



#### The Need for Resilience Interventions

#### Climate threats to grid infrastructure



#### Cross-border dependencies



#### Increasing reliance on reliable electricity supply



#### Rapid changes in the energy landscape

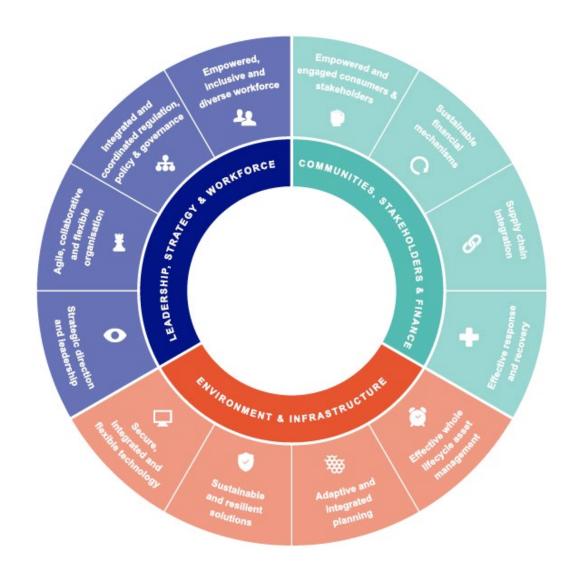




### Resilience Assessment Framework

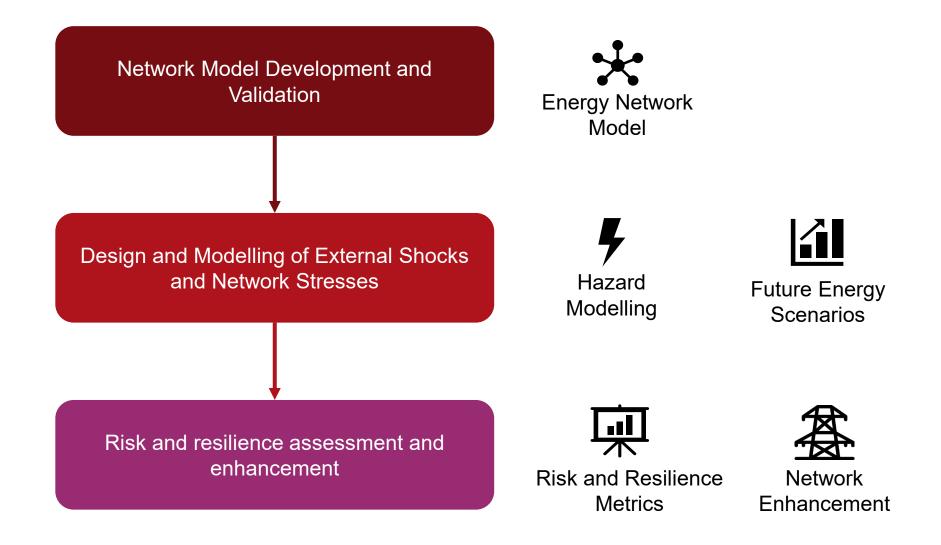
Identifying what is important for resilience

- Resilience is analysed through:
  - 3 dimensions
  - 12 goals
  - 43 indicators





### Quantitative Resilience Assessment (QRA)



### Highlights of QRA Tool

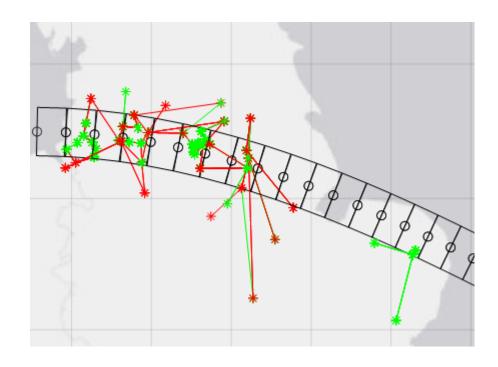


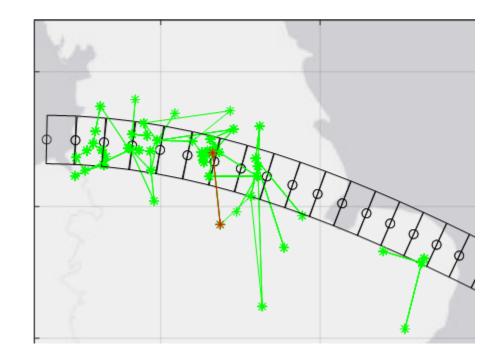
Spatial and Temporal Impact Assessment of Extreme Shocks and Future **Energy Scenarios** Network stress-testing for the determination of its "breaking point". Design and application of holistic resilience metric systems Advanced GIS-based visualization of network vulnerability and metrics. Risk-driven identification and multi-criteria assessment of network reinforcement options.



# Windstorm Example

EENS	Probability of Interruption to Supply	Breaking Point
(MWh per windstorm)	(%)	(m/s)
15,555	9.8	32.5
4,800	2.6	38.5







## Resilience Maturity



Goal	Indicator	Maturity
Supply chain integration	Accountable, ethical and sustainable supply chain	
	Clear communication and collaboration across the existing supply chain	
	Contingency plans for supply chain failure	
	Understanding of supplier market risks and opportunities	
Effective response & recovery	Ensuring continuity of service to all	
	Regular and comprehensive stress testing with defined roles and responsibilities	



### Intervention Pathway

**Short-term** 

<6 months

**Medium-term** 

6 months – 2 years

Long-term

2 years – 5 years

- Improve internal communication across departments to encourage a collaborative culture
- Engage with stakeholders to take a coherent approach to resilience across interdependent systems

- Review of future trends and scenarios to inform resilience planning
- Integrate an overarching data strategy defining management and governance of data

- Integrating resilience into decision making
- Collaborating with external infrastructure operators
- Continuous improvement of the resilience approach

# ARUP