EMP

Energy Modelling Platform for Europe

EMP-E 2021: Re-Energising Sustainable Transitions in Europe

Energy System Modelling, Methods & Results to support the European Green Deal

26th to 28th October · online

Future Energy System – towards a decarbonised Europe

Jonas Lotze
TransnetBW GmbH, Germany

TRANSNET BW

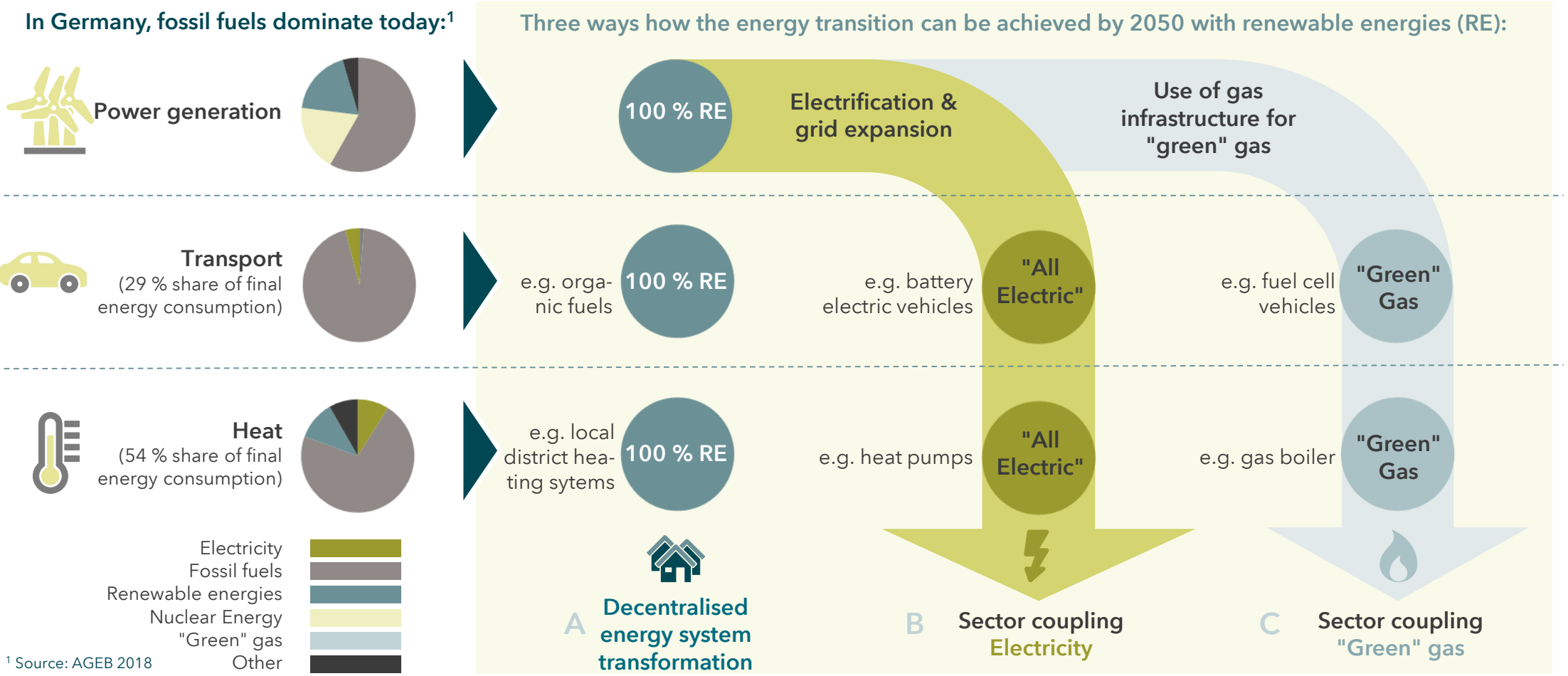
October 27, 2021, Session Modelling Policy Targets to Implementation

hosted in cooperation with the European Commission

TRANSNET BW ENERGY SYSTEM 2050 Towards a decarbonised Europe

EMP Energy Modelling Platform for Europe

The important Role of sector coupling for a cost-optimised energy transition



[1] Source: AGEB 2018

TRANSNET BW ENERGY SYSTEM 2050 Towards a decarbonised Europe EMP Energy Modelling Platform for Europe

How will the future energy system look like?

What role has sector coupling to play in the future energy system?

What are the necessary investments related to this transition?

How much infrastructure does the energy transition need? And when do we have to start planning?

How does the economical path of the EU energy system towards 2050 look like in terms of the generation capacities, technologies and grid development?

What challenges does the energy transition create for the operability of the power system?

How can the current grid development framework be modified to take into account long-term challenges?

Which trade-off exists among different flexibility measures (storages, e-mobility, demand side management, electrolyzers, grid expansion)?

What we already know today

Increased **energy efficiency** leads to a **decrease** in **final energy consumption** across all sectors.

Despite increasing efficiency, "**new consumers**" from the transportation, heating, and industrial sectors are leading to an **increase in electricity demand**.

Electricity and gas infrastructure are key to the **success of the European energy transition**.

In the future, **electricity** becomes the **dominant energy source**.

Electricity must be thought in a new way

- Due to its outstanding decarbonisation properties, **the power sector is the main driver of sector integration**. Wind and photovoltaic will be the main sources for power generation.

- Electricity generation can be decarbonised at comparatively low cost, but for that the current high degree of generation flexibility is given up. **This lack of flexibility is bought from other sectors**.

- The integration of energy systems goes hand in hand with increasingly **enhanced infrastructural links**, which enable imports of low-cost power.

- The conventional idea of serving demand with generation no longer applies in the future energy system. Instead, the markets must develop balances that are no longer determined by the demand, but by the **degrees of flexibility of all energy applications**.

TRANSNET BW | ENERGY SYSTEM 2050 Towards a decarbonised Europe | EMP Energy Modelling Platform for Europe

Little Green Deal: Test lab "Germany 2050"

A review of the „Stromnetz 2050" study (published in April 2020)

Electricity demand

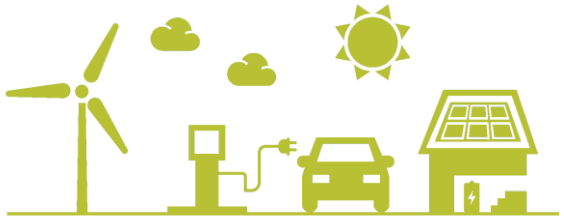
Increased electricity demand due to electrification (Increase of 55% to 842 TWh)

Electricity: final energy consumption of 527 TWh

Heat: heat pumps and resistance heating systems electrification of 40% of **heat demand**,**+93 TWh**

H_2

Transport: direct and indirect (P2G) electrification
Battery EVs: +152 TWh
Fuel cell EVs with +70 TWh



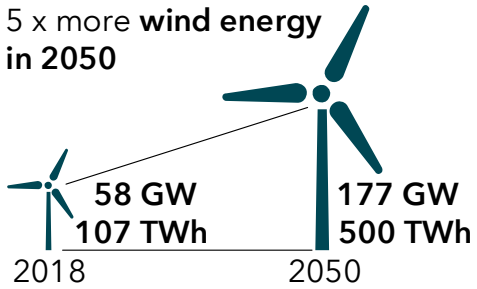
Sector coupling holds high potential for flexibilization of electricity demand

maximum simultaneous net electricity demand increases to **over 200 GW** (2018: 82 GW)

Electricity generation

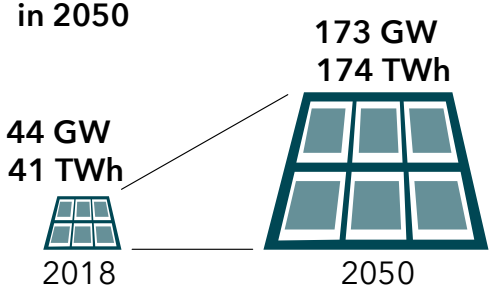
Massive expansion of wind & PV
(80% RES with a max infeed of 223 GW)

5 x more **wind energy in 2050**



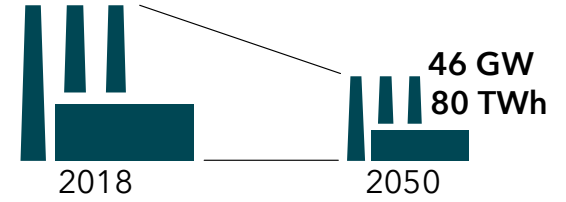
47% Wind energy offshore (2050)

4 x more **photovoltaics in 2050**



Securing electricity and heat supply

50% less **thermal generation capacity in 2050**

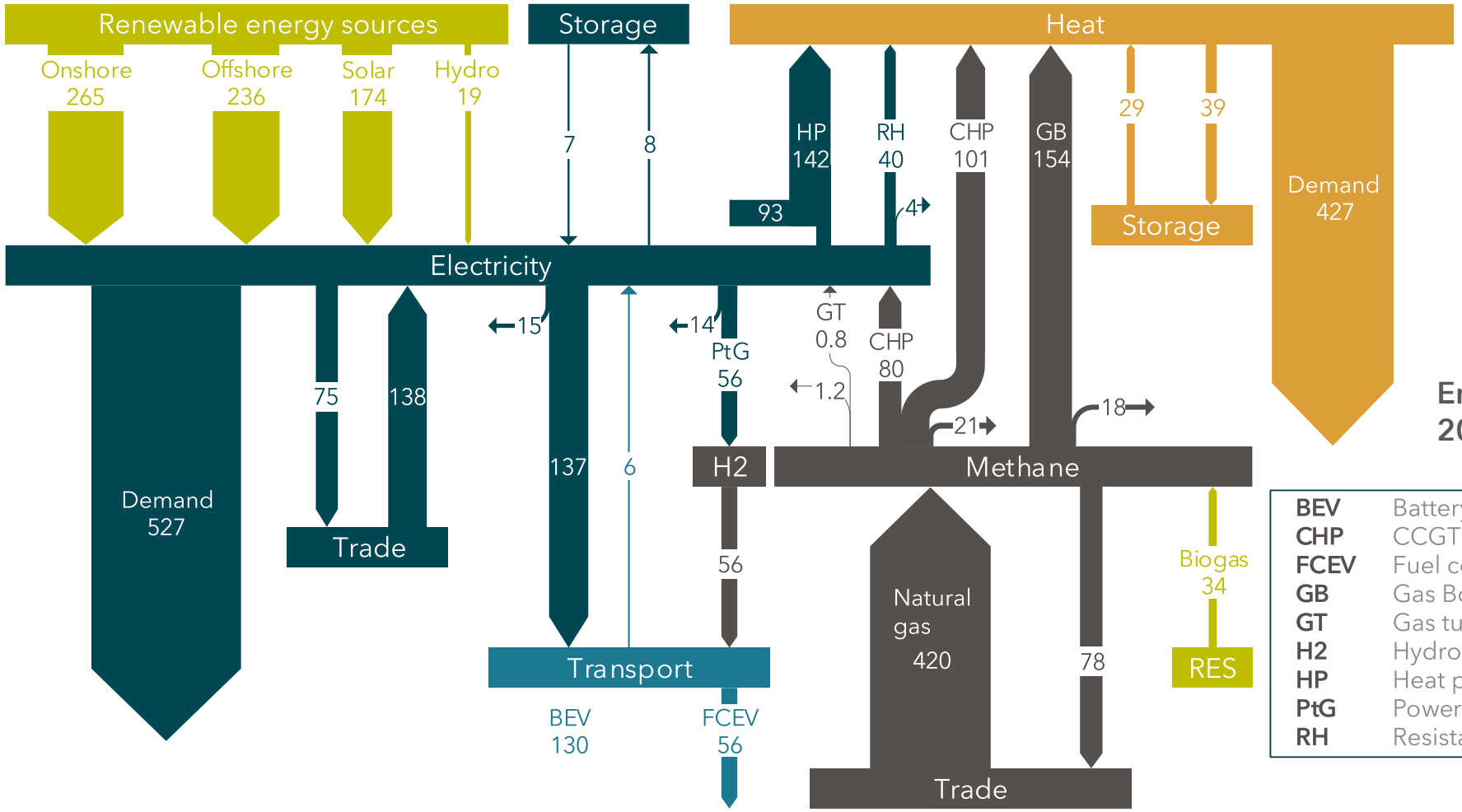


Germany becomes an importer of electricity

TRANSNET BW | ENERGY SYSTEM 2050 Towards a decarbonised Europe | EMP Energy Modelling Platform for Europe

Little Green Deal: Test lab "Germany 2050"

A review of the „Stromnetz 2050" study (published in April 2020)



How does an energy system with 90% decarbonization work?

Energy flows in Germany in 2050. All data in TWh.

BEV	Battery electric vehicle
CHP	CCGT plant with combined heat and power generation
FCEV	Fuel cell electric vehicle
GB	Gas Boiler
GT	Gas turbine
H2	Hydrogen
HP	Heat pumps
PtG	Power to gas
RH	Resistance heating system

Source: Own calculations.

* CO_2-emissions from gas combustion in 2050 = **70.4 million tonnes**

Little Green Deal: Test lab "Germany 2050"

A review of the „Stromnetz 2050" study (published in April 2020)

Reference grid: grid expansion according to confirmed German NEP 2030, version 2019

Analysis of grid utilization:

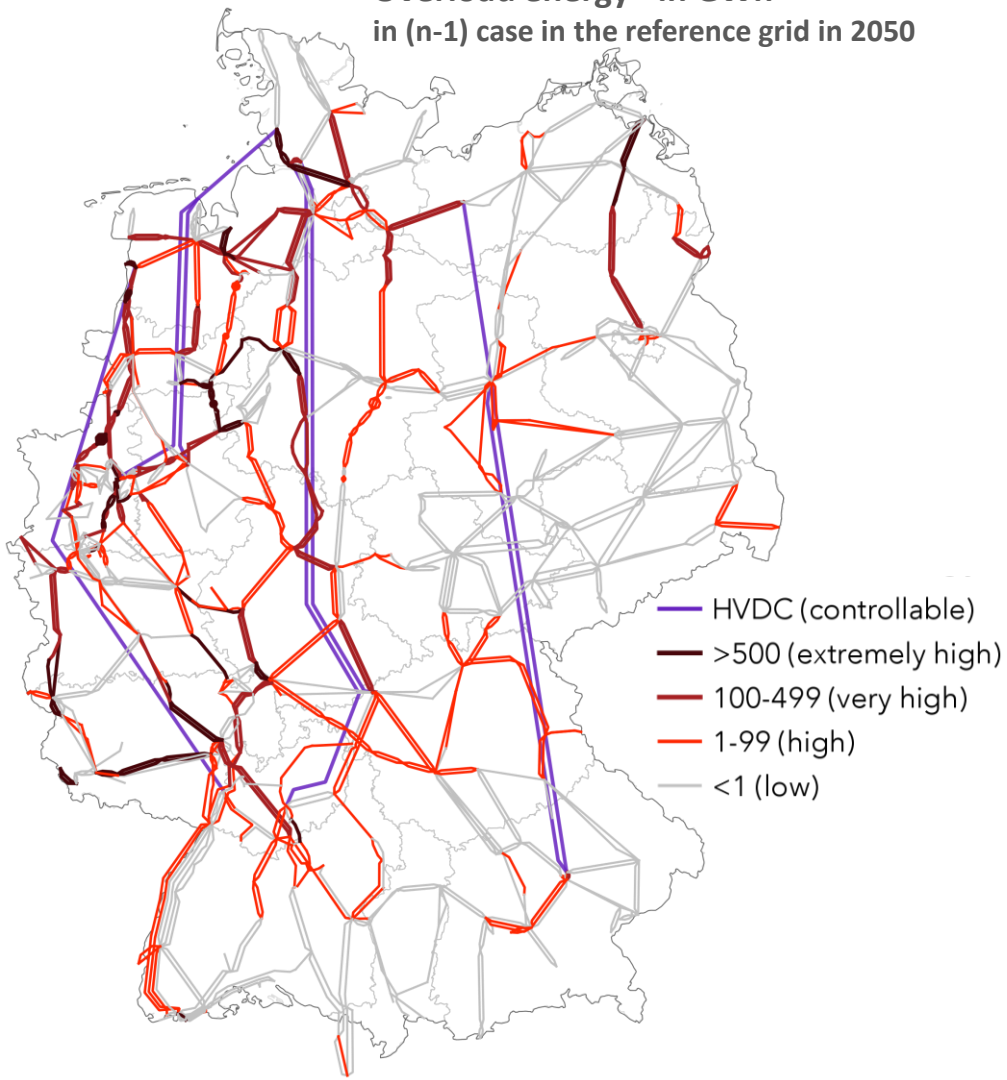
15,700 km

and therefore

40% of the extra-high voltage grid have unacceptable overloads

The integration of renewable energies requires a Germany-wide package of expansion measures that goes well beyond the measures already identified in the German grid development plan ("NEP V19")

Overload energy[1] in GWh
in (n-1) case in the reference grid in 2050



[1] Amount of energy that cannot be transmitted in the (n-1) case due to an overload.

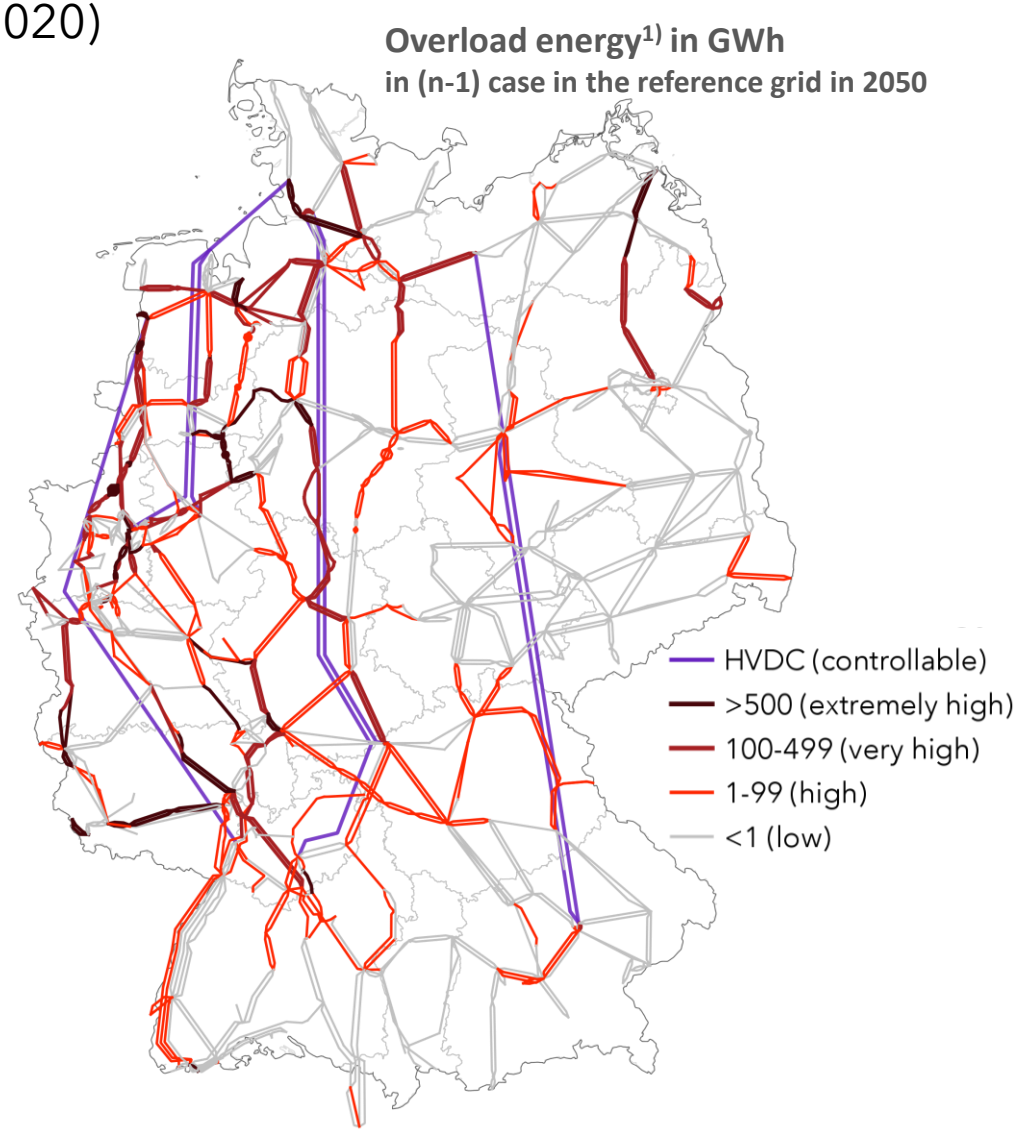
Little Green Deal: Test lab "Germany 2050"

A review of the „Stromnetz 2050" study (published in April 2020)

Conclusions:

- To develop a "no regret"-grid for 2050, you need to **think the energy transition "back from the end"**
- Baden Württemberg and Germany can be thought of as case studies: **the same principles apply to the rest of Europe**
- The study also shows results for the energy system that are not exactly within the scope of a TSO:
  - **Sector coupling** will play an important role
  - **Energy Exchange** between countries and a European analysis will become more important in the future.
- Planning with a **30-year horizon** into the future is not only necessary, it is also possible. This study shows how it can be done. For TransnetBW, this study is only the beginning!

For further information and the study document click here.

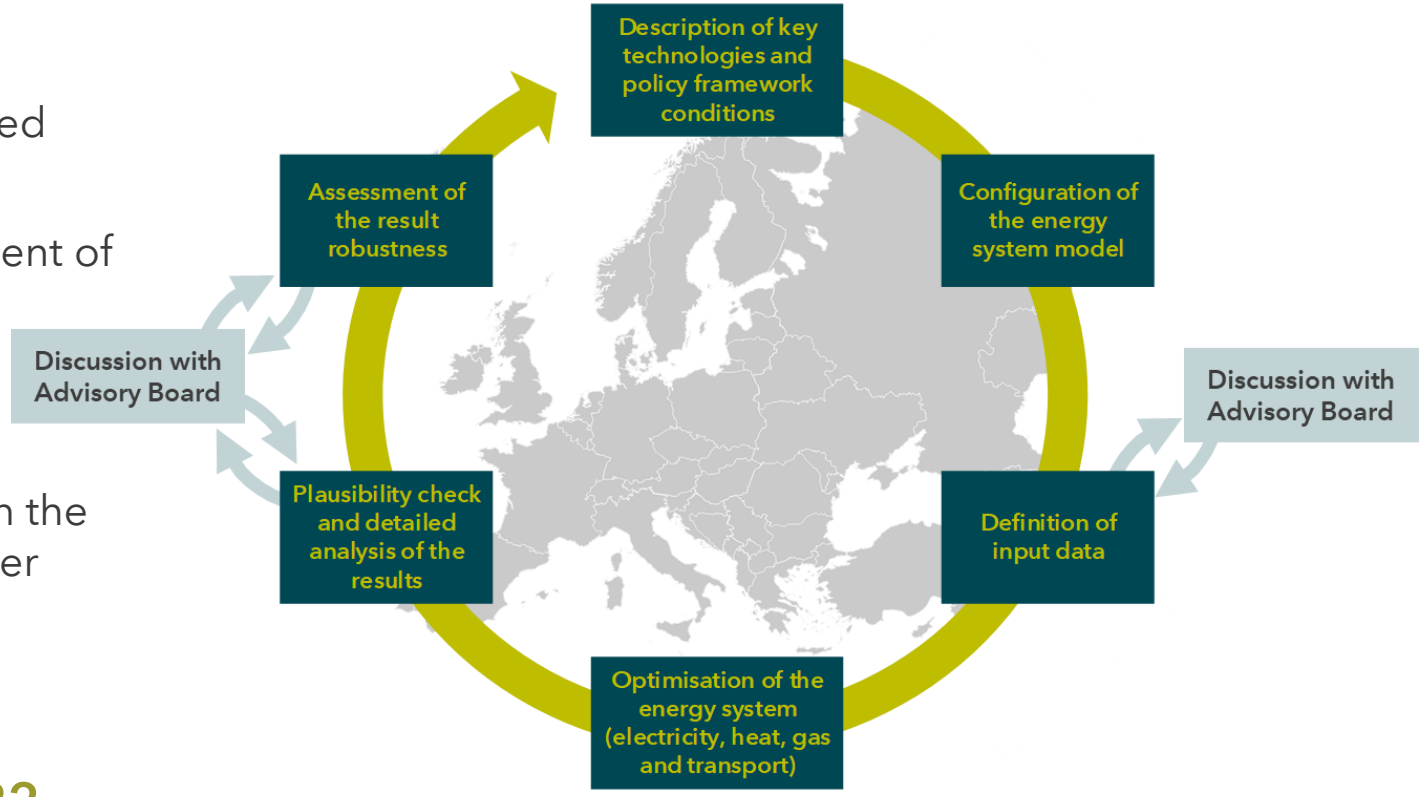


TRANSNET BW ENERGY SYSTEM 2050 Towards a decarbonised Europe

EMP Energy Modelling Platform for Europe

Energy System 2050 study: actively driving forward the energy transition

- TransnetBW develops a picture of a cost-optimized climate-neutral energy system for Europe
- Study findings outline the direction of development of current energy policy goals
- As transmission system operators, we need to proactively adapt for future challenges
- That's why the study also evaluates innovations in the power grid and the operability of the future power system



Stay tuned!

Full publication Spring 2022.

Thank you very much for your attention!

If you have any questions, the following contact is available for you:

Jonas Lotze

Project manager
Engineer Strategic Grid Planning
T +49 711 21858 3389
M +49 170 8410809
j.lotze@transnetbw.de

Terms and conditions for using presentations:

Copyrights:

/ This document is protected by copyright. Complete or partial duplication, any transmission to a third party or any other use of this presentation are only permitted after obtaining explicit consent from TransnetBW GmbH.

Liability:

/ This document was prepared with great care. However, TransnetBW GmbH cannot be held liable for the information contained therein being up to date, accurate and complete.