

Empirical Investigation of the Value of Security of Supply in Private Households

A Case Study in the Energy Smart Home Lab

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Controlled power cuts in private households

The progressing decarbonization of the energy system, as well as a lack of transmission capacities, lead to new challenges for a guaranteed security of supply in Germany.

Controlled power cuts are one way of handling extreme situations. Already common practice in industry [1], for private households the willingness to provide flexibility through controlled power cuts has so far only been investigated through hypothetical scenarios in surveys.

The experiment is conducted in the living lab **Energy Smart Home Lab (ESHL)** of the KIT. Hereby, consumers are confronted with power-cuts, considering the willingness to accept (WTA) and willingness to pay (WTP). The value of security of supply, as well as the consumers' reactions and behavioral adaption is investigated.



Figure 1 – Graphic User Interface and interior of the Energy Smart Home Lab

Tariff I	Tariff II	Tariff III	Tariff IV
Frequency: 2 times per week	Frequency: 2 times per week	Frequency: 2 times per week	Frequency: no power cuts!
Duration: 4 hours	Duration: 2 hours	Duration: 1 hour	Duration: -
Advance-notice-time: 24 hours	Advance-notice-time: 24 hours	Advance-notice-time: 24 hours	Advance-notice-time: -
Compensation: 30 €	Compensation: 15 €	Compensation: 7,50 €	No Compensation

Figure 2 – Tariff options of the second week of the experiment, addressing the willingness to accept (WTA)

Procedure

- Two tenants living in the smart home for six weeks
- Communication via tablet and web-interface
- Every week selection of one tariff-option, considering four parameters (see Figure 2)
- Power cuts at arbitrary times during the week
- Two weeks WTA – two weeks WTP – one week WTA-WTP combination
- Two in-depth interviews to investigate motives and changes in behavior

Findings

Value of Lost Load (VoLL)

- Overall ten power cuts
- VoLL:**
- for WTA: 4,31 – 8,62 €/kWh
- for WTP: 0 – 2,16 €/kWh
- Disparity between WTA and WTP, as perceived in literature [2]

Priorities & Limitations

- Advance-notice-time: min. 24 hours preferred
- Working from home & weather limit adaptability
- Power cut duration: 1 hour (never bothersome)
- 20 power cuts per month acceptable (w. sufficient advance-notice-time)

Fears & Routines

- Food decay, data loss, restricted cooking → ungrounded fears
- New routines and adapted behavior to occurring power cuts (time spend outdoors for errands or recreation, domestic work wo. light)

Conclusion

- Consumers demand higher compensation than fees for alleviating a power cut
- Tenants are quick to adapt to power cuts and develop new routines and behaviors
- Working from home represents the main factor for finding a power cut bothering
- Advance-notice-time has the main priority, power cut frequency the lowest priority

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Literature

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