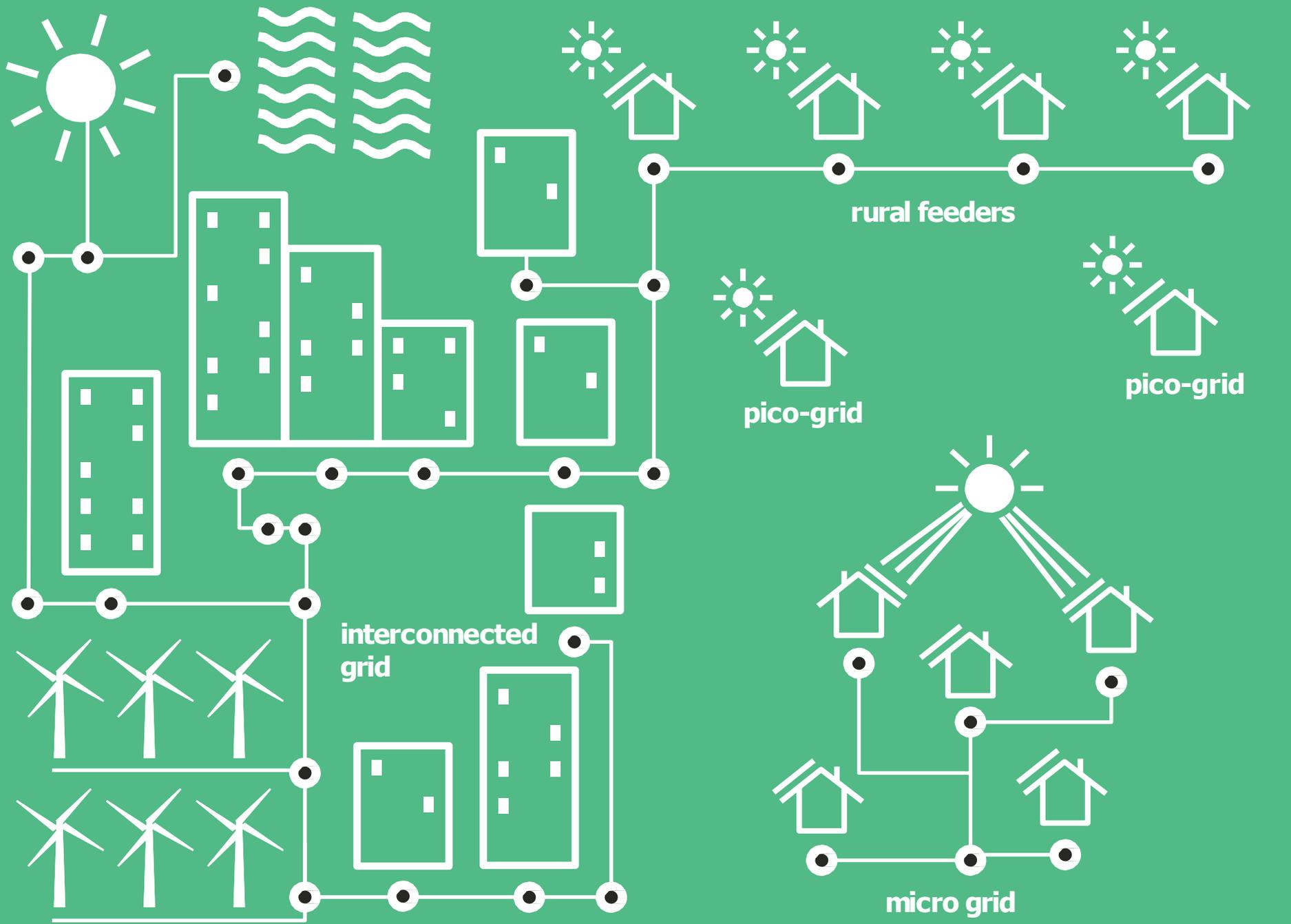


Typical technologies, operation paradigms and planning approaches can be also applied to systems in emerging economies.

However, the context in emerging economies is very different:

- Lack or limited existing electrical infrastructure
- Informal and inadequate supply arrangements (e.g. power theft)
- Lack of authority and control (e.g. corruption)
- Growing power demand
- Social unrest
- Who has the power to take decisions? The city, the utility, the community?





An example of a different framework to analyse resilience in systems

- The City Resilience Framework provides a lens through which it is possible to understand the complexity of cities and the factors which contributed to the city's resilience.



- 7 Qualities
- 4 Categories
- 12 Indicators

City Resilience Index

City Resilience Framework

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THE
ROCKEFELLER
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Reflective

Robust

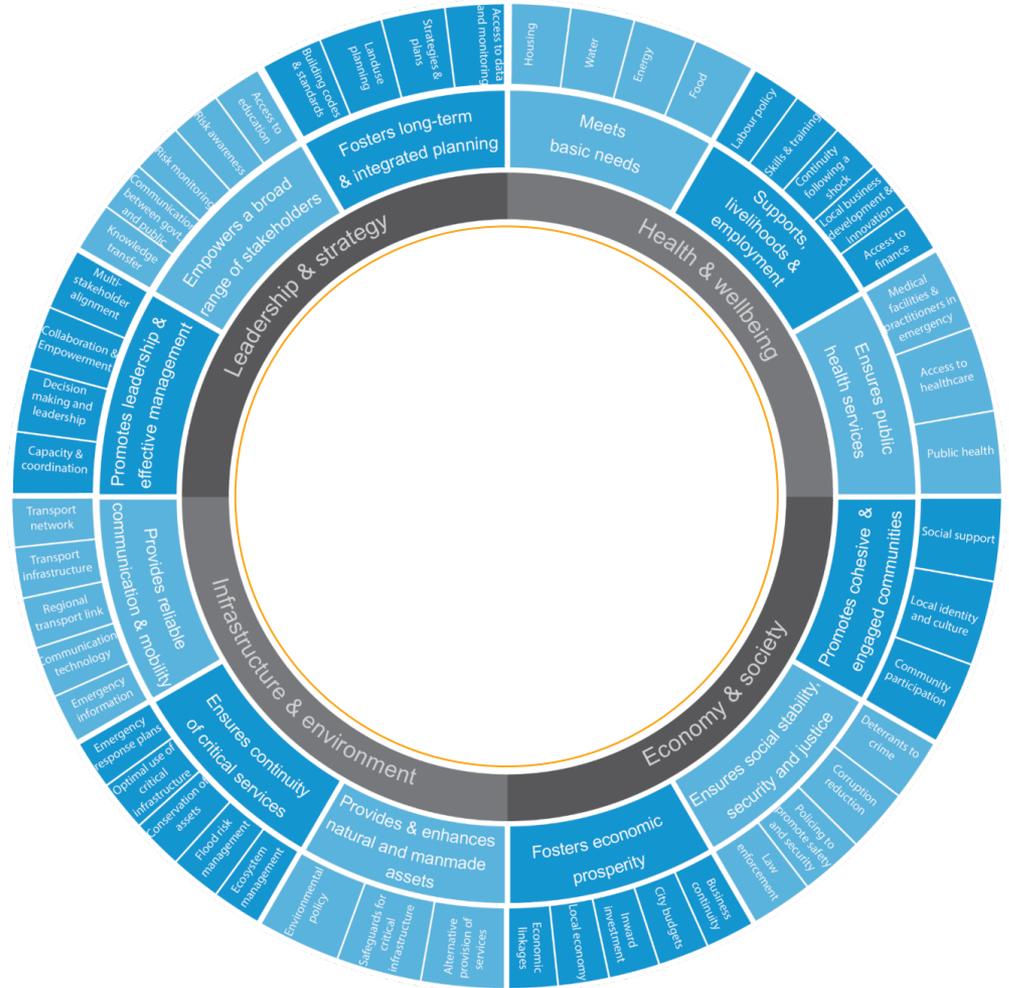
Redundant

Flexible

Resourceful

Inclusive

Integrated



*Task force objective:
to develop an analysis tool to understand and plan for resilient
power supply in the context of emerging economies*

Systems definition (users' focus)

- Cities
- Informal settlements
- Villages
- Off-grid communities

Systems definition (infrastructure's focus)

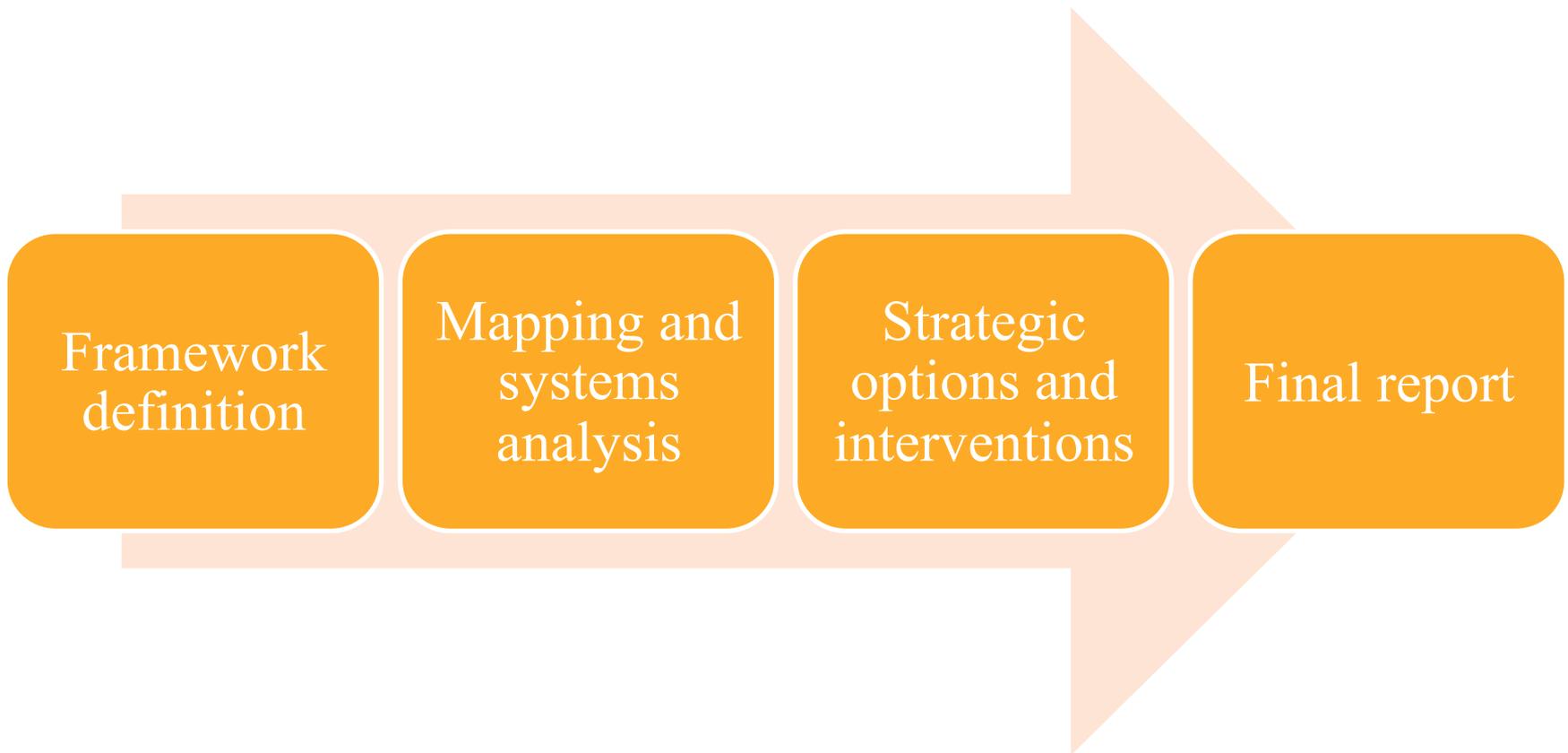
- Extended electrification
- Peri-urban electrification
- Limited grid access (e.g. power theft and illegal connections)
- Off-grid system

Literature Review

- Best practice
- Emerging technologies and operation
- Existing barriers and powers

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Next steps:

- Gather interest and share experience ... let's start today in this room 😊
- Explore and discuss the content of the task force...to follow soon...
- Develop a plan of work with subtasks.
- Get the work started!



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