# Research and development of Demand-side flexibility

## Summary

*The increase of new kind of loads (electric vehicles, battery storage) and the increase of overall electrical energy consumption with higher peak load has to be covered by new flexible operation functions. Any new and more flexible operation including a higher degree in automation will lead to opportunities in operating power systems more efficient. The evolution of the distribution networks through increased electrification and new load and generation technologies and patterns, calls for an increased overall need for flexibility in the operation and planning of distribution networks. In addition to technological solutions, there is also a clear need for new ways of thinking regarding organizing and regulating the DSO business, together with needs for involving the grid consumers/ prosumers.*

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| Research field: | Electrical Power Engineering and Mechatronics |
| Supervisors: | Roya Ahmadiahangar<br>Argo Rosin |
| Availability: | This position is available. |
| Offered by: | School of Engineering<br>Department of Electrical Power Engineering and Mechatronics |
| Application deadline: | Applications are accepted between November 16, 2020 00:00 and December 16, 2020 23:59 (Europe/Zurich) |

## Description

**The main objectives** are the identification of the available flexibility in the demand side, optimization and aggregation solutions at the system level with machine learning-based methods.

- Integration of real-data into power system operation to improve the efficiency
- Utilizing the available flexibility of local and distributed storage, and residential loads to increase the grid stability and customer cost-effectiveness

Expected/hypothetical content of the thesis

1. Introduction
2. State of the Art
    1. Challenges and opportunities in the demand side flexibility
    2. Overview of machine learning algorithms and their application in smart grids
3. Prediction and identification
    1. State of art analysis
    2. Development and simulation of Learning systems
    3. Results
4. Optimization
    1. State of art analysis
    2. Development of optimization methods
    3. Development of coordinated Demand Response programs
    4. Results
5. Validation and evaluation of designed solution

6. Conclusion and discussions

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