Resilience of Power Supply Systems against Natural Disaster Impacts

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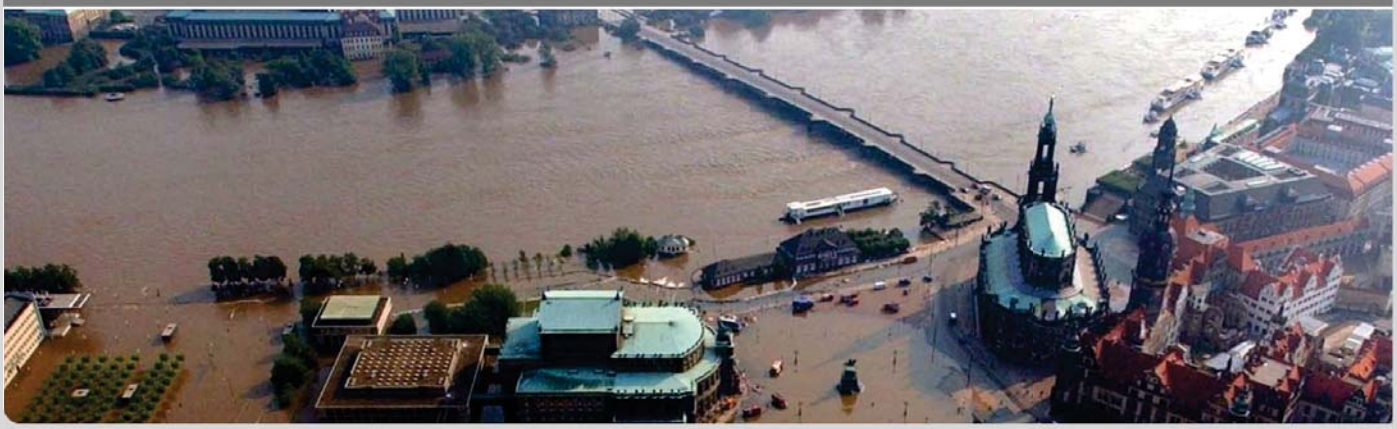

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Key Statements

Functionality of power systems is absolutely vital to societies.

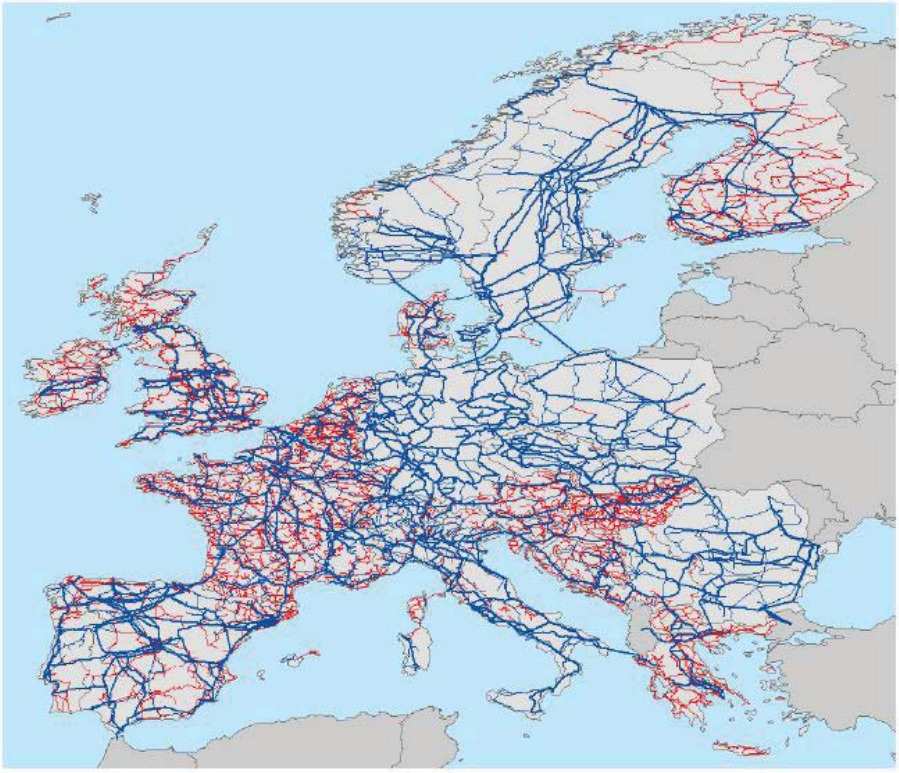
Large scale natural disasters do have the ‘power’ to significantly disrupt the power supply system. Using technical failures observed so far as proxy for natural hazard impact potential is worrying.

Power systems are in a rapid transformation process by (a) decentralization, (b) growing amounts of solar, wind and other renewables with unpredictable fluctuations (c) European networking.

This rapid transformation makes power systems very much different to other engineered systems, and thus demand a high effort to make them resilient. The natural disasters we’ll face in the future are also changing with time (climate change, space weather, rare events such as earthquakes,..).

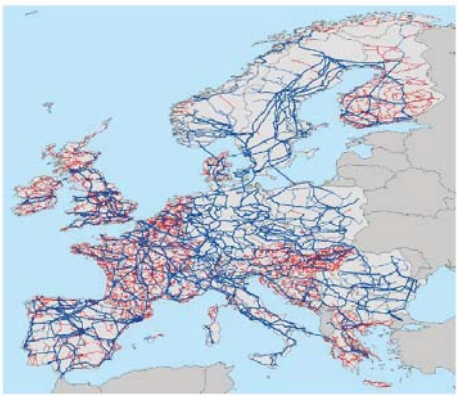
This high degree of complexity (power system) and uncertainties (hazards) requires significant efforts towards resilience. This may require new forms of co-operation, of network operators, utilities, regulators, research community, and other stakeholders.

Interdependency Other Systems affected



The European high voltage transmission grid, composed of lines with a voltage greater or equal to 220 kV, is displayed. The image has been taken from Poljanšek *et al* (2010).

Interdependency Other Systems affected



Blackout 2006, Germany incl. Western Europe

- On November 4, 2006 the German TSO E.ON Netz had to switch off a high voltage line to let a ship pass underneath.
- Simultaneously there was a high amount of wind electricity which fed into the grid 10,000 MW from wind turbines to Western and Southern Europe grids.
- Insufficient communication about this switch-off led to instabilities of the frequency in the grid and to overloading of lines.
- Devices had to switch customers off in the countries affected to cope with this lack of power in the Western zone automatic.
- The blackout lasted up to two hours.

The meteorological events we've seen before

Winterstorm Lothar, Christmas 1999, up to 70 m/s

Münsterland Ice Event, November 2005

Kyrill, January 2007, up to 56 m/s

Emma, February 2008, up to 62 m/s

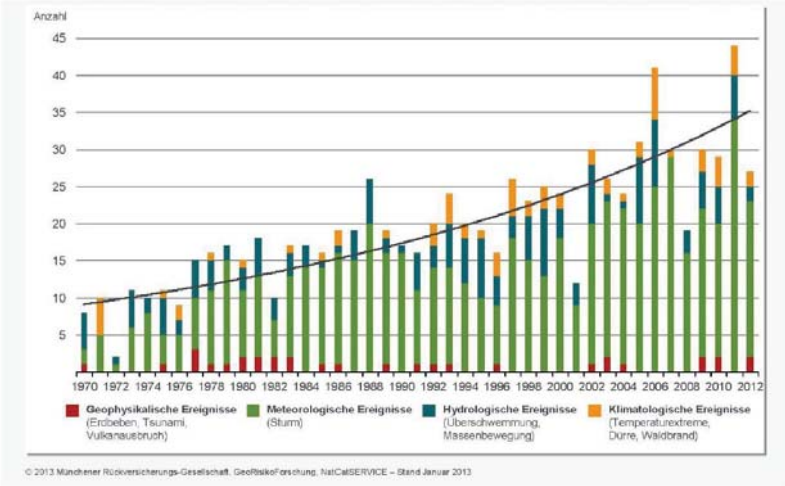


Abbildung 2-5: Naturkatastrophen in Deutschland (1970 – 2012) – Anzahl der Ereignisse [Quelle: Münchener Rückversicherungs-Gesellschaft]

Events we havn't seen (frequently) before

Earthquake, Space Weather, Bombing, Cyber Attack

Models for integration research communities and stakeholders in risk mitigation

Priority for research, little incentive for implementation (many FP6, FP7 projects in the environmental field),

Systematic stakeholder interaction processes (for instance in FP7 MATRIX) using national Hyogo Framework Platforms,

Designing research upfront from user perspectives (H2020) based on a white paper,

.. but …is it adequat .. ?

This high degree of complexity (power system) and uncertainties (hazards) requires significant efforts towards resilience. This may require new forms of co-operation, of network operators, utilities, regulators, research community, and other stakeholders.

Is science of implementation a new research direction?