Energy Valley Bavaria: Flexible Power Plants

Modeling & Analysis of the Future European Transmission System

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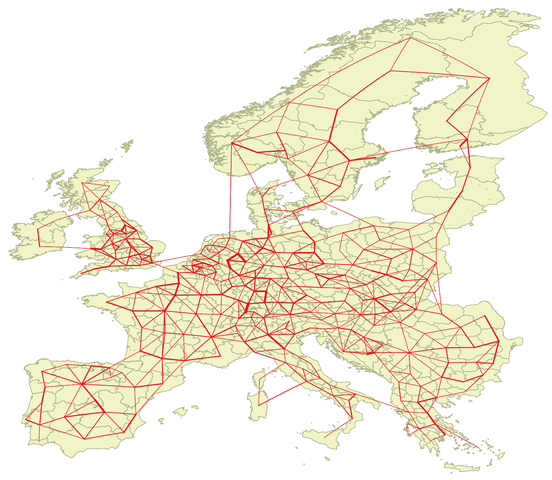
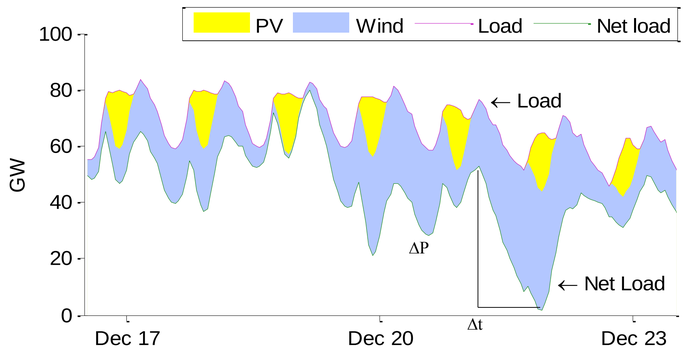
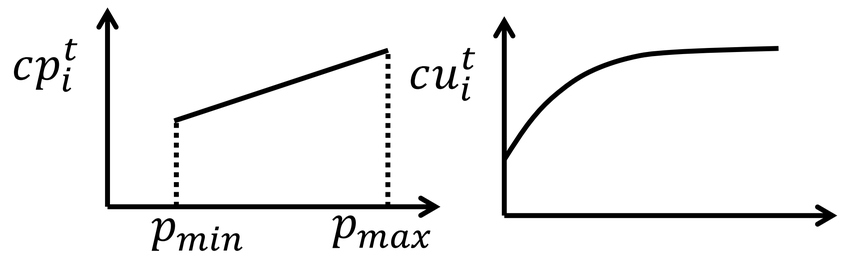
The large-scale deployment of renewable generation within the future European power system poses a range of challenges in the field of network planning and operation. Improvement of existing transmission infrastructure and use of new operational strategies, such as curtailment of renewable generation, will be required to avoid line overloading during times of peak feed-in, whilst advanced generator dispatch strategies will be used to ensure sufficient generator ramping flexibility is provided.

Modeling: Unit Commitment & Power Flow





$$\min cost = \min \sum_{i,t} cp_i^t + cu_i^t$$



Load Flow Model

- Impedance network calculated from geographical line lengths

Time-Series Input Data

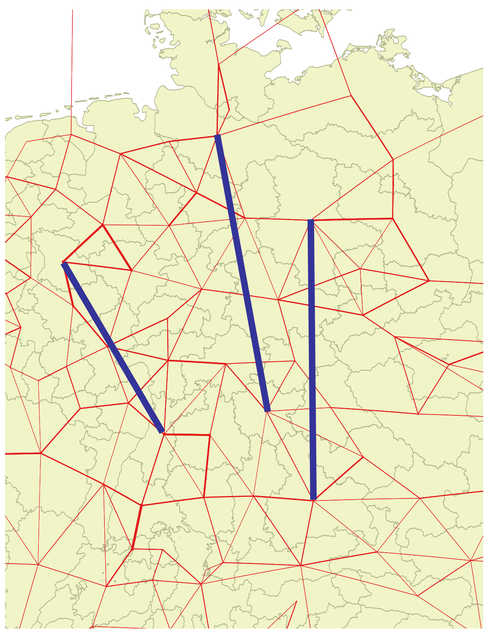
- Hourly weather and load information

Unit Commitment & Dispatch

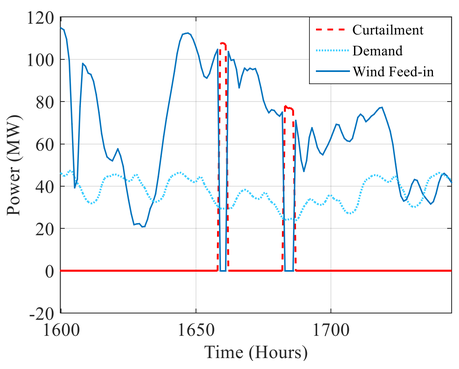
- Finding cost optimal solution for power plant operation to model the electricity market

Analysis: How to Guarantee a Stable and Secure Energy Supply?

Upgrade of Transmission Lines



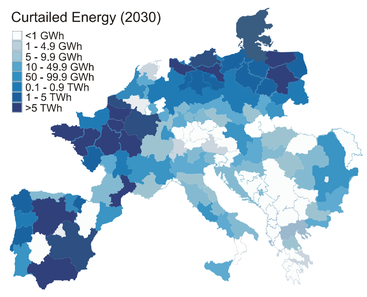
Planned HVDC links in Germany are included in the model to evaluate their effects on the power systems. Policy advice can be derived from the scenarios.



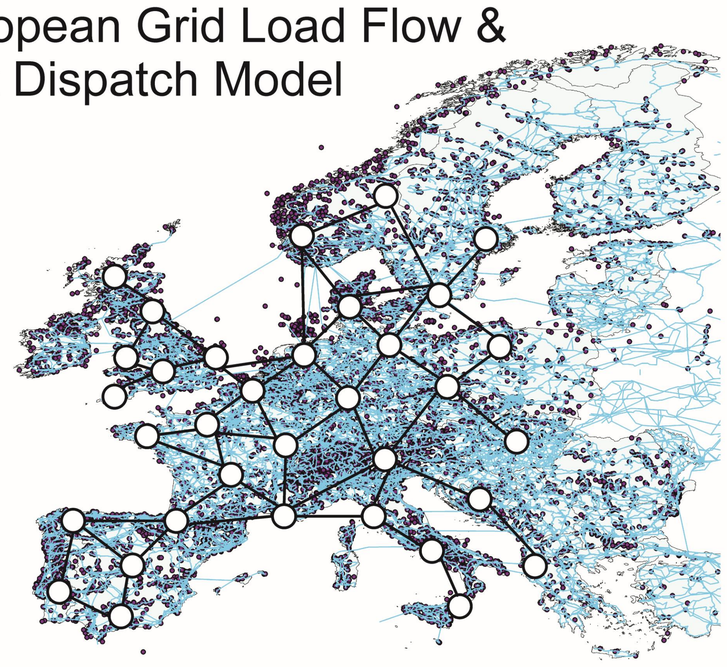
Renewable Energy Curtailment

During peak feed-in, line overloading can occur. Feed-in curtailment (left) may cost less than line upgrades.

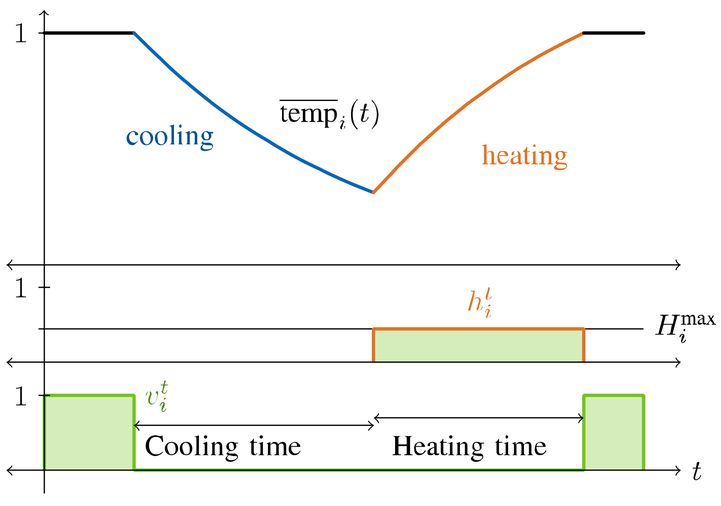
Potential grid plans are assessed by their curtailment requirements (right).



European Grid Load Flow & Unit Dispatch Model

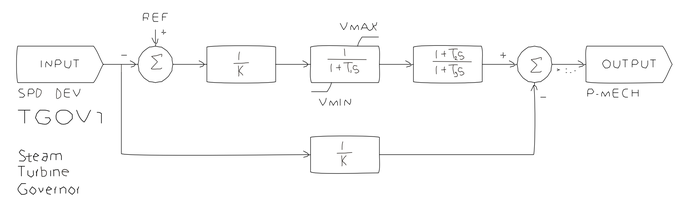


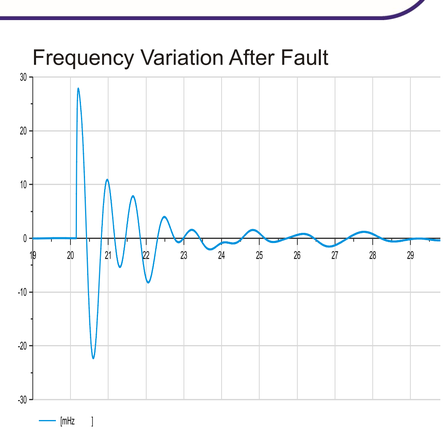
Optimal Generator Dispatch



Including temperature in UC allows to find optimal preheating strategies. New options for flexible power plants can be evaluated.

Dynamic Stability





The addition of power plant control system models (above) allows the investigation of dynamic stability after system faults such as line and generator outages (left). This gives a measure of how secure the supply is during high renewable feed-in.

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