

# Analysis and Synthesis of Robustly Controlled Smart-Grid-Systems (ROCS-Grid)

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- Conventional power systems

- Transmission and distribution lines owned by the same company
- No uncertainty arising from renewable-based power-producing units

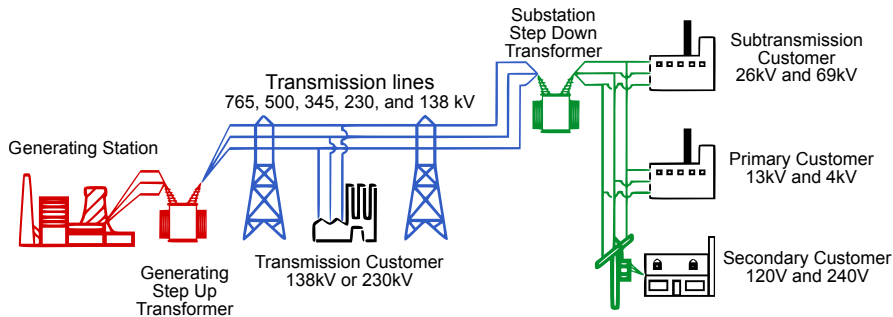


Figure: Overview of the conventional power grid operation.

- Smart grid systems
  - Management of bidirectional energy flow in a competitive market
  - Less predictable operation of the overall system

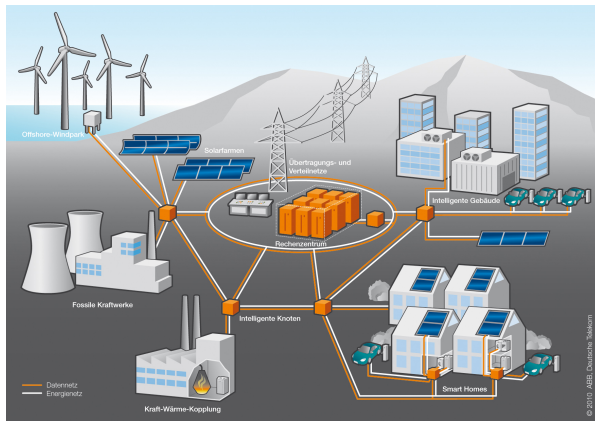


Figure: Overview of the smart grid.

# Topic 1: Assessment of Power Systems

- Current techniques
  - Deterministic simulations using (N-1) security assessment
  - Lyapunov direct method
  - Set-based reachability analysis
- **Task:**
  - Literature review about Lyapunov stability in power system
  - State-of-the-art with regards to the estimation of the domain of attraction
  - Implementation on a simple example in power systems (e.g. SMIB)

## Topic 2: Impact of Renewable Resources on Power Systems

### ● Background

- Variable nature of renewable resources (wind, solar) introduces uncertainty
- The effect on the generation side is not known due to forecast errors

### ● Task:

- Literature review about impact of renewable resources
- Implementation on a simple example in power systems (e.g. SMIB)

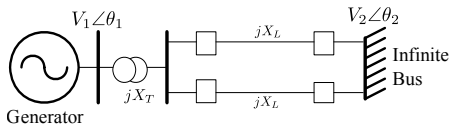


Figure: Overview of a single-machine-infinite-bus (SMIB)

## Topic 3: Identification of Cyber Attacks in the Smart-Grid

- **Background**

- Several challenges in the grid due to the interaction between the IT systems and the power transmission and distribution system
- The Automatic Generation Control (AGC) is one of the few control loops that are closed over the SCADA system without human operator intervention

- **Task:**

- Literature review about application of reachability methods in the case of a cyber attack
- Implementation on a simple example in power systems (e.g. SMIB)