



Active Distribution Networks

Roles and Challenges

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Presentation of Seminar Paper

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Outline



- Introduction & background
- Quantification
- Model & Results



- Initiating Event: **shortages in residential sector**

H1: Current Systems overloaded by energy transition

- System Analysis

H2: ADNs are a general possible partial solution

ADN = active distribution network

H3: ADN applicable for CZ and AT

- Linear Modeling (Unit commitment)

Inertia, stability and flexibility



- **Inertia**: electrical system's own characteristic that evens out voltage fluctuation
- **Stability**: how well voltage fluctuation is endured
- **Flexibility**: technologies that are used to add stability
 - DSR (consumption)
 - Generation
 - Sector Coupling
 - Transmission
 - Distribution
 - Storage



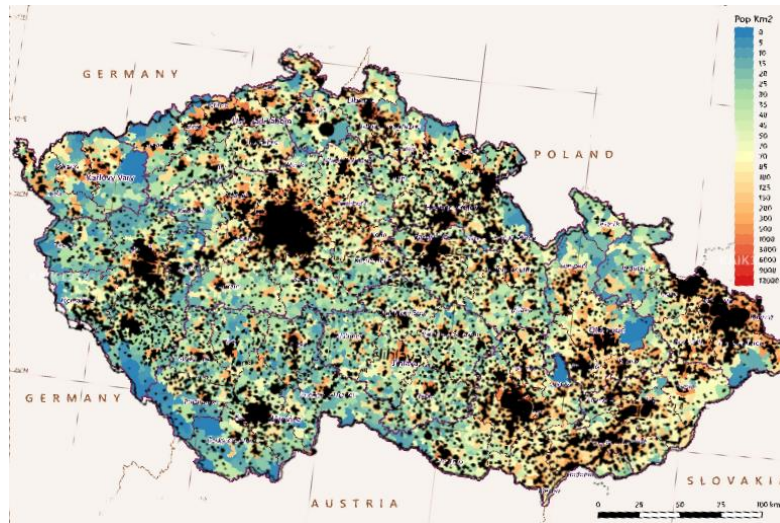
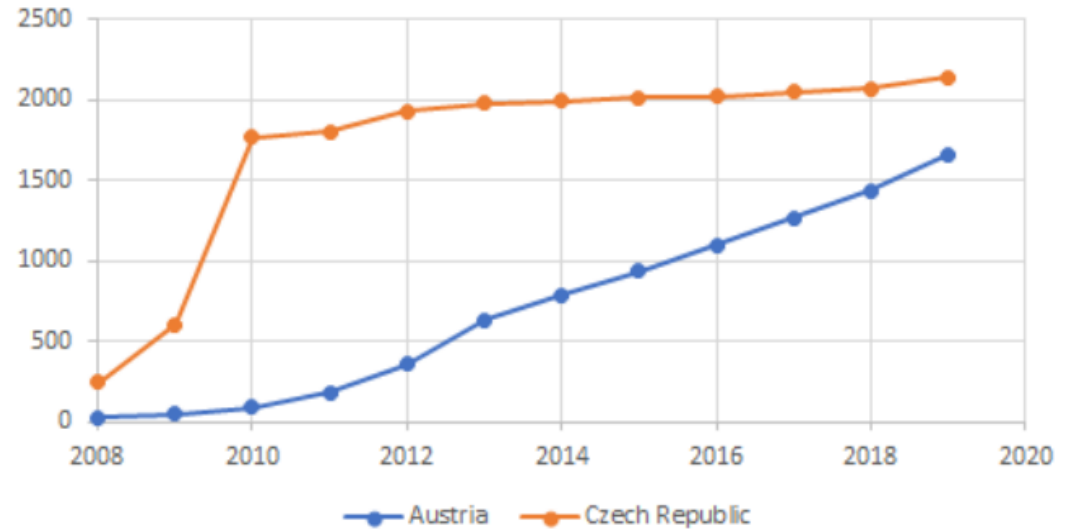
- Introduction & background
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Renewables

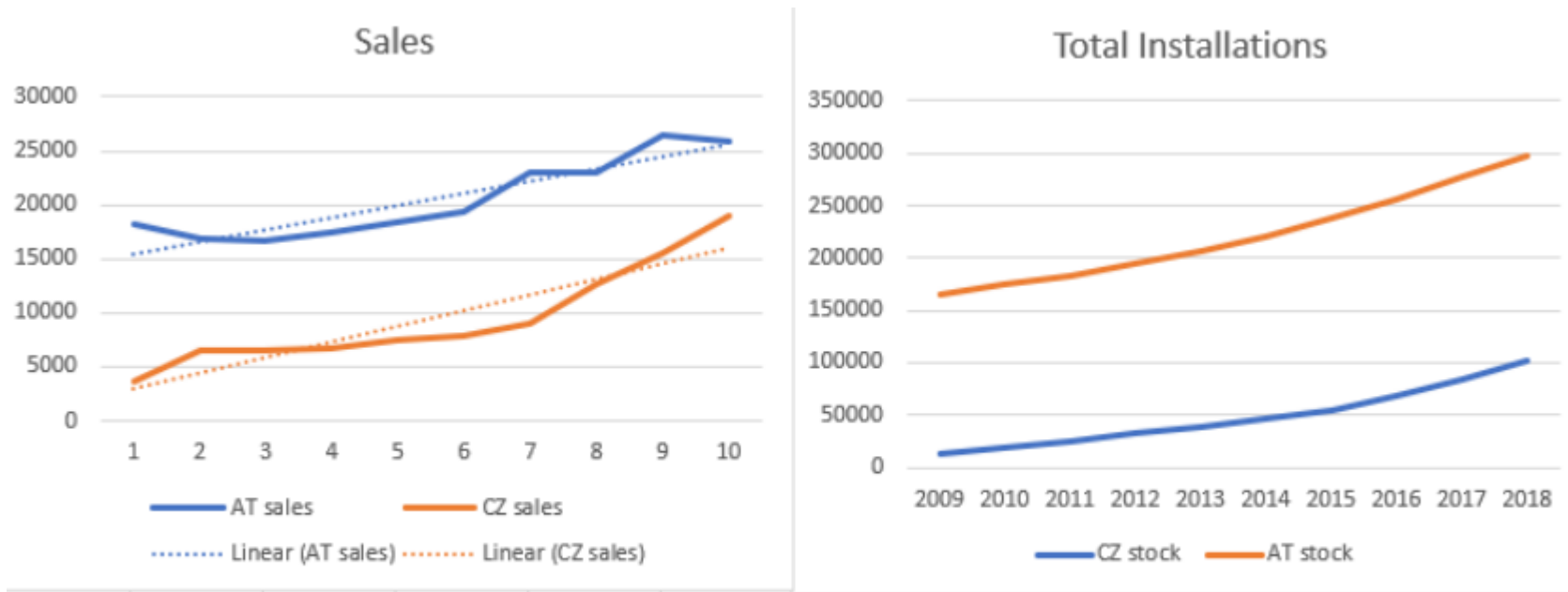


- Current fossil fuels as well as new consumption are both being covered by RES
- Low inertia value

Total PV capacities in MW



Electrification of Heating

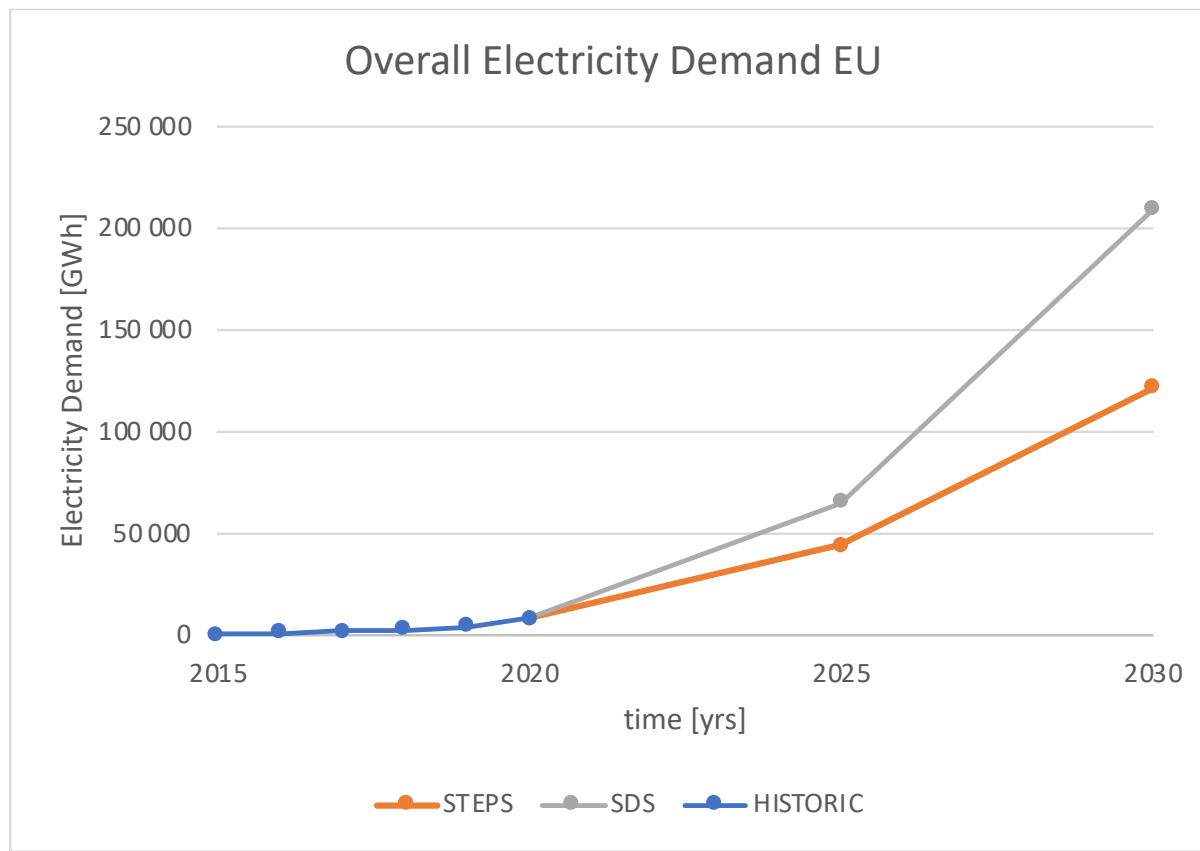


Yearly AHP sales [left] and total installations [right] in AT and CZ.

- Mostly Air Heat Pumps (AHP), but also air-water heat pumps, electric boilers, and geothermal solutions, etc.

EVs

- Transport Sector Transition poses great burden
- Increasing peaking behavior





- **Active Distribution Networks (ADNs)**
- “at least some production within the DN)”
 - Supports distribution generation
 - Environment for smart grid implementations
 - Aids the implementation of flexibility-adding technologies
 - Creates possibilities for prosumers



- Introduction & background
- Quantification
- **Model & Results**

Modeling concept

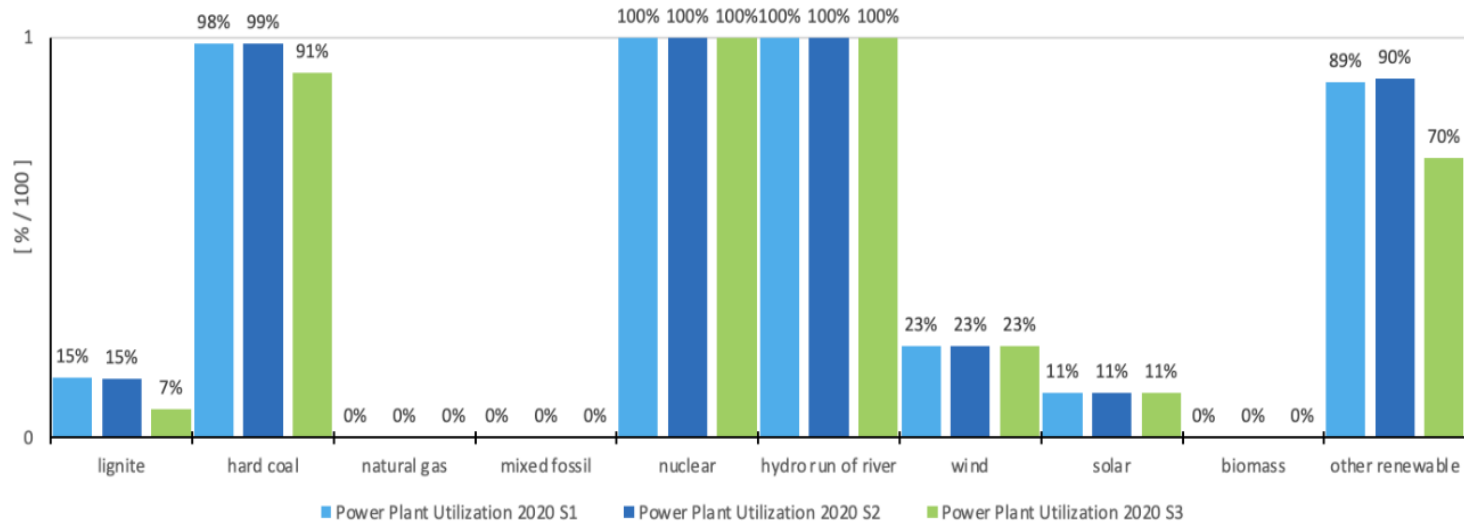
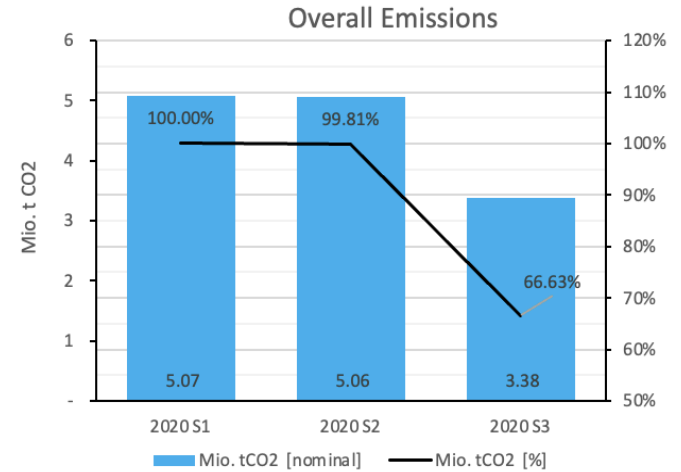


- Linear optimization, hourly resolution
- Limited application!
- 3 Scenarios:
 - Business As Usual (BAU)
 - Flexibility on Micro Level (external peak shaving)
 - Flexibility on Macro Level (optimal DSR)

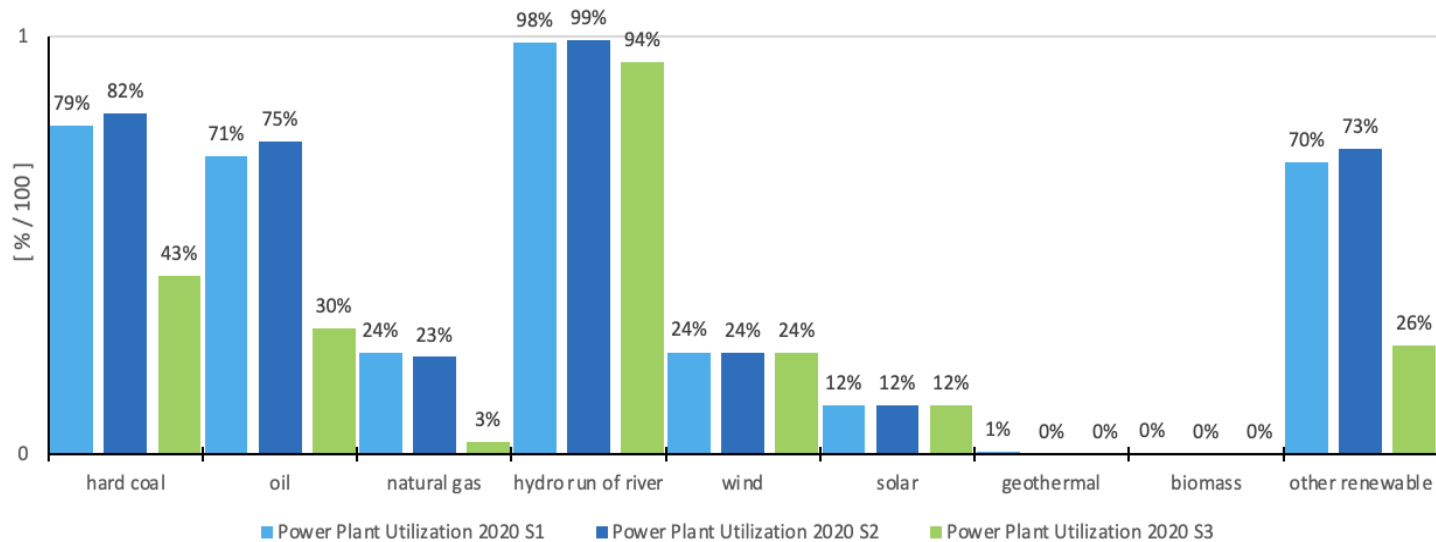
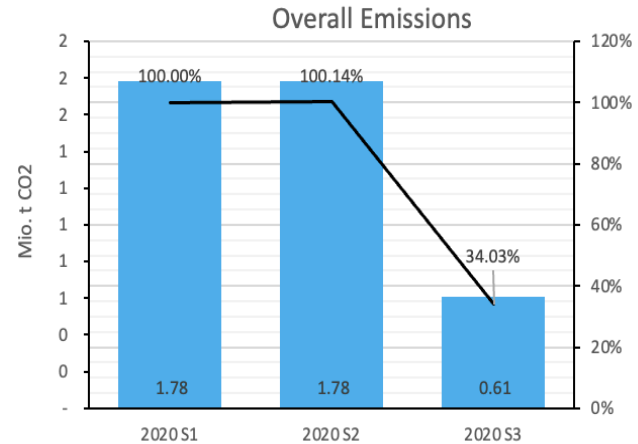
$$\min_{P_j} C_{total} = \sum_{t=1}^T \sum_j (P_{j,t} LCOE_j)$$

- Realistic Degrees of Freedom rDoF

→ = 4



- Greater rDoF (=6)
 - More deployable flexibility
 - More Emission, Cost reduction



Conclusions



- EVs & electrification of heating => more consumption => more RES => less inertia => less stability => need for flexibility => need for ADNs
- H1: Current Systems overloaded by energy transition **confirmed**
- H2: ADNs are a general possible partial solution **confirmed**
- H3: ADN applicable for CZ and AT **confirmed**
- Macro level Flexibility aided by rDoF, System capacities



Thank you!

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