

From Component Reliability to Resilient Energy Supply Chain Modelling and Optimisation

1 Problem statement

Techno-economic performance does not guarantee supply resilience.

Energy system optimisation can identify architectures with similar cost and environmental performance. However, these systems may respond very differently to component failures, leading to different levels of service continuity at the industrial end use.

Key message: Well-performing designs are not necessarily equally resilient.

2 Research question and hypotheses

Research question: How can component failure and repair behaviour be translated into actionable information for resilient energy supply chain modelling and optimisation?

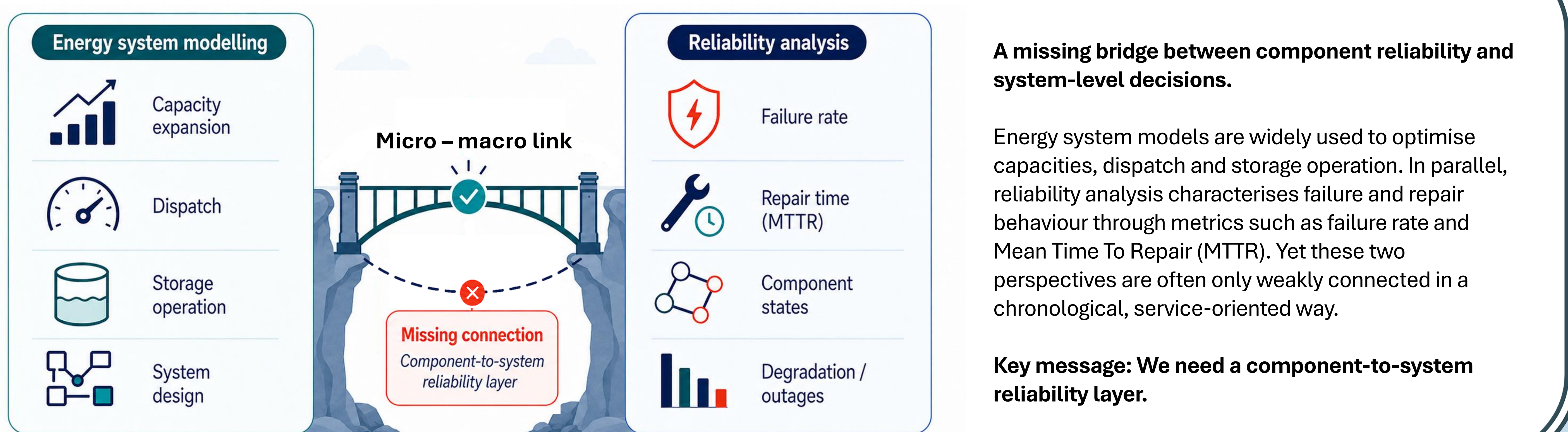
Hypotheses:

H1. Component availability alone is insufficient to explain system-level service continuity.

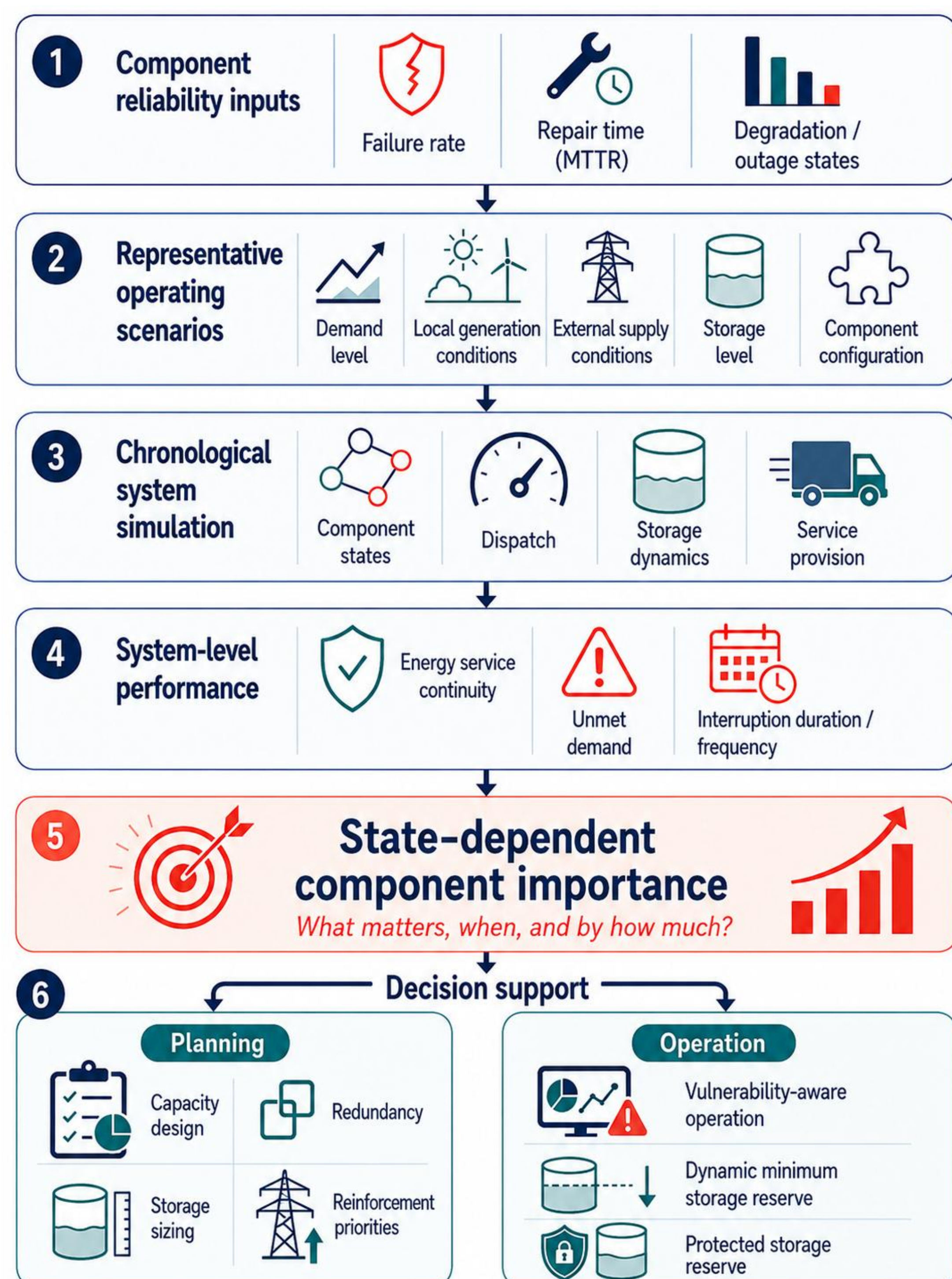
H2. Component importance depends on the operating state of the system and therefore changes over time.

H3. State-dependent component importance can support both capacity planning and operational decision-making.

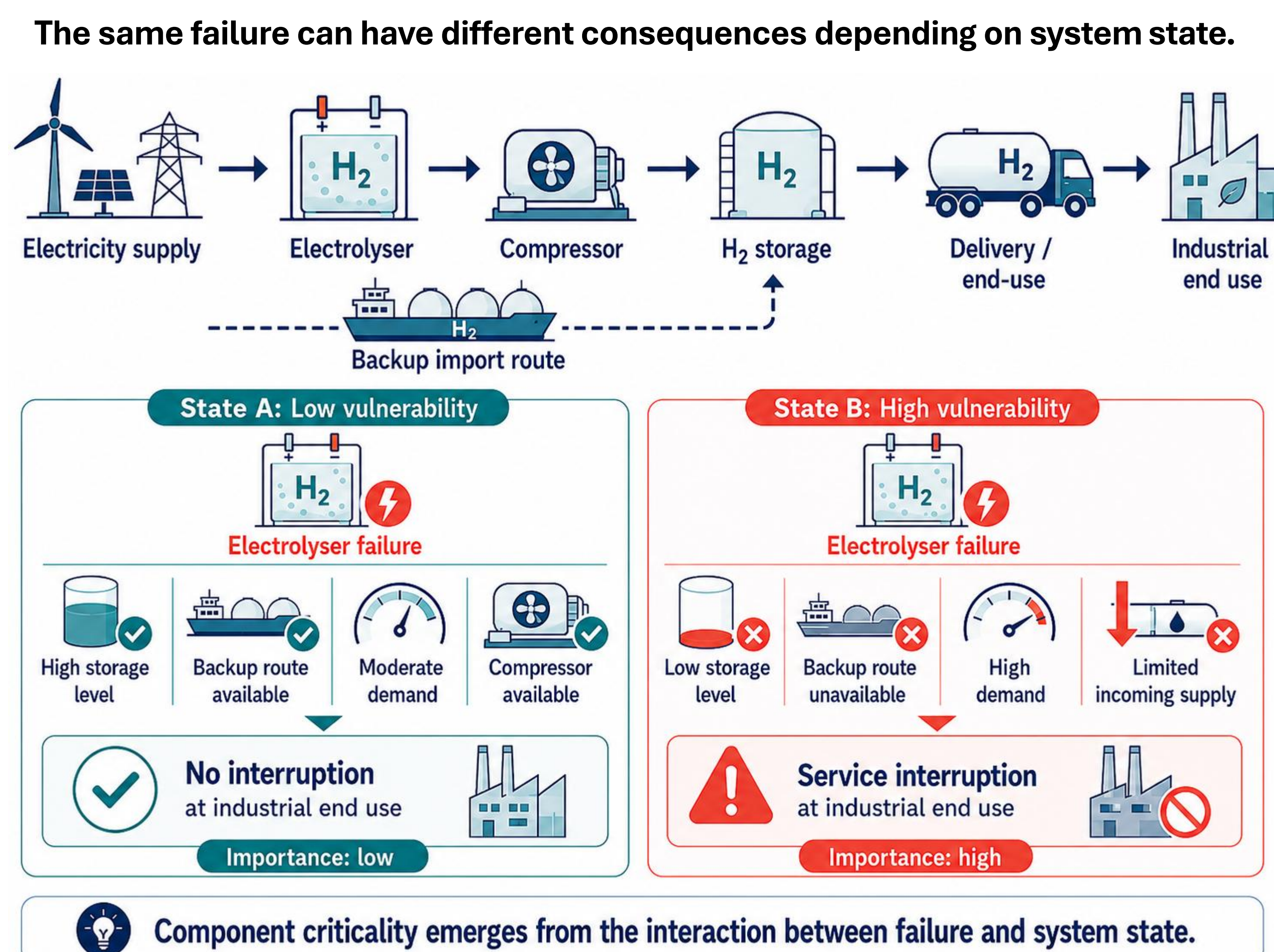
3 Background and modelling gap



4 Proposed framework



5 Illustrative example



Take-home message: Reliability-informed modelling for more resilient energy supply chains.

- Component failures should be assessed through their effect on service continuity.
- Component importance is state-dependent, not purely static.
- Reliability information can support both capacity planning and operational strategies.



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Oxford Energy Day 2026 - Towards resilient energy systems:
Research, policy, and practice