

BTU Cottbus-Senftenberg  
Chair of Energy Distribution and High Voltage Engineering

## Task Definition for Master Thesis

### Topic: Cellular Approach in Formation of Smart Energy Regions

It is highlighted in many studies that energy supply with 100% renewable energies in Germany, Europe as well as worldwide is possible. However, it requires decentralized power generation along with sufficient energy storage options. In order to increase the share of renewable energies in the electricity supply system, it is not appropriate to produce and store the energy in certain regions where energy production from renewable sources is economically viable, but each region must provide its contribution in energy supply by means of using its potentials.

With increasing decentralized energy production, the necessity of power grid expansion increases also. Since, the originally designed distribution electricity grids in some regions are connected to strong RE potentials which sometimes must transmit high capacities. Looking for new solutions, current research projects focus on regional energy supply concepts in the medium and low voltage levels. These research projects include new aspects as well as perspectives for the electricity supply grid and propose new supply structures with respect to the existing electricity grid. Smart Grids and Smart Regions are good examples of implementation of self-contained regional energy supply systems in practice.

In order to reduce the supra-regional energy transport and to reduce the grid expansion demands, it is strived for the utmost autonomy of the regional energy supply systems. Nevertheless, it will be necessary to link the individual regions with each other in order to exchange energy. The cellular approach can therefore not only follow the strategy of fully balancing the individual cells with regard to regenerative production and consumption, but it must also take into account the exchange potentials with the neighboring regions. To what extent the individual regions / cells have to be self-sufficient (degree of self-sufficiency), is a crucial question of these investigations.

The following topics are to be dealt with as part of this master thesis:

Theoretical considerations:

- Characterization of possible cell types for different objectives of the operation
- Development of a criteria catalog for required components in the respective cell types
- Operating concepts for largely autonomous cells (responsibilities, competence, classification of the roles of the TSO and the DSO in this structure)

Application of the theoretical model in practice:

- Transfer of the theoretical approaches to a regional grid in Brandenburg, including statements on
  - Feasibility
  - Economic impacts
  - Impacts on grid infrastructure