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Centre for intelligent electricity distribution
- to empower the future Smart Grid

Techno-economic optimization for analysing consumer flexibility and related market structures

Güray Kara,
NTNU-INDØK, Norway

Supervisor: Asgeir Tomasgard,
NTNU-INDØK, Norway

Co-Supervisor: Hossein Farahmand,
NTNU-ELKRAFT, Norway

Motivation and Objectives

- "Uncertainty" appears in power and energy system as way to affect market efficiency.
- In addition, the increase in power consumption needs to be addressed by the power and energy system.
- For coping with the uncertainty, power market actors are using flexibility.
- Our objective is to find an efficient solution for flexibility usage. The power and energy system flexibilities could capture long-term (investment) and short-term (operational) uncertainties.

Methods/Approach

- We aim to use flexibility in existing market designs as well as in a local flexibility market design.
- Microeconomics, stochastic optimization, and power market theory are essentials of our research.
- We work on qualitative aspects and hypotheses about flexibility with quantitative methodologies.
- Main research questions include:
  - understanding flexibility,
  - efficient usage of flexibility,
  - a new local flexibility market design, and
  - DSO and TSO coordination for flexibility.

Results and findings

- The flexibility in power and energy systems are appearing in different "dimensions" such as *time*, *spatiality*, and *technology*.
- Among these dimensions, the time has strongest impact on decision making, especially for grid operations.
- It is efficient to use flexibility for grid operations such as *voltage*, *losses*, and *congestion*, however one should consider dimensions in decision making.
- From customer perspective, electricity prices is strongest indicator for end-user participation in demand-side and storage flexibilities.
- The amount of uncertainty changes over time and decision maker requires optimal amount of time to make flexibility available otherwise efficiency is lost.

Conclusions

To have a better understanding of current energy and power systems, we need to consider technological and economical fundamentals of power markets.

In this study, we offer analysis and usage of the end-user flexibility for efficient and productive power markets and system under uncertainty. We believe that this research will contribute to literature and industry with our philosophy

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