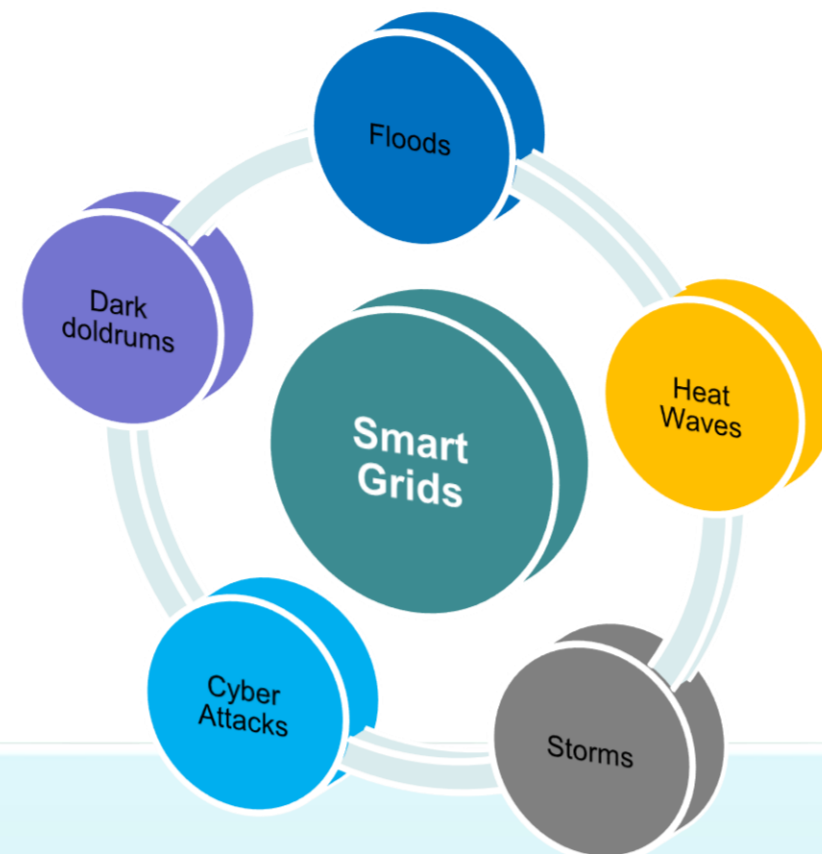


Continuous and Urban Resilient Power Supply during Critical States

Smart Grids & Critical Infrastructures: Emerging Supply Risks

Dependencies:

- Most critical infrastructures like hospitals or the water supply **depend** on the continuous supply of power
- Power **dependencies will increase further** - potentially in Smart Cities



Risks:

- Fluctuation** of power generation
- Climate Change** related risks
- Drastic change in power consumption** due to
 - climate change,
 - dissemination of new technologies
- Cyber risks...**

Objectives

Find **system-embedded** controls or management options to...

- ...maintain **Security of Supply** as far as possible with regard to **critical services!**
- ...enable **continuous** and **fair** power supply of **critical services** in the phase of a degraded state of the power system.

Criticality & Flexibility: Supply Index

- Criticality** c_l of an infrastructure x_l measures the severity of the consequences a failure has to an urban population – result of a socio-political process and the dynamic features of demand and supply [Ot]
- Power demand interval** $[P_{D,min}^l, P_{D,max}^l]$ of x_l - power range, where essential services are running.

Supply Index:

$$si = \sum_{i \in I} \tilde{c}_i q_i(sp_i, P_{D,min}^i, P_{D,max}^i)$$

Resilient Smart Controls Management

- Advanced Metering Infrastructures, Smart Meters
- Energy and Distribution Management System
 - Resilient real-time Controls
 - Smart Contingency Planning, Scheduling

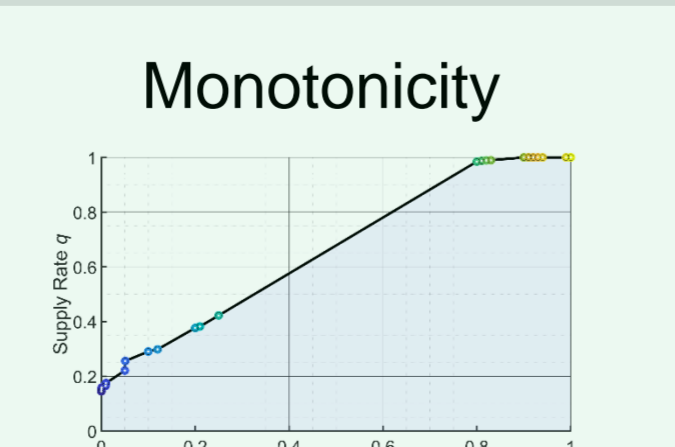
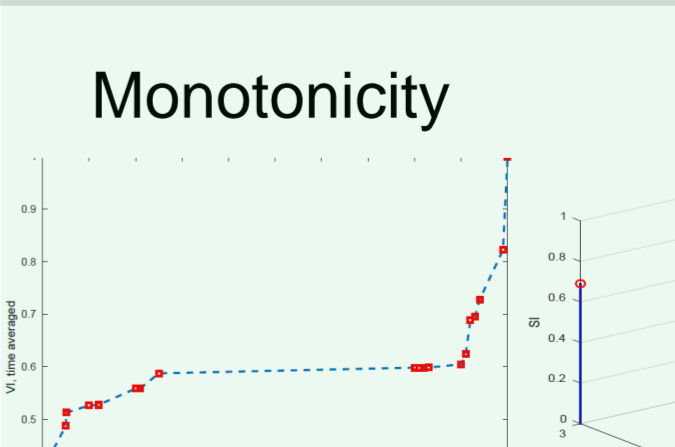
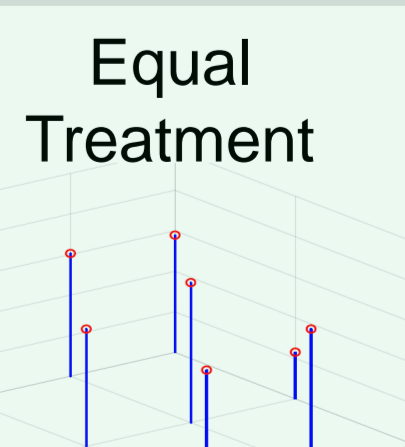
Composite Resilience Supply Metric:

$$w_1 \cdot si + w_2 \cdot se + w_3 \cdot \rho, \quad w_1, w_2, w_3 \geq 0; w_1 + w_2 + w_3 = 1,$$

where se is an **efficiency indicator** and ρ **measures fairness** in terms of equal treatment

Methodology & Results

Benchmark-Cases: Blackouts occur, systemically in terms of contingency planning e.g. rolling blackouts – 75 % of current demand

	Blackout	Smart Resilient Control	Rolling Blackout	Smart Resilient Scheduling
si	0	> 0.5	0.66	> 0.5
Fairness	On/Off-Equal Treatment	Monotonicity 	On/Off-Equal Treatment	Monotonicity  Equal Treatment 

[Ot] Ottenburger, S.S., Münzberg, Th., Strittmatter, M. (2018), *Smart Grid Topologies Paving the Way for an Urban Resilient Continuity Management*, International Journal of Information systems for Crisis Response and Management 9 (4), p. 1 – 22, DOI: 10.4018/IJISCRAM.2017100101