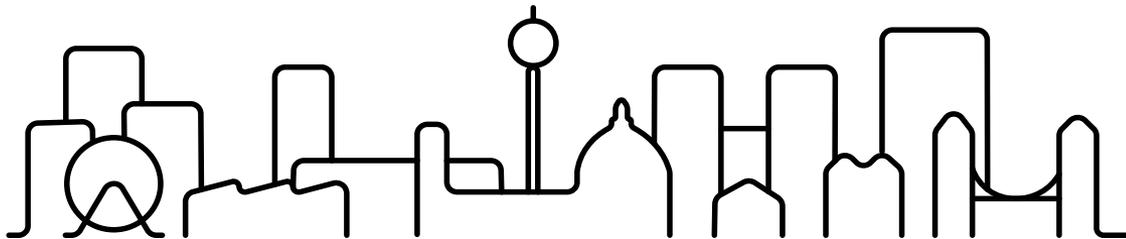


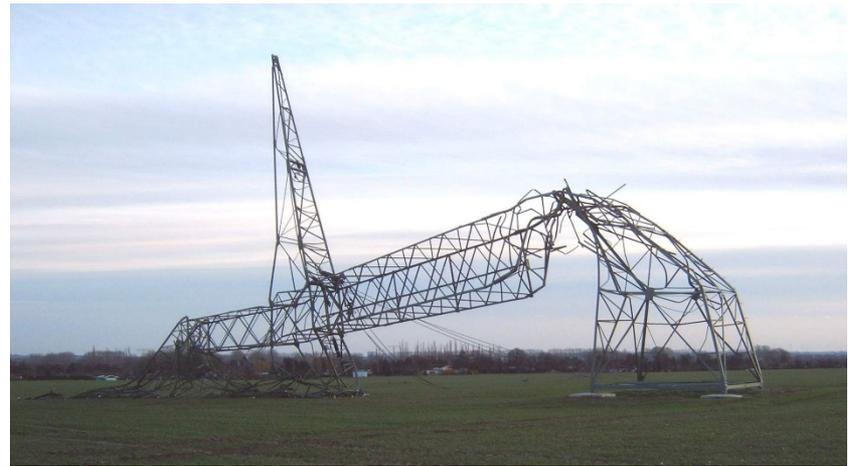


A Collaborative Framework to Improve Urban Grid Resilience

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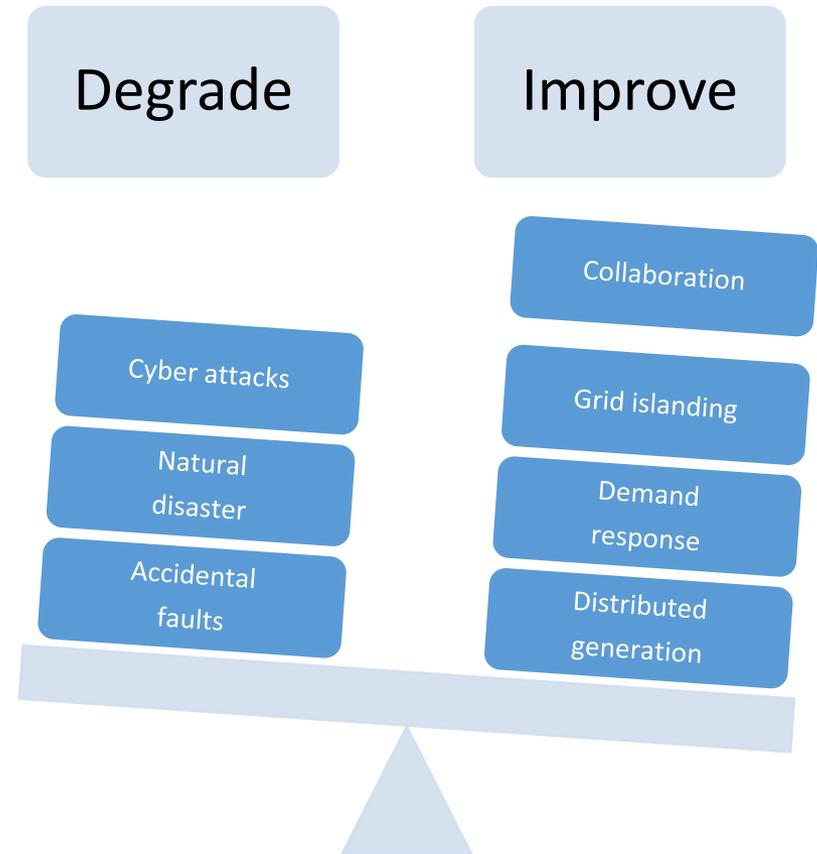
- Long term power outages can have a severe social impacts
- Severe impact after 8 hours
- After 24 hours most critical infrastructures fail
- Use distributed generation in urban areas to supply in particular critical loads



The IRENE approach



- The proliferation of Smart Grid Technologies exposes electricity grids to new threats
- The Smart Grid can act as an enabler for the improving grid resilience
- Stakeholders are required to respond to incidents in a well coordinated manner

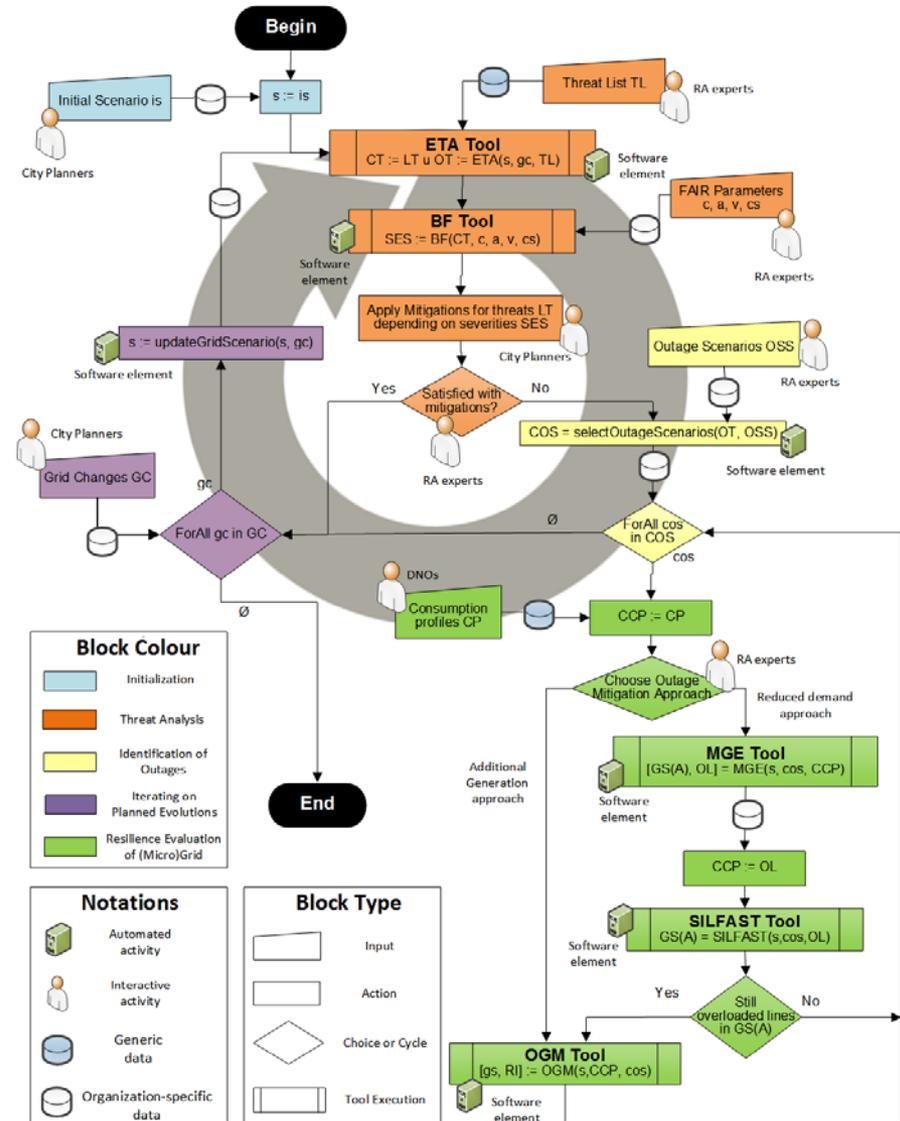
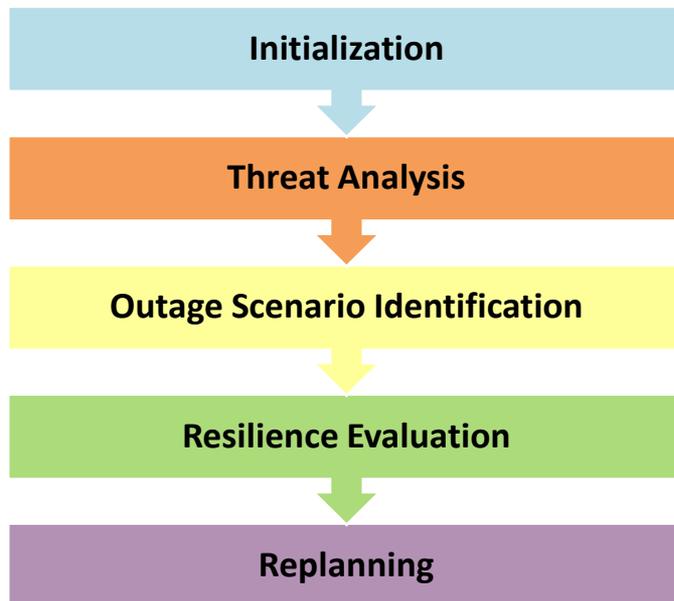


Stakeholder collaboration is key for handling crisis situations

IRENE framework and workflow

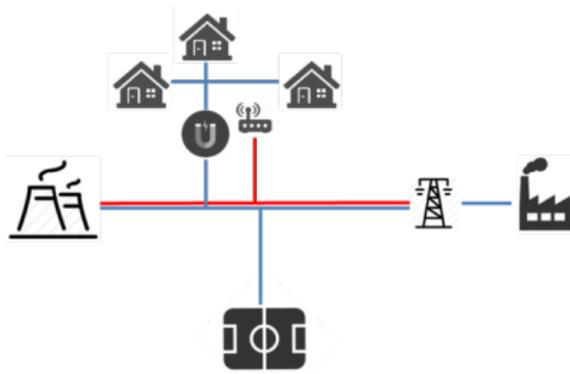


- Implemented as a *workflow*
 - a flow of information
 - a sequence of actions users should follow
- Goal: find optimized grid settings

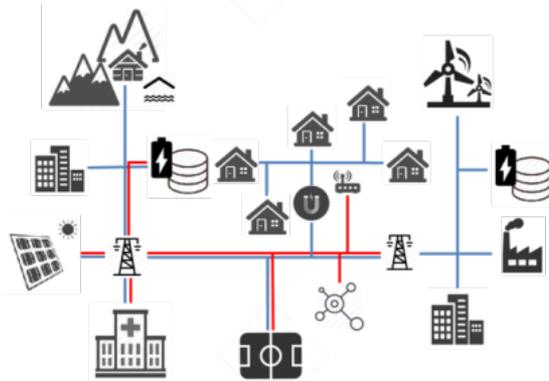


Grid and threat evolution

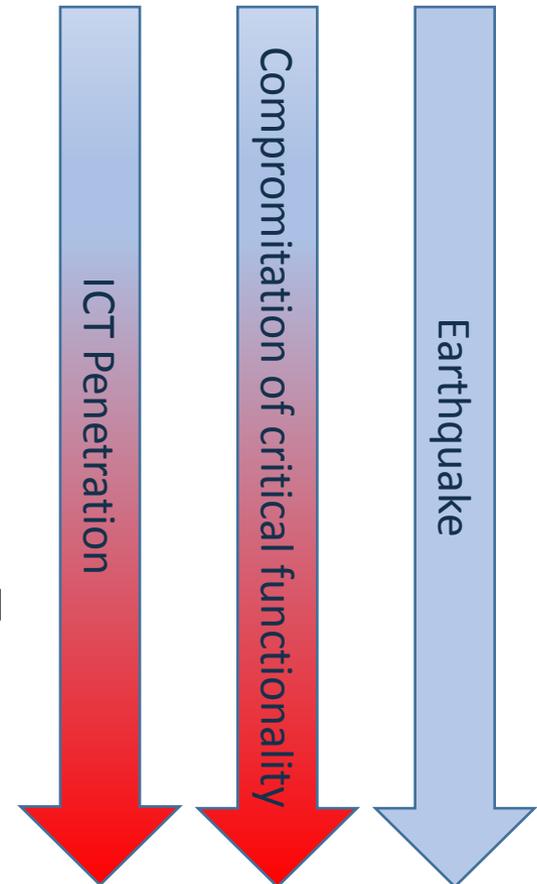
- Grid evolution introduces new threats
- Threat analysis based on NIST 800-30
- 38 threats identified from the (102) NIST ones



Initial „low smart“ scenario



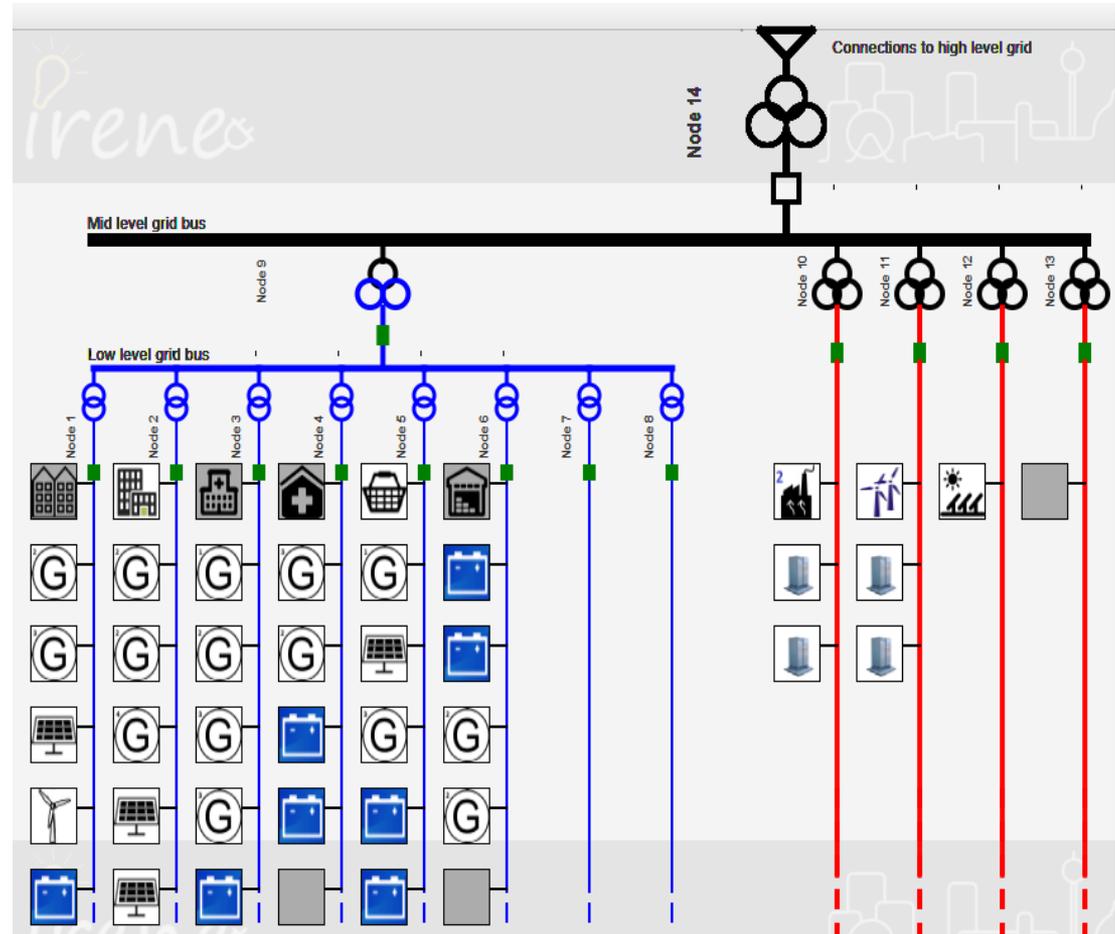
Distribution automation and demand side response



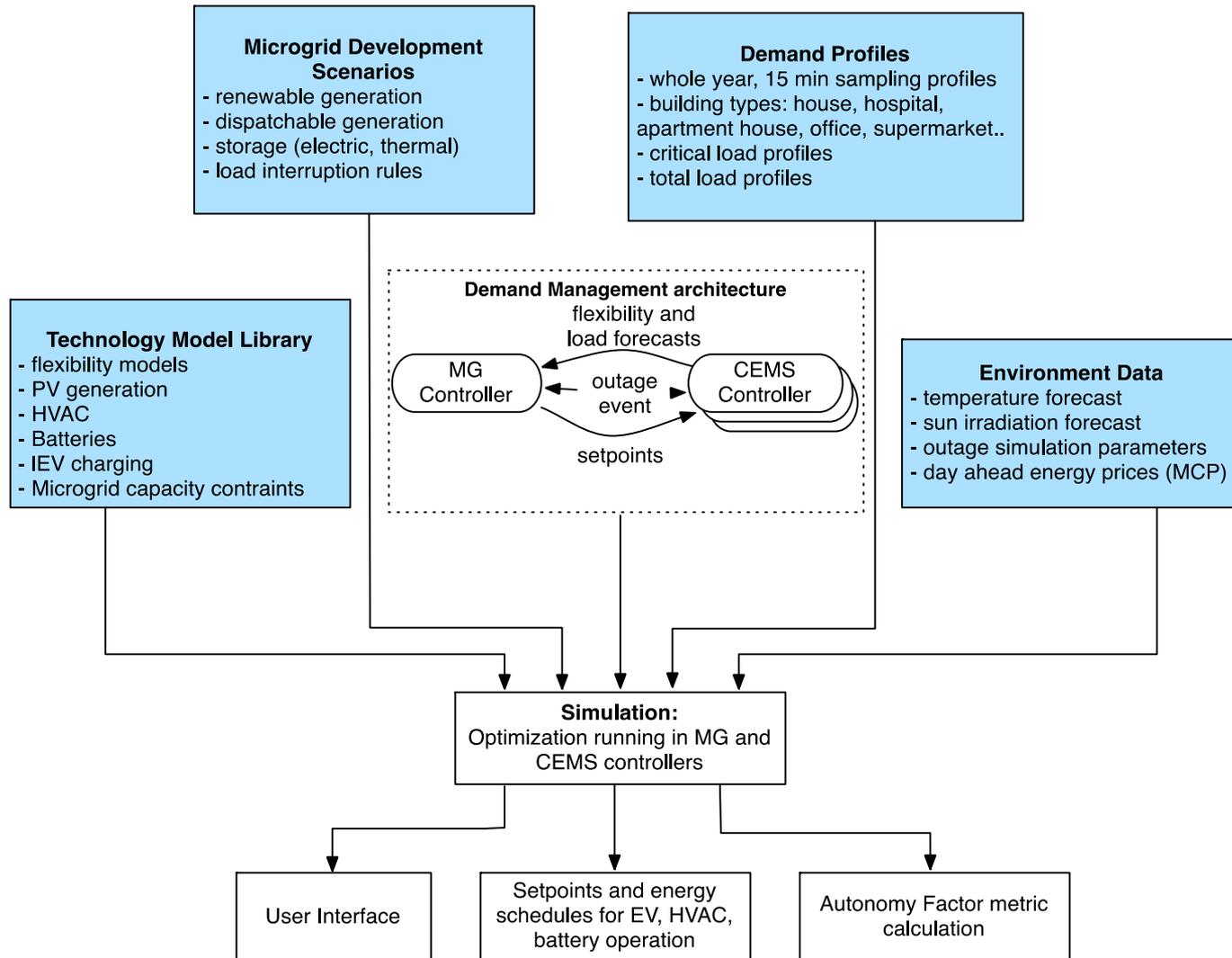
Grid modelling



- Simulation of outage, islanding operation, cost and resilience analysis.
- Calculate changes in the resilience coefficient and monetary cost whenever a new case/scenario is applied



Microgrid evaluation





- City planners have to define resilience targets
- Relevant stakeholders need to get involved early in the process in order to plan for responses
- Microgrid solution can improve grid resilience
- Fully islanded microgrids are technically feasible but in most cases economically rarely viable



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