WestfalenWIND

„Grid integration of high volumes of Renewable Energies – Exceeding the system boundary of electricity sector“

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WestfalenWIND

What is WestfalenWIND?

- WestfalenWind is a wind farm developer
- we run some “Bürgerwindparks” (owned by citizens)
- our special focus: high degree of participation of local citizens and maximum municipal benefit
- Wind farms owned by some hundred shareholders
- offering 10 years fixed price tariffs for households

System transformation towards a RES future

RES showed a high market dynamic and a high technological dynamic during past two decades.

- No precise definition of an energy scenario 2050, but an open path development process
- Smart legal framework (obligations, incentives) provide competition among the best solutions for RES system transformation,
  The main guidelines are sustainability principles.

Grid requirements

RES power generation characteristics:

- high degree of fluctuating sources like wind and solar
- high peak power compared to average power
- decentralized systems reduce average transport distance of electricity form generation to consumers, but
- Power balancing on a local or regional level is more expensive than a wide area balancing via expanded grids:
- therefore peak transportation distance can be very long
- far distance generation like form offshore wind, north African solar, or Scandinavian hydro sources cause a very large grid expansion.

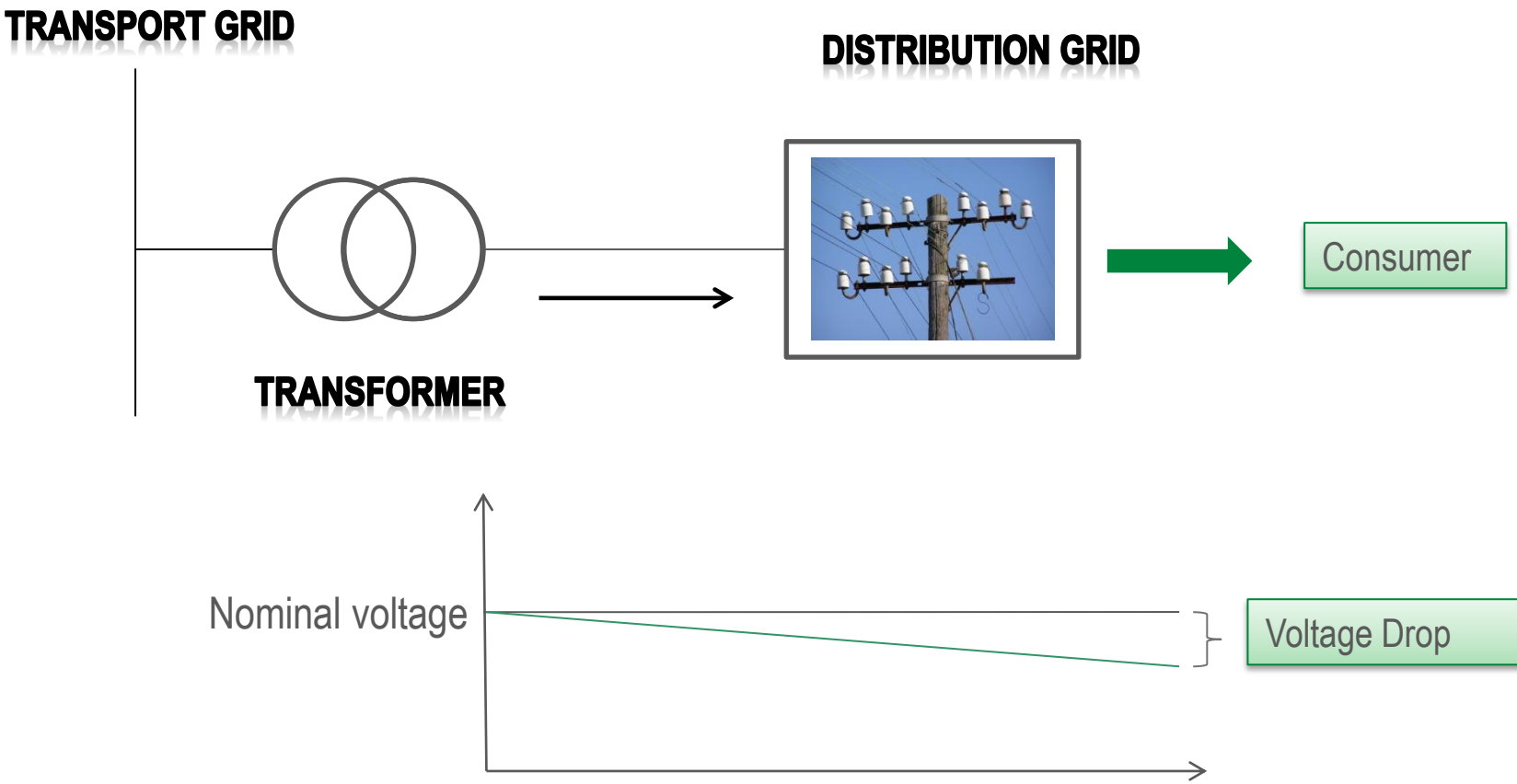
Question: will people accept new high voltage power lines in their landscape, if offshore and desertec power is higher granted than power from decentralized units owned by local people?

Grid requirements (smart grid)

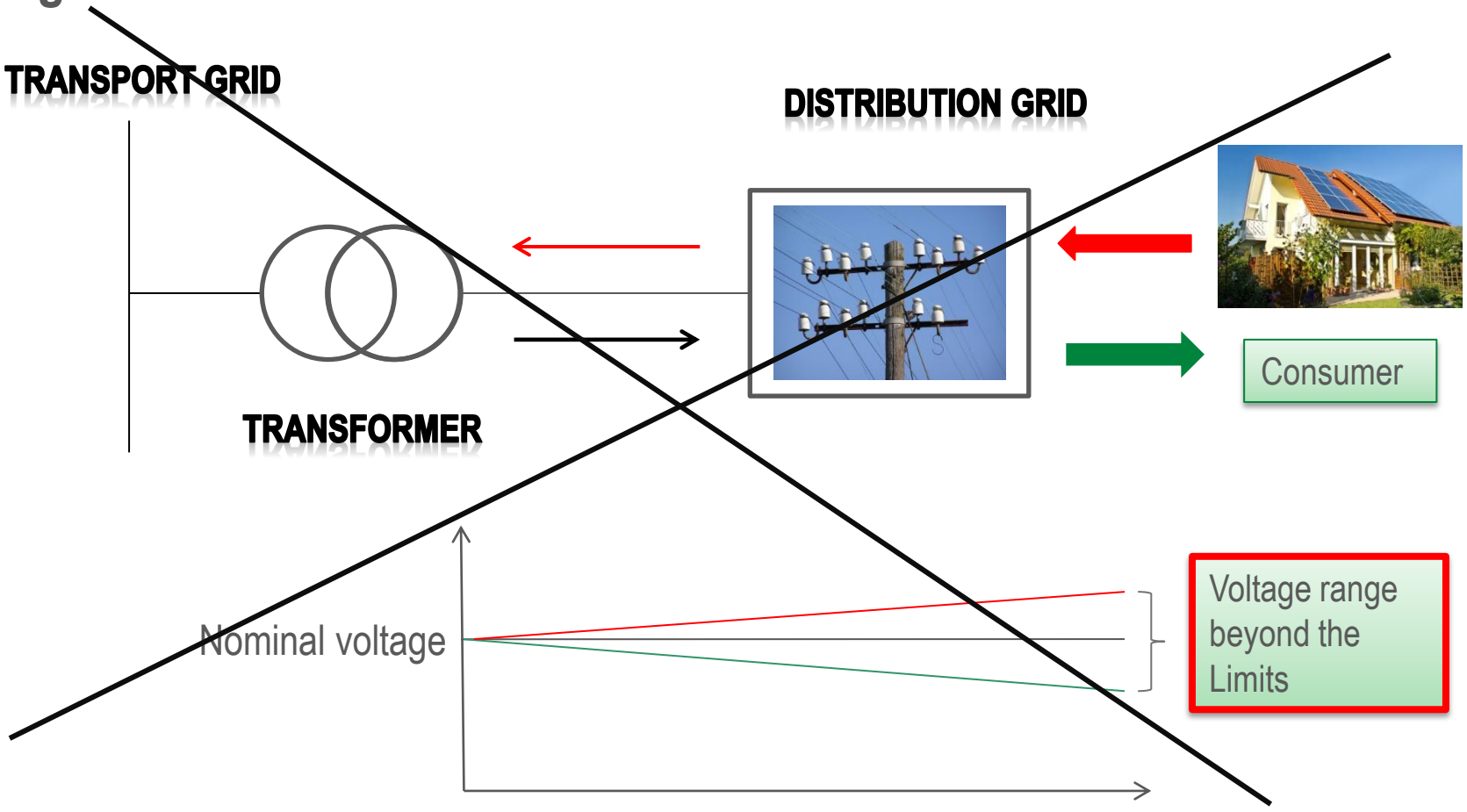
Smart grid concepts are designed for a complete balancing of the total power volume, if balancing process is limited to the electricity sector only

Items of smart grid concept	**relevance**
• Monitoring system (load, generation, voltage, frequency etc)	***must***
• Smart metering	***optional***
• Power management (peak generation cutoff)	***ultima ratio*** (in case of emergency or only few hours a year)
• Power generation time shift (biomass, hydro)	***must*** (smart market)
• Load shift (heating, cooling, existing physical storages)	***important*** (smart market)
• Adjustable transformers in distribution grids	***important*** *in rural areas*
• Voltage control by inductive load regulation	***low cost, easy to handle***
• Additional physical storages (pump storage, batteries, power to gas etc)	***necessary*** *in long term scenarios,* ***expensive***

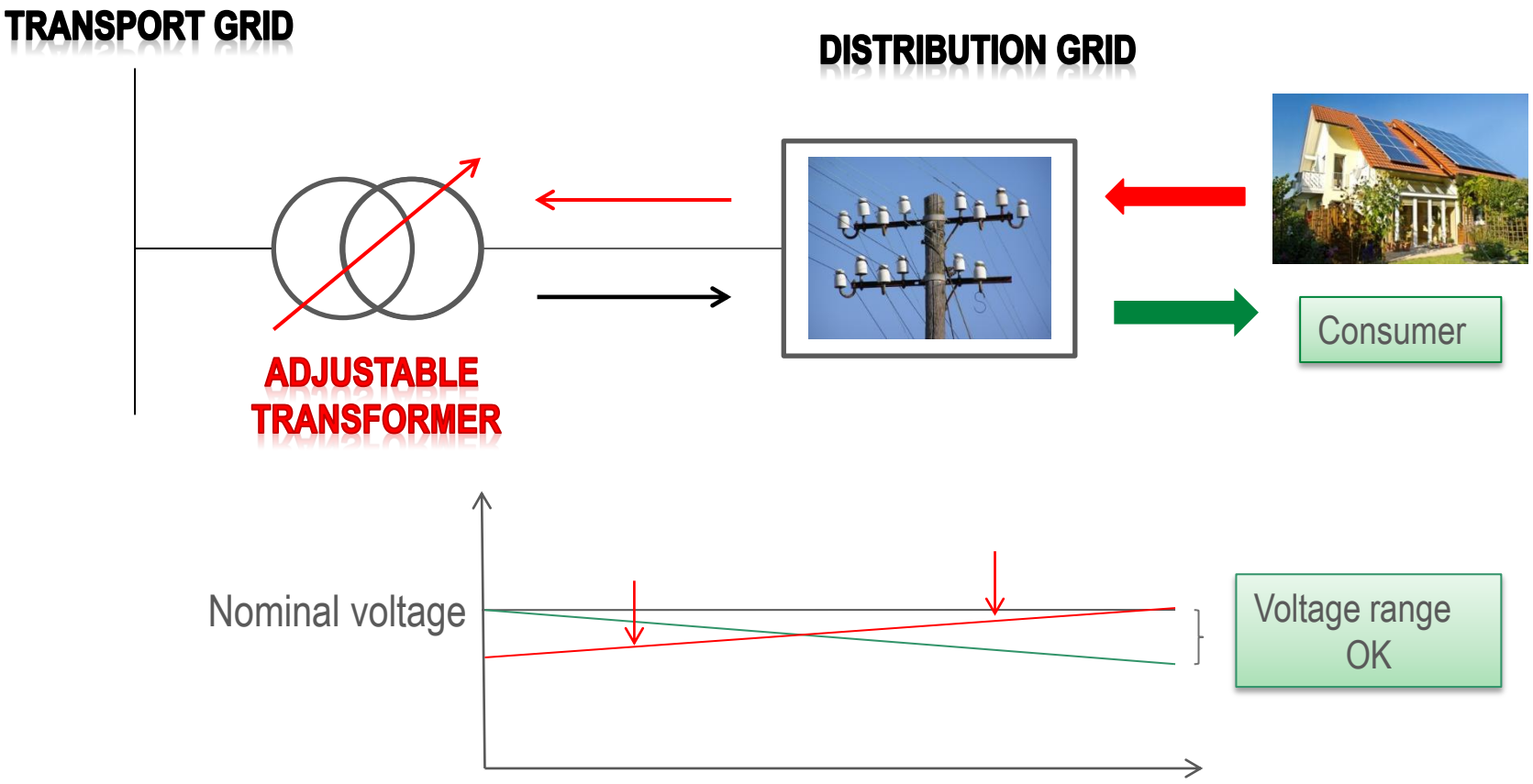
Smart grid


TRANSPORT GRID
DISTRIBUTION GRID
Consumer
TRANSFORMER
Nominal voltage
Voltage Drop

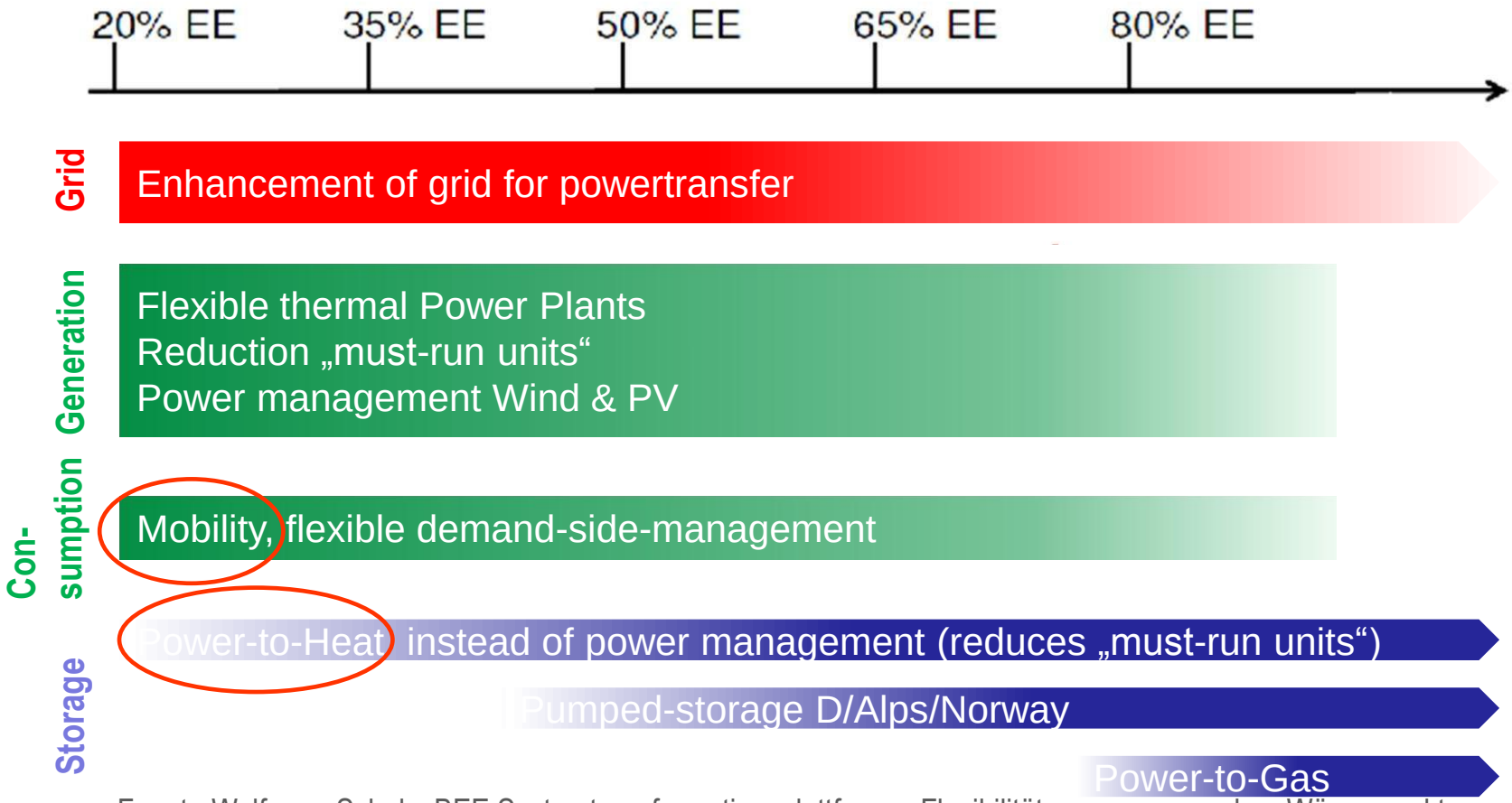
Smart grid


TRANSPORT GRID
DISTRIBUTION GRID
TRANSFORMER
Consumer
Nominal voltage
Voltage range beyond the Limits

Smart grid


TRANSPORT GRID
DISTRIBUTION GRID
ADJUSTABLE TRANSFORMER
Consumer
Nominal voltage
Voltage range OK

Exceeding the system boundary of electricity sector



Fount:: Wolfgang Schulz, BEE Systemtransformationsplattform – Flexibilitätsreserven aus dem Wärmemarkt

Exceeding the system boundary of electricity sector

There are some real economic benefits, if we include **heating sector** and **mobility sector** in the scope of system integration of RES:

Since investment into power capacities like wind onshore and solar is cheaper than investment into storages, it is economically reasonable in the long term to create an **overcapacity** of electric power generation. In peak production times electric power can substitute other conventional or renewable resources in the heating sector and mobility sector. An overcapacity cannot avoid any requirement of storage solutions, but it can reduce the demand of storage capacity significantly.

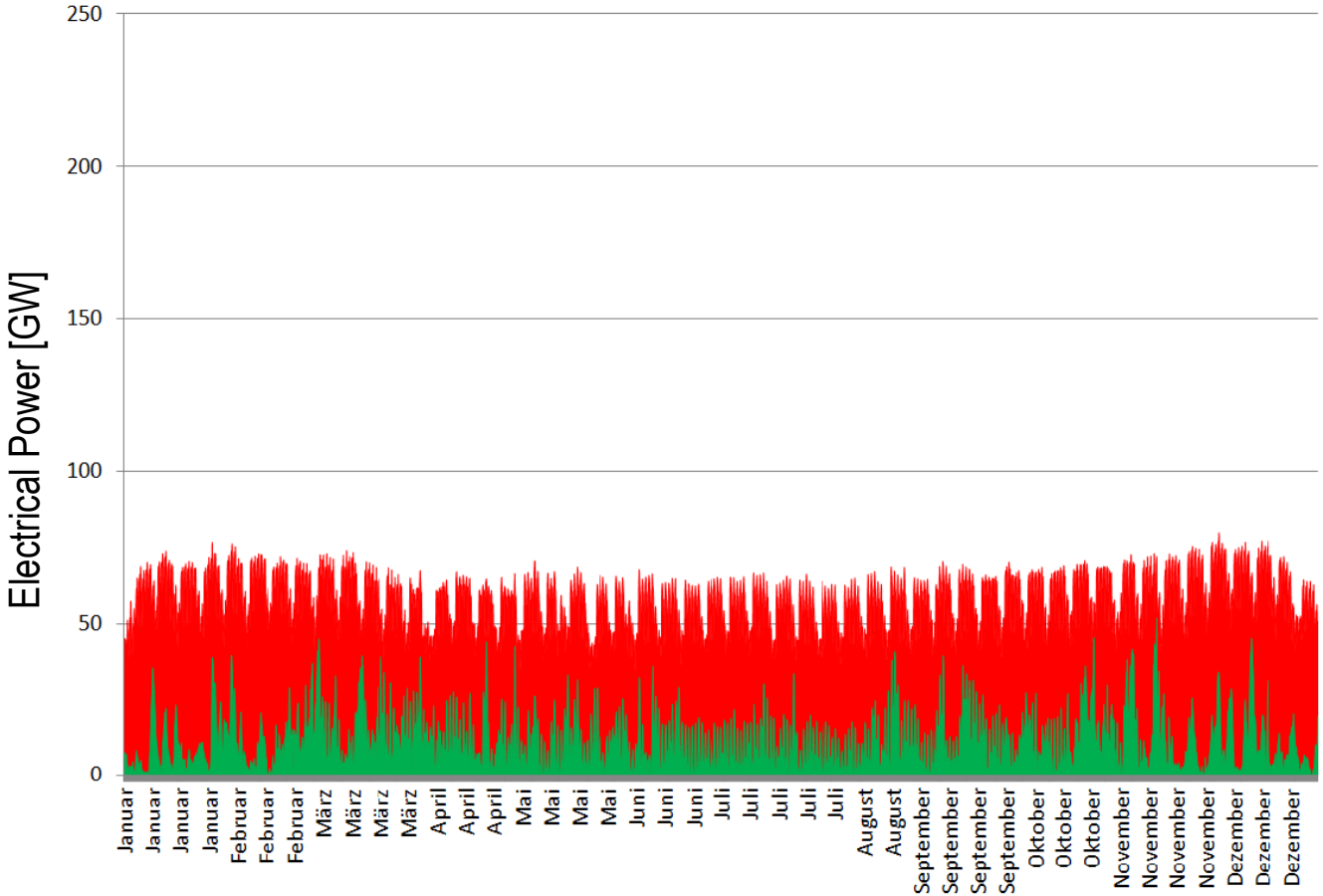
Exceeding the system boundary of electricity sector

Furthermore the sources for the heating sector which mainly are biogas, woodchips, pellets, natural gas, which are intermittently replaced by electric power, can be buffered without additional cost or conversion losses. These buffered resources are available for additional power production in times when RES power resources like wind and solar are not sufficient.

This energy exchange between electricity and other energy sectors requires mainly **dual based systems** like biomass heaters combined with immersion heaters or hybrid cars and hybrid trucks. The additional costs are far below electric power storage systems.

Last but not least: transferring renewable electric power into heating and mobility applications can contribute to a faster growth of RES shares in these sectors, which are often neglected compared to electricity market.

Renewable power (20%) & power consumption 2010 Germany

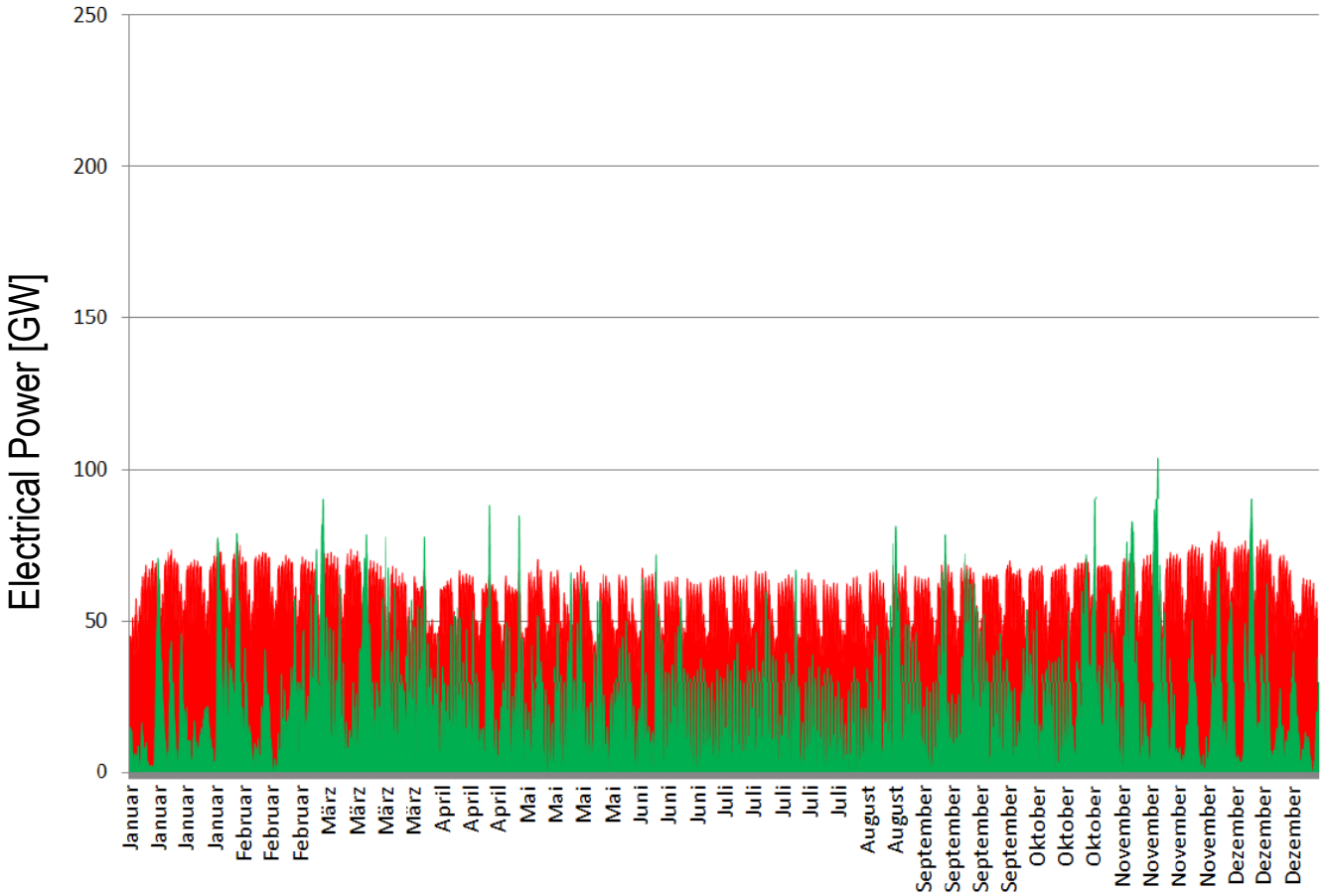


red consumption

green wind & solar production only

Quelle:
Prof. Dr. –Ing. habil. Ingo Stadler

Renewable power (40%) & power consumption 2010 Germany

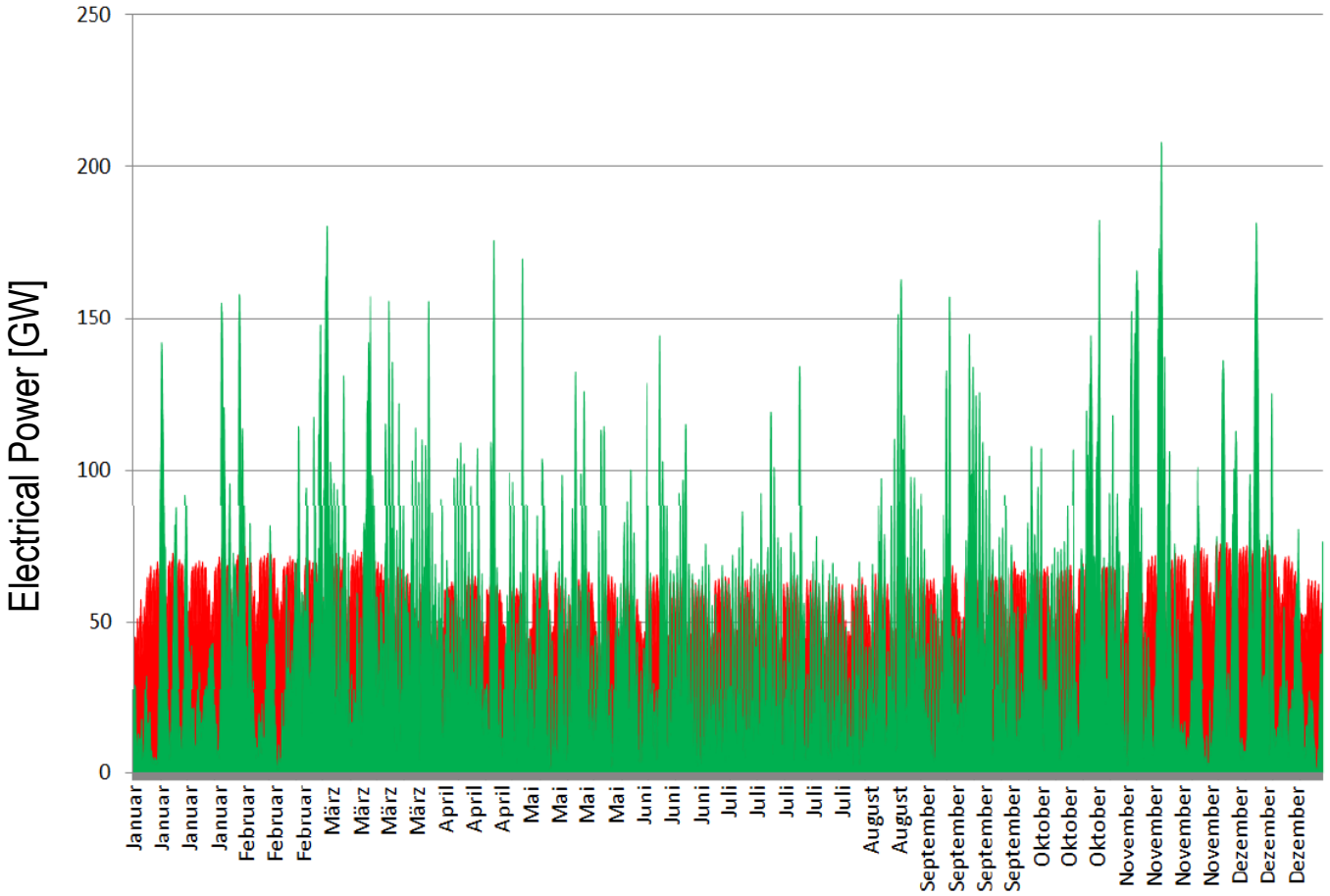


red **consumption**

green **wind & solar production only**

Quelle:
Prof. Dr. –Ing. habil. Ingo Stadler

Renewable power (80%) & power consumption 2010 Germany

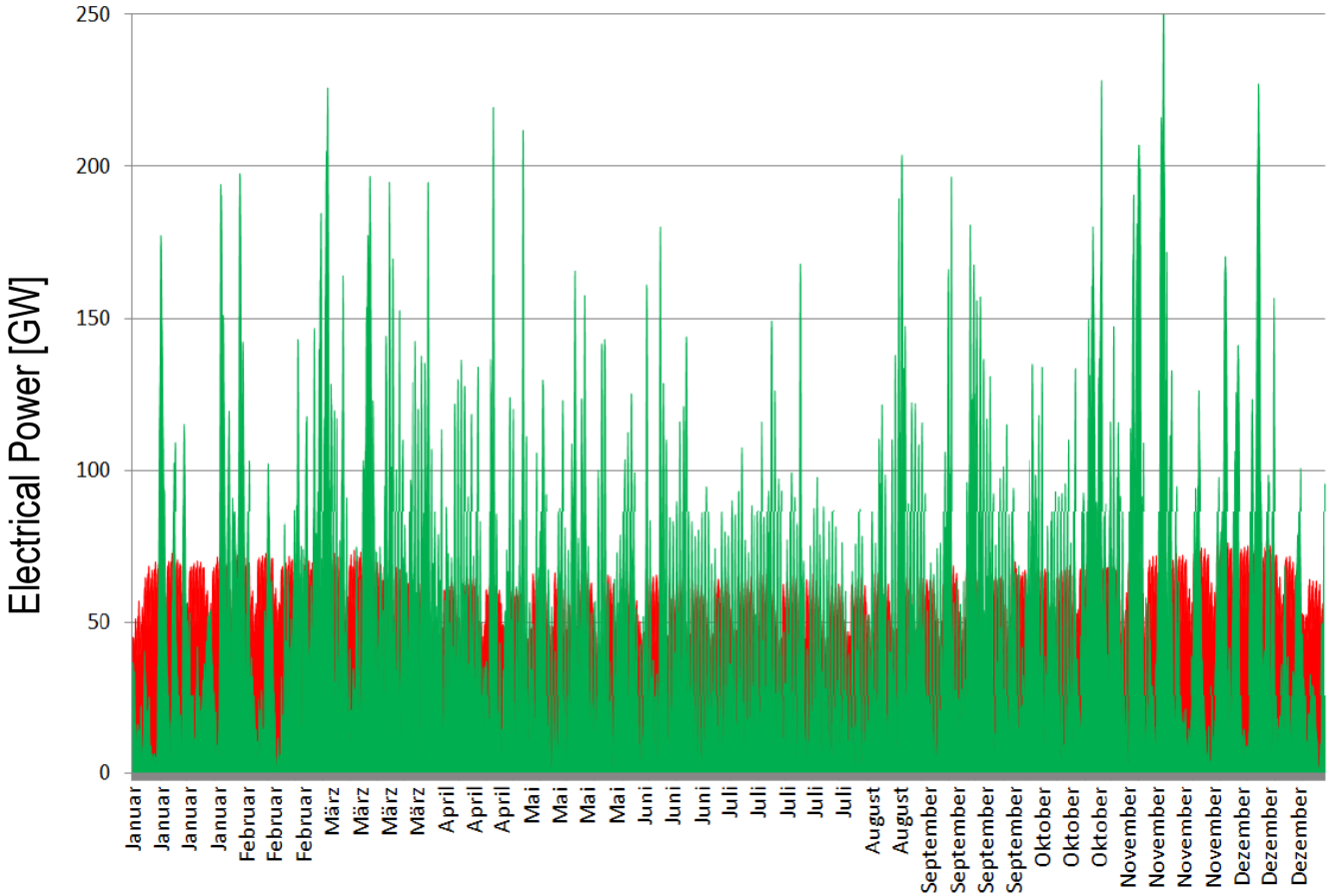


red consumption

green wind & solar production only

Quelle:
Prof. Dr. –Ing. habil. Ingo Stadler

Renewable power (100%) & power consumption 2010 Germany

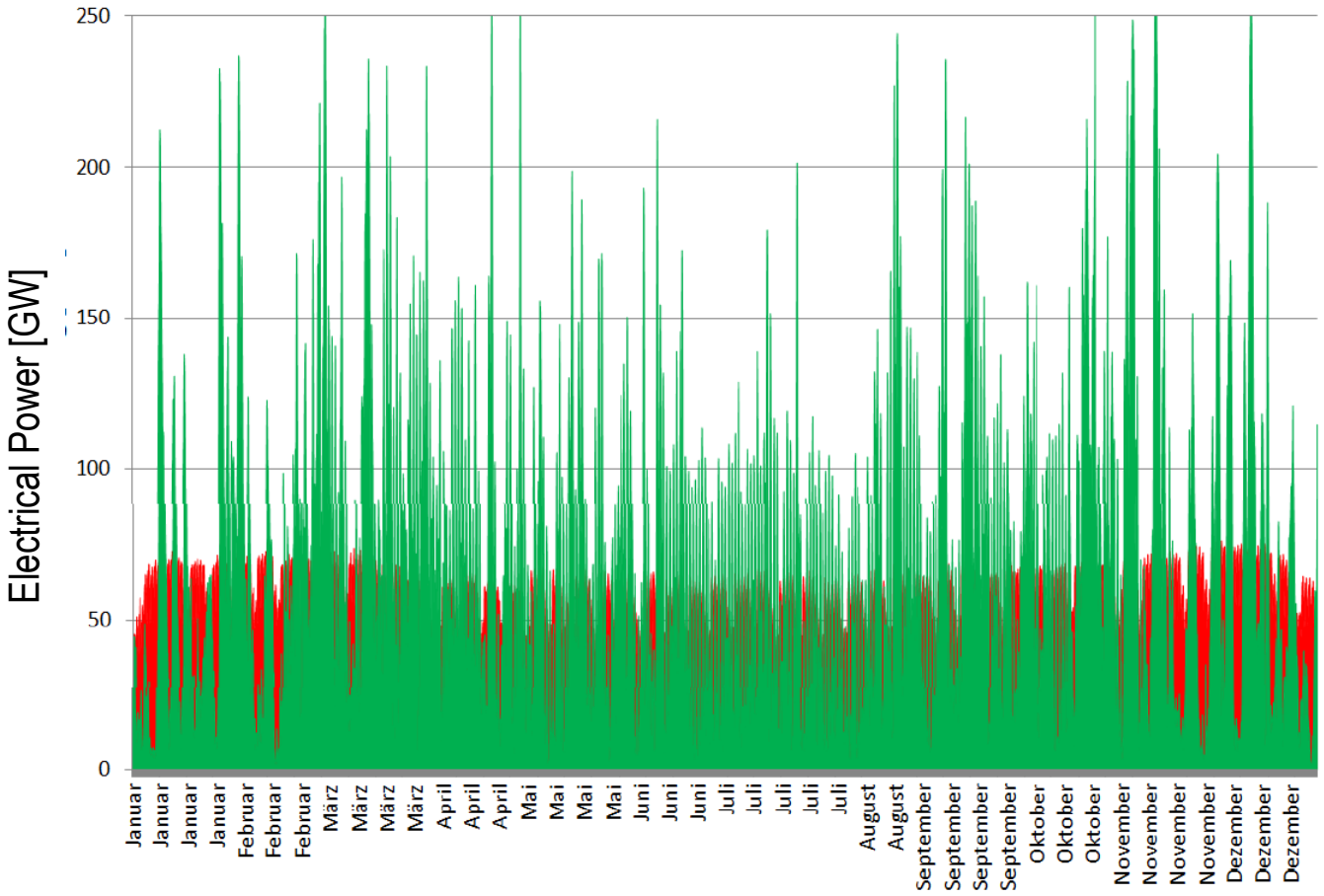


red consumption

green wind & solar production only

Quelle:
Prof. Dr. –Ing. habil. Ingo Stadler

Renewable power (120%) & power consumption 2010 Germany

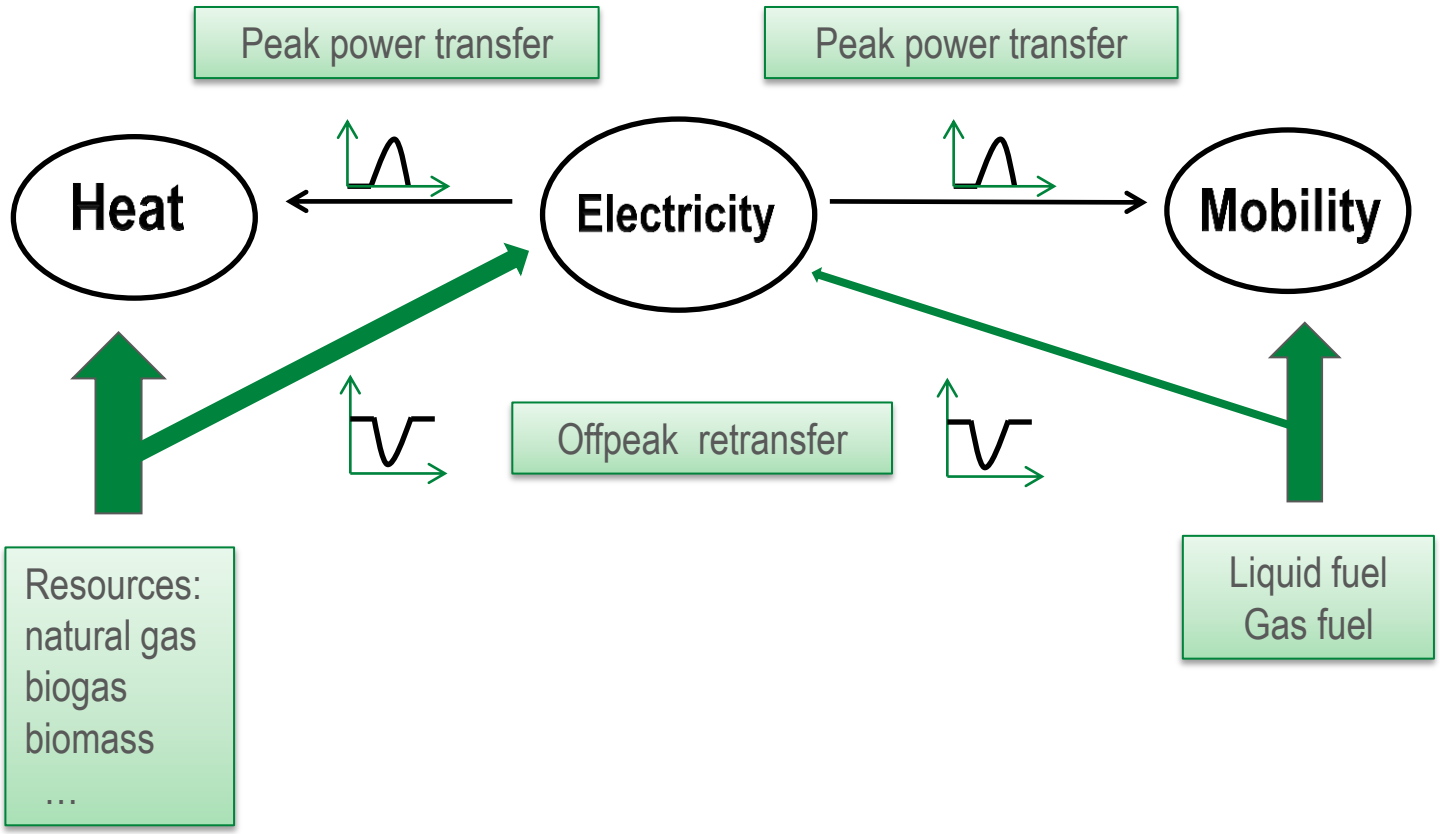


red consumption

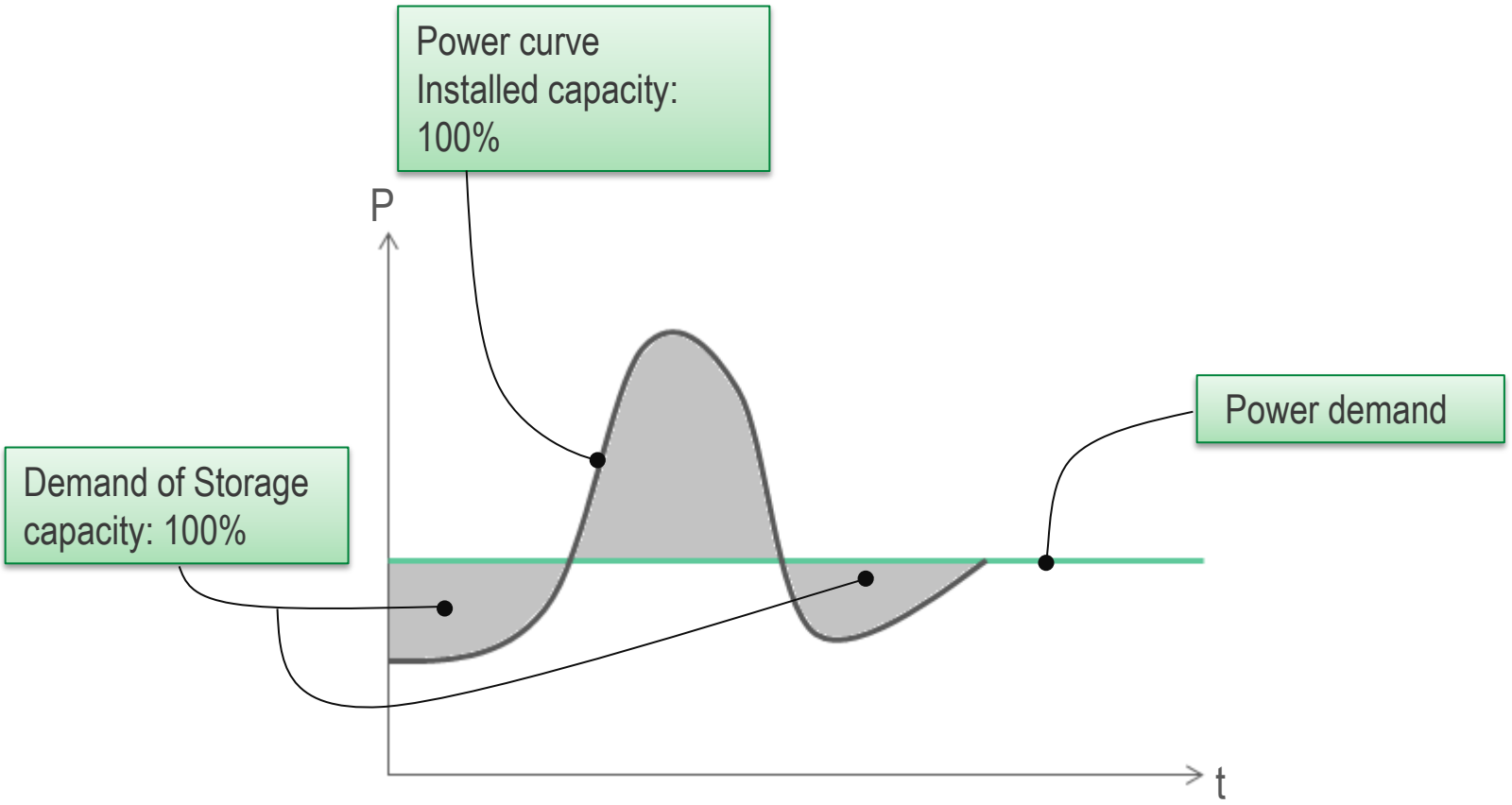
green wind & solar production only

Quelle:
Prof. Dr. –Ing. habil. Ingo Stadler

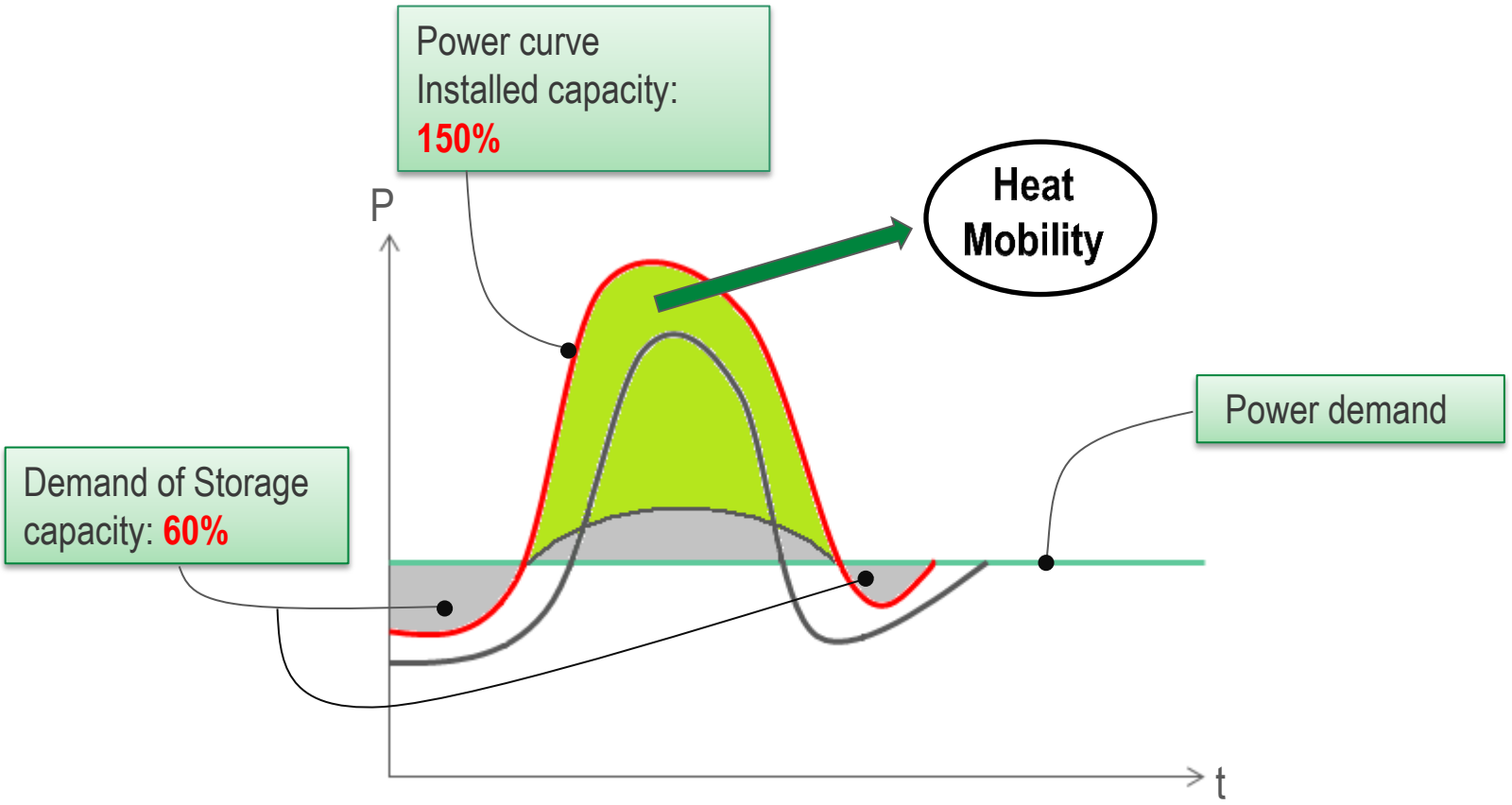
Exceeding the system boundary of electricity sector



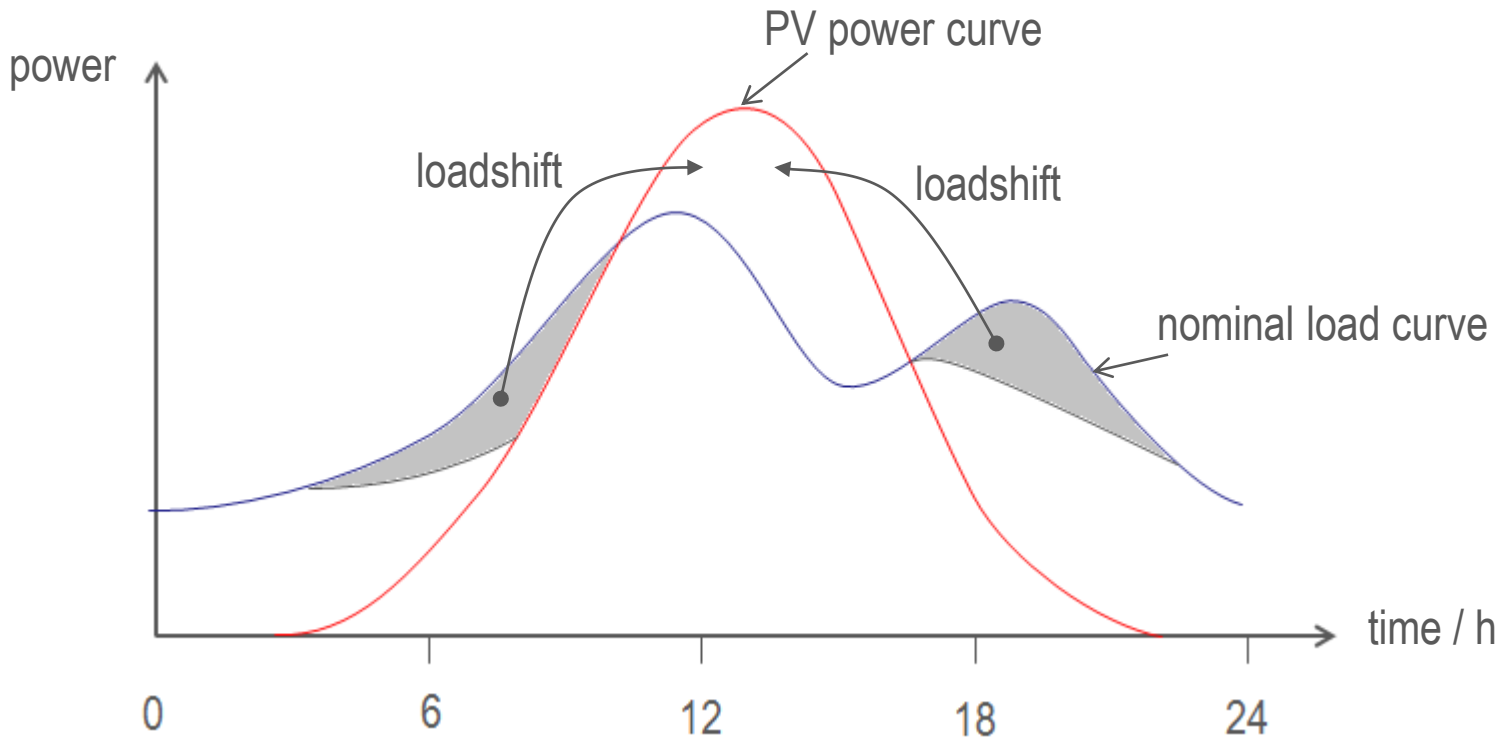
Exceeding the system boundary of electricity sector



Exceeding the system boundary of electricity sector



Loadshift instead of batteries

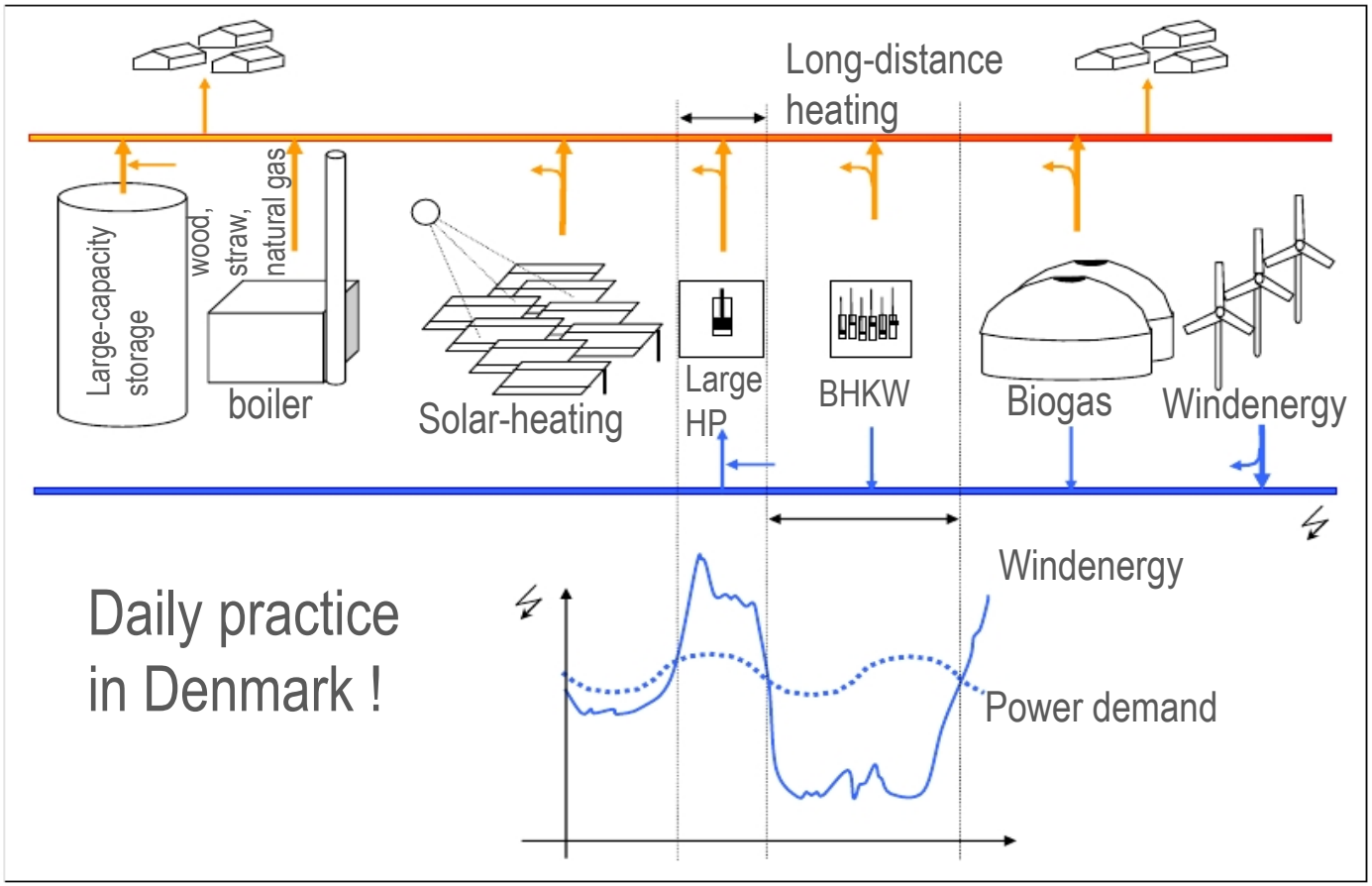


Grid connected mobility instead of batteries

Fount: www.spiegel.de

Proposed by german expert council for environment (SRU)

Heating instead of batteries, example from Denmark



Fount:: Wolfgang Schulz, BEE Systemtransformationsplattform – Flexibilitätsreserven aus dem Wärmemarkt

Results for the existing district-heating in Germany

- In present 150 CHP-plants (upwards 10 MWth) from district-heating in combination with heat-storages (with a range of 10h) are disposal.

  - Up to 3,6 GWel more electricity-generation is being available.
  - Reduction of power-generation up to 6,7 GWel possible.
  - Including direct electrical storage-heating reduction up to 18,4 GWel is possible.

→ These measures result in a significant flexibility of the power-sector, that is more comprehensive, more cost-effective and more efficient than other options (pump-storages, compressed air, batteries, windenergy to gas,….) and is implementable in a short time.

Conclusions

- 100 % RES power requires expanded grids
- Smart grids can reduce the expenses for grid expansion and power storages
- Enlarged system boundaries inlc. Heating and Mobility lead to higher RES power capacities
- These „overcapacities“ contribute to less consumption of fossil sources within the complete energy market.
- Overcapacities in power generation are cheaper than storarges and they can reduce storage capacities
- Overcapacities must correspond with dual power units in heating and mobility sector
- The storage of primary energy sources is cheaper and leads to less conversion losses than direct storage of electric power.

WestfalenWIND

Thank you for your interest !

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