

Challenges in Energy System Planning, including Stakeholder Perspectives

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How does system transformation change the relationship between regulation and policy-making?

Liberalisation: Network regulation as an apolitical task

- Focus on efficiency and competition
- Implementation is a technical task → independent regulator

System transformation: networks have significant impact on future developments.

- Networks no longer a neutral infrastructure
- But networks become part of the political discourse

Is infrastructure transformation still a technical question that can be addressed by an independent regulator?

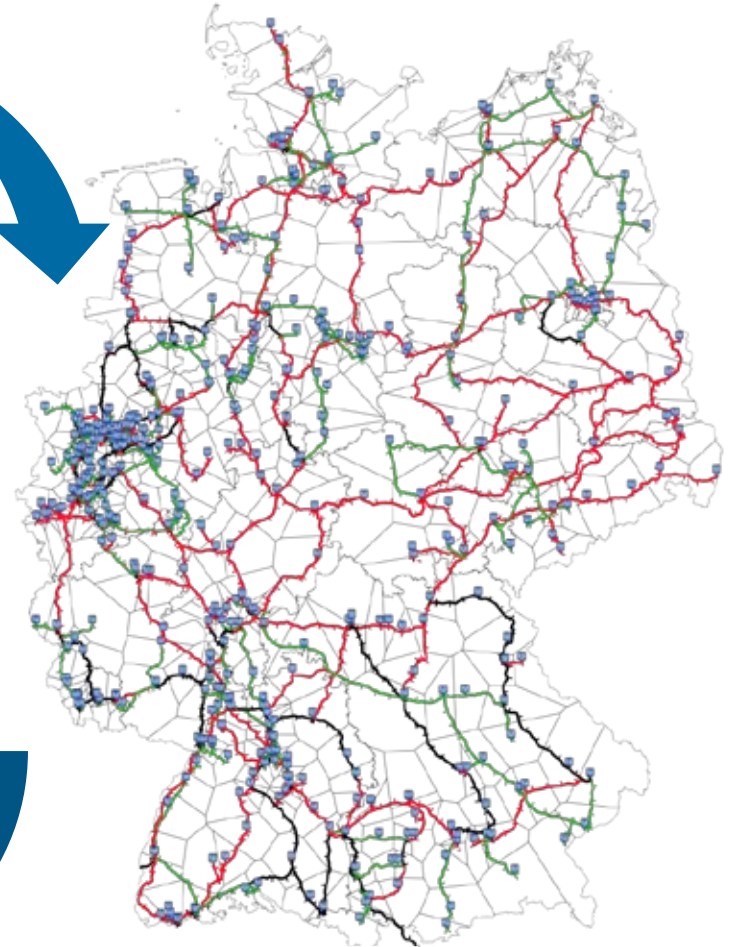
→ Network development process with stakeholder participation

Project: Transparency of Power Network Development Access for stakeholders to network modelling

**Stakeholder
discourse**

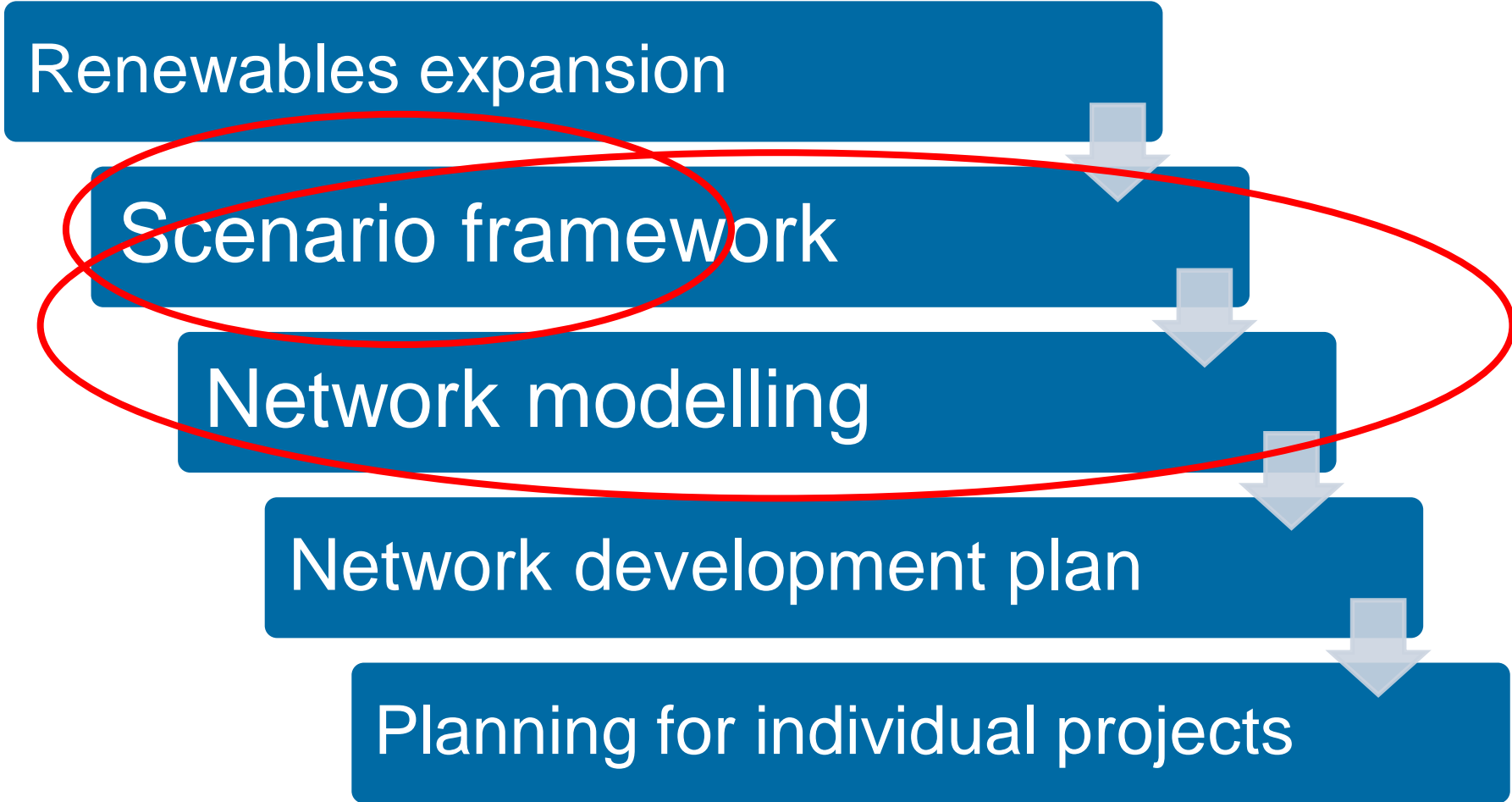


GEFÖRDERT VOM



DC network model

The discourse on network expansion in different procedural steps



Renewables expansion

- No consensus on network expansion
- In principle, it is accepted that demand for network expansion is triggered by renewables.
 - Nuclear phase-out has weakened the argument that infrastructure expansion is due to the „old energy system“ (e.g. discussion on pumped storage before the nuclear phase-out).
- But: Discussion on „lignite lines“
 - Also triggered by RES expansion
 - But are these lines needed to promote fossil plants in a renewable world?
- But: Is network expansion due to the EU internal market?

Scenario framework

Within the discourse on energy transformation, there are

- Different visions and scenarios for the future renewables system,
- Different views on how these affect the demand for network expansion,
- Different views on the role of the network:
 - Network expansion should enable all market interactions
 - Network modelling based on market model results
 - vs. network constraints should not necessarily be removed, but managed (based on price signals)
 - Integrated modelling of network and markets / „Redispatch“

Scenario framework

Scenario framework should cover the range of these developments

Is network expansion the cheapest flexibility option, or should other options have priority (Storage, Load management)?

Centralised or decentralised system: Can network expansion be reduced by

- decentralised plants
- and/or decentralised system control
- This goes far beyond the network expansion debate.

Network modelling

Two potential problems:

- Modelling results are not reliable
- Modelling not transparent, only network operators have access

The project addresses the second issue.

Also relevant is the interpretation of modelling results

- A key question discussed in the stakeholder discourse is how to define the necessity of a line
 - Peak load threshold for one hour
 - Peak load threshold for several hours
 - Cost benefit analysis

Stakeholder process: Scenario definition

Scenarios focusing on assumptions about the electricity market:

- Future amount of installed capacity of lignite power plants (scenario 1)
- Future level of decentralization (ongoing)

Scenarios focusing on assumptions about the underlying grid:

- Necessity of Corridor D (scenario 2)
- Modification of Corridor C (scenario 3)
 - Additional converter station in Mecklar instead of the AC power line connecting Mecklar with Grafenrheinfeld (P43/74)

Basic methodology

Solve optimization problem (GAMS) minimizing operating costs

- ~ 500 nodes, AC grid, DC lines, individual power plants, simplified European energy exchange, hourly resolution

Run model on reference scenario and modified scenario

Compare key figures of

- electricity market
- grid usage

Focus on necessity of planned grid development projects

Example: Stakeholder scenario 2: „Avoiding Corridor D“



Reference scenario

- 2nd draft of GDP2024 commented by BNetzA
- Usage of corridor D at a level of 60%, transporting 9 TWh from Saxony-Anhalt to Bavaria and 1 TWh the other way round

Scenario variation:

- Avoiding the planned construction of corridor D connecting Wolmirstedt to Gundremmingen in 2022

Stakeholders' interest:

- Assumption: Need of corridor D is caused by infeed of lignite power plants rather than RE integration

Reference scenario vs. corridor D scenario: Electricity market – key figures

Lignite generation in Germany

- Decrease by 1.5 TWh (-1.5%)

Overall costs Europe incl. Germany:

- Increase by 70m € (+0.07%)

CO₂ emissions Europe incl. Germany:

- Decrease by 1.9m t CO₂ (-0.16%)

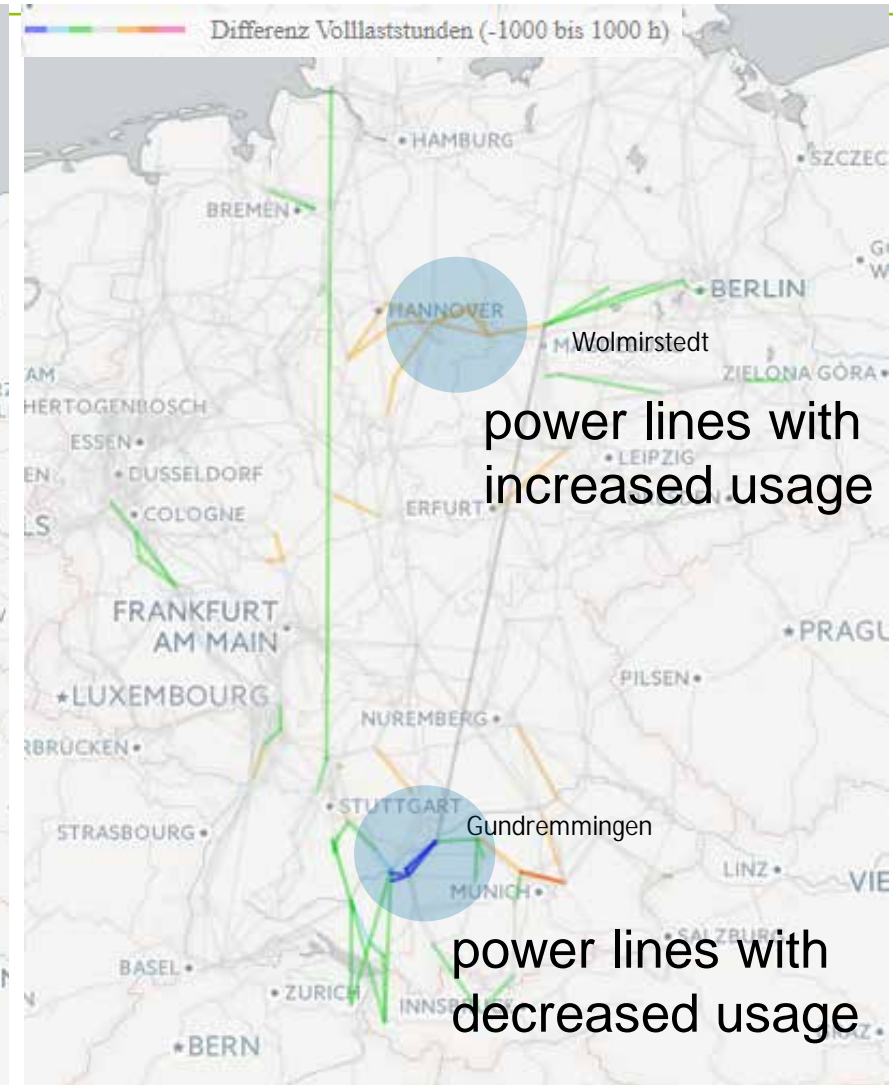
Electricity exchange (German perspective):

- Increase of exports to PL (+1.3 TWh), DK/NL/BE (+0.6 TWh)
- Increase of imports esp. from AT (+3.5 TWh)

Differences in production / load flow:

- Energy production in Bavaria: +1,5 TWh natural gas
- Usage of Corridor A directed to BaWü: +3,5 TWh
- Increase of AC load flow between Thuringia and Bavaria: +1,5 TWh

Reference scenario vs. corridor D scenario: Comparing grid usage



Reference Scenario vs. Corridor D Scenario: Changes in the demand for grid extension?

In case of decreases:

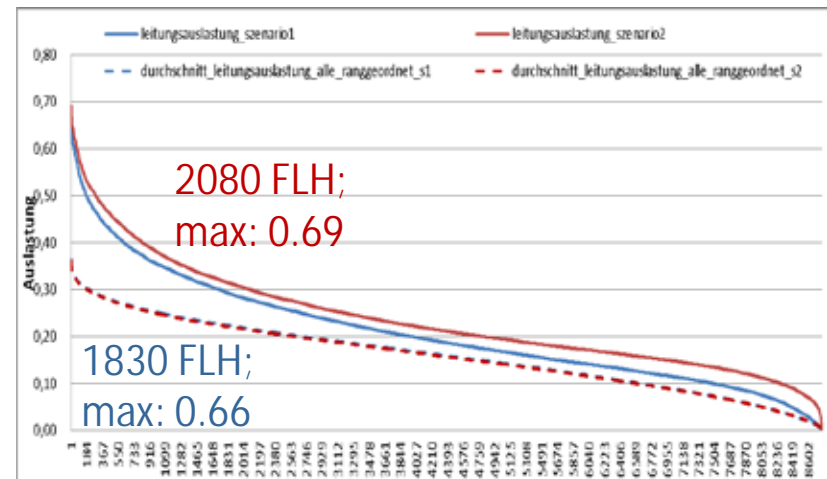
- Still necessary according to the definition of BNetzA (or other)?
- Peak Loads
- Load Duration Curves

Problem:

A profound analysis of the necessity of any power lines should provide the proof whether the lack of a certain power line does provoke congestions.

In case of increases:

- Potential new congestions?
- Peak load at maximum capacity?
- Number of hours close to maximum capacity
- Comparison of high operation levels at hours of special interest



Reference Scenario vs. Corridor D Scenario: Results discussed with the stakeholders

- Electricity production of lignite power plants does not decrease significantly. Corridor D cannot be confirmed to be a lignite corridor.
- Effects to substitute the transportation role of Corridor D (neighbouring countries, increasing generation in the south of Germany, AC grid, DC corridors)
- Between Thuringia and Bavaria, new congestions take place. To maintain a common electricity market, grid extensions in this region are necessary.
- Value of corridor D may increase over time, but effect on lignite may also increase → Analysis for 2034