Title: Flexibility coordination schemes for transmission and distribution system operators

Description: Over the years, increasing shares of distributed energy resources are pooled by aggregators to provide flexibility to ancillary services markets at the Transmission System Operator (TSO) level or to local markets at the Distribution System Operator (DSO) level. Today, TSOs and DSOs do not systematically coordinate the access to and activation of distributed flexibility. As a result, there is a rising concern about the efficient usage of available flexibility as well as the potential side effects of flexibility activations by the TSO on the DSO grid, or vice versa.

This student project will investigate market designs and develop methods to coordinate and optimize the utilization of aggregated flexibility simultaneously by TSOs and DSOs. The overall objective is to use flexibility for the services and grid levels with the highest value at any point in time, while considering network constraints. The project will focus on the needs of the Swiss system and will be part of a larger ongoing R&D activity at Swissgrid.

Previous work in the scientific literature can be categorized into five market design models: (1) Centralized ancillary service market; (2) Local ancillary service market; (3) Shared balancing responsibility model; (4) Common TSO-DSO ancillary service market; and (5) Integrated flexibility market. Although market clearing and Optimal Power Flow (OPF) algorithms are key elements for each of the five market models, different organizational and technical challenges exist for each of them including split of roles, computational performance, and necessary data exchange.

Current work in the R&D team has focused on conceptualizing possible market designs for the Swiss system inspired by the previously mentioned market models. Under the guidance of the R&D team, the student will contribute to the conceptual designs and work on their software implementation. Specifically, the following activities are conceivable:

- Contribute to conceptual work by reviewing TSO-DSO coordination schemes available in the literature or used by other system operators and make suggestions.
- Propose new and extend existing mathematical optimization problem formulations for selected TSO-DSO coordination market designs.
- Address key aspects of the problem, for example, an efficient representation of DSO grid constraints into the TSO problem, and data communication needs between the TSO and DSO.
- Improve computational performance, scalability and convergence, e.g., using decomposition techniques, reduced-order network models or distributed approaches.
- Implement selected approaches into a software prototype together with a simple Graphical User Interface (GUI) to facilitate usage.
- Define simulation use cases to demonstrate the benefit of TSO-DSO coordination and to compare the investigated approaches.
- Coordinate with internal and external stakeholders to ensure that the developed approaches are aligned with the overall requirements and business needs.

Based on the list above, the exact tasks will be defined together with the student depending on the progress of the larger ongoing R&D activity, the student's interests and the project duration.

Type: Master thesis, internship, or combination of these (duration 6 – 12 months).

Student profile: The skills of a successful candidate include:

- Solid background in electric power systems, good understanding of the Swiss electricity sector and, ideally, prior experience with optimal power flow problems.
- Strong background in mathematical optimization and/or metaheuristic optimization.
- Very good programming skills for developing software prototypes (preferably in Matlab and Python).
- Prior experience with power systems analysis tools (preferably PSS/E) is a plus.
- Ability to work independently and efficiently prioritize tasks.
- Very good communication and presentation skills and willingness to excel in a business environment.
- Languages: excellent command of English; knowledge of German and/or French is a plus.

Benefit for the student: As part of an innovative team, the student will have the chance to work on a mathematically intriguing problem, apply optimization methods and create added value, while solving an important problem for the TSO/DSO industry in general and the Swiss system in particular.

Application process: Interested candidates can either submit their applications directly to the email address below or through the posting of the open position at Swissgrid's website: https://recruitingapp-2472.umantis.com/Vacancies/1810/Description/2?lang=eng.
Applications should include a cover letter, a CV, and transcripts of records.

Contact details:

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