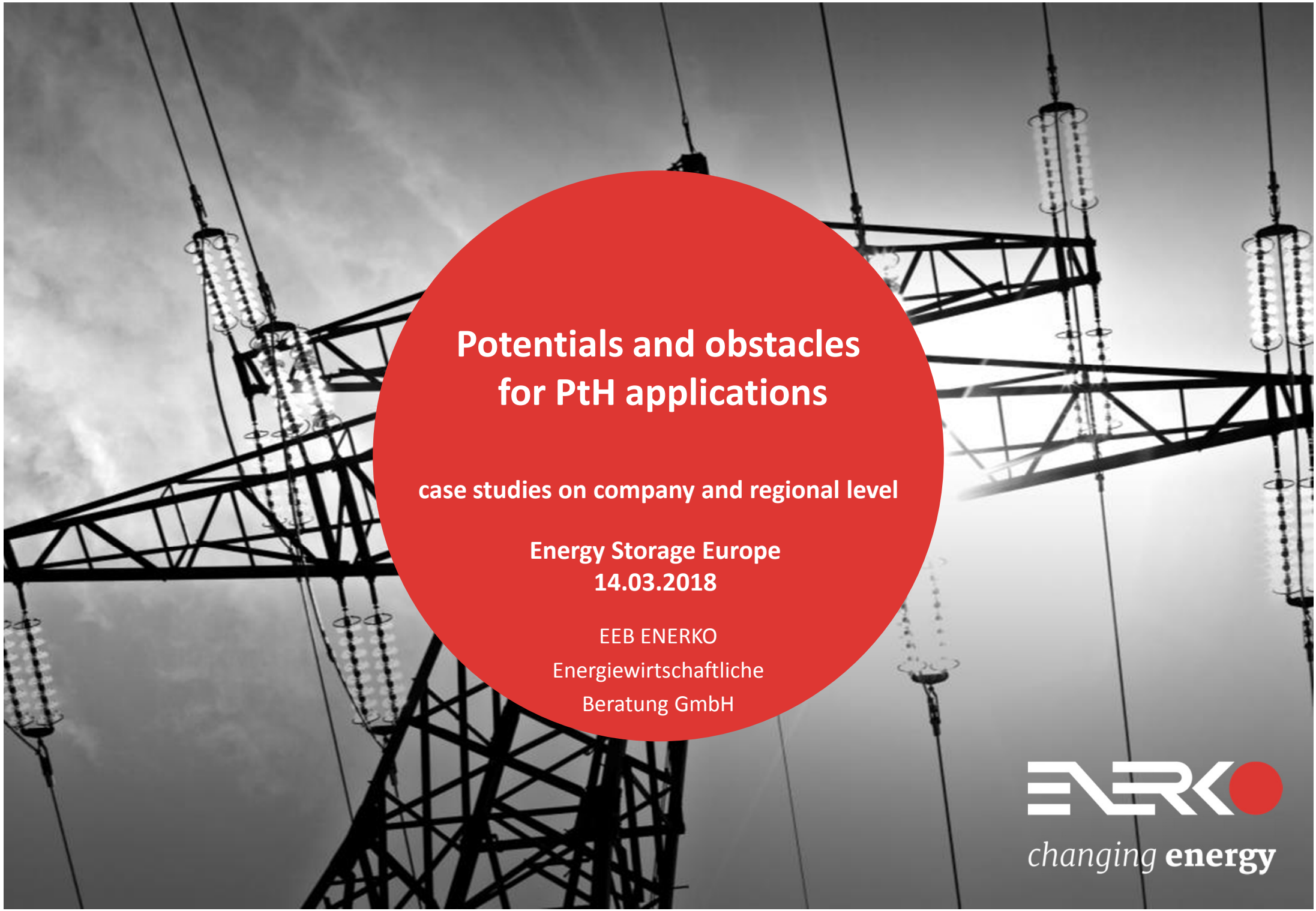


Potentials and obstacles for PtH applications

case studies on company and regional level

Energy Storage Europe
14.03.2018

EEB ENERKO
Energiewirtschaftliche
Beratung GmbH

ENERKO
changing **energy**

EEB ENERKO: main consulting activities

Located in Aldenhoven near Aachen and Berlin • 40 employees

changing **energy**

Concepts and reports

- Corporate development
- Climate protection concepts
- Power plant and CHP analyses
- District heating concepts
- Primary energy factors and high efficiency certificates
- Energy management ISO 50001

Consulting for the energy business

- Business strategies
- Grid evaluation and acquisition
- Grid fees
- Electricity and gas procurement
- Emissions trading
- Operational supervision

Technical planning

- Heating and CHP plants
- Grids: electricity, gas, district heating
- Industrial media supply
- Storage systems for district heating and gas
- Power generation from renewables

Agenda

- Present situation and regulatory framework
- PtH applications – case studies
  - Company level – conditions for profitable operation
  - State level - contribution of sector coupling: case study for the federal state of Sachsen-Anhalt
- conclusions

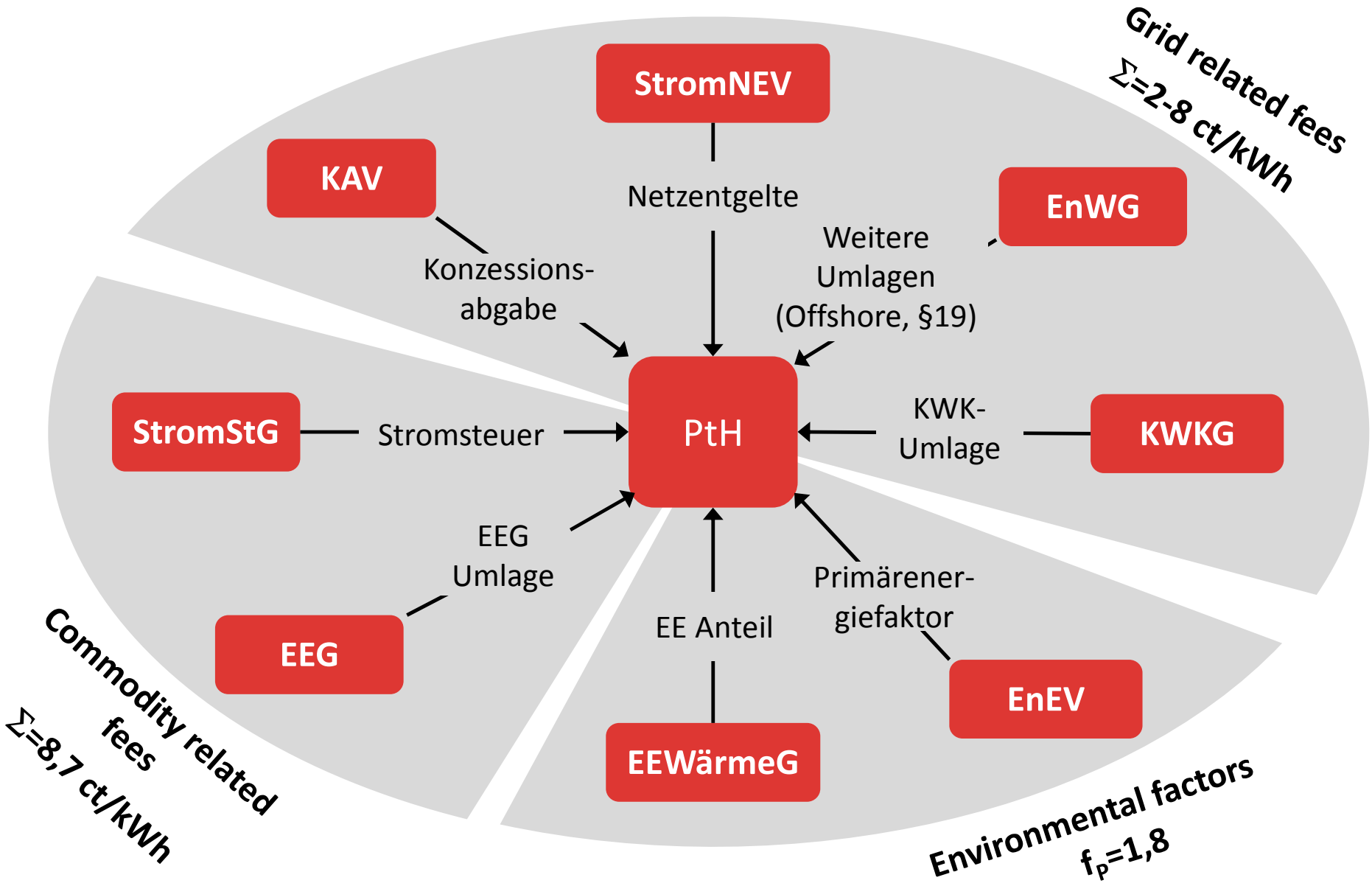
Situation 2018 in Germany

Renewable Power

- Share of REN has reached 36% in 2017
- Ren power exceeds demand in electricity sector more and more
  - 5 TWh renewable power have to be cut due to congestion management (Einspeisemanagement)
    Strong increase since 2013
  - Export increased to 60 TWh -
    Germany is net export country nearly all around the year
  - Number of grid safety management measures increased likewise
  - „Spitzenkappung“ allows grid providers to adopt REN cut off (up to 3%) as a permanent measure to reduce grid expansion measures
    => locally usable renewable excess production will remain and increase in the next decades

Regulatory framework

Power to Heat: PtH is classified as final use



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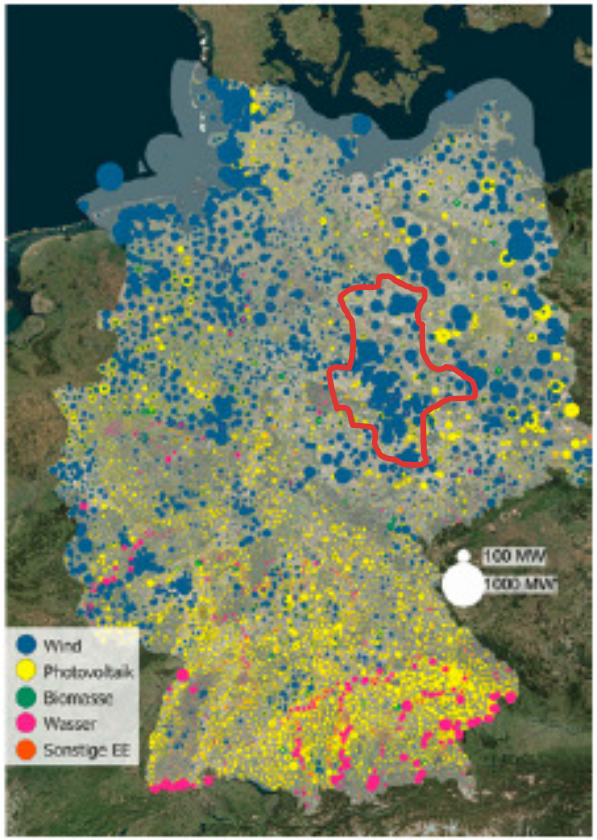
Case study PtH

„Nutzung von Strom aus Erneuerbaren Energien im Wärmebereich“

- Study on behalf of the „Ministerium für Umwelt, Landwirtschaft und Energie in Sachsen-Anhalt“
- Project team: EEB ENERKO & Mitnetz Strom



- Project scope:
  1) REN scenarios for Sachsen-Anhalt
  2) Analysis and prognosis of the heat market
  3) Contribution of PtH to integrate renewables
  4) Supportive regulatory Framework ?

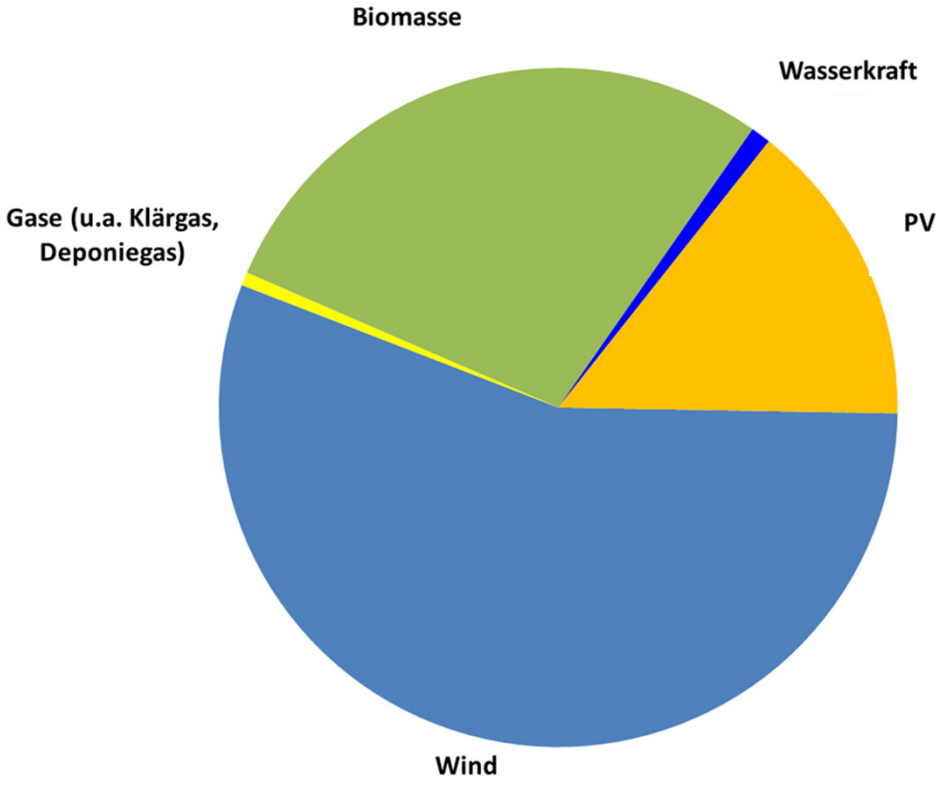
➢ *More informationen : lena.sachsen-anhalt.de/lena/download/*

➢ *www.enerko.de/wp-content/uploads/2017/12/Endbericht_PtH_web.pdf*

Renewable Power in Sachsen Anhalt

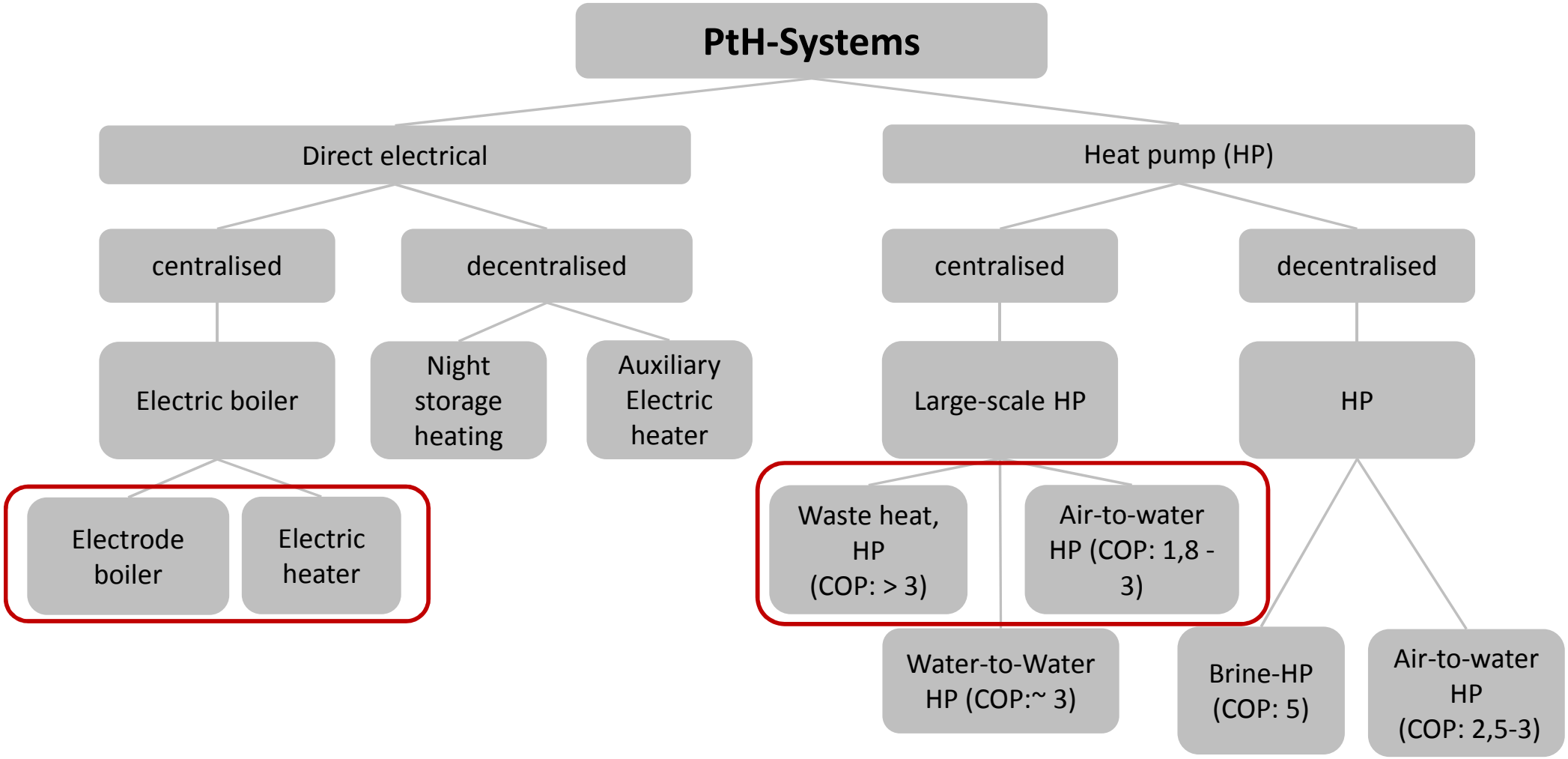
Status Quo

- 13 TWh renewable power in 2015 in Sachsen Anhalt (~60% of gross consumption)
- about 60% share of wind energy
- about 1 % as excess power
  - 2015: 130 GWh
  - 2016: 150 GWh
- High share of heat grid base heat supply (about 2600 GWh heat supply) even in smaller cities
- High industrial heat demand



Power to Heat technologies

Overview



- Focus on large-size PtH applications

Case studies

4 cases on company level (heat pump/boiler/steam)

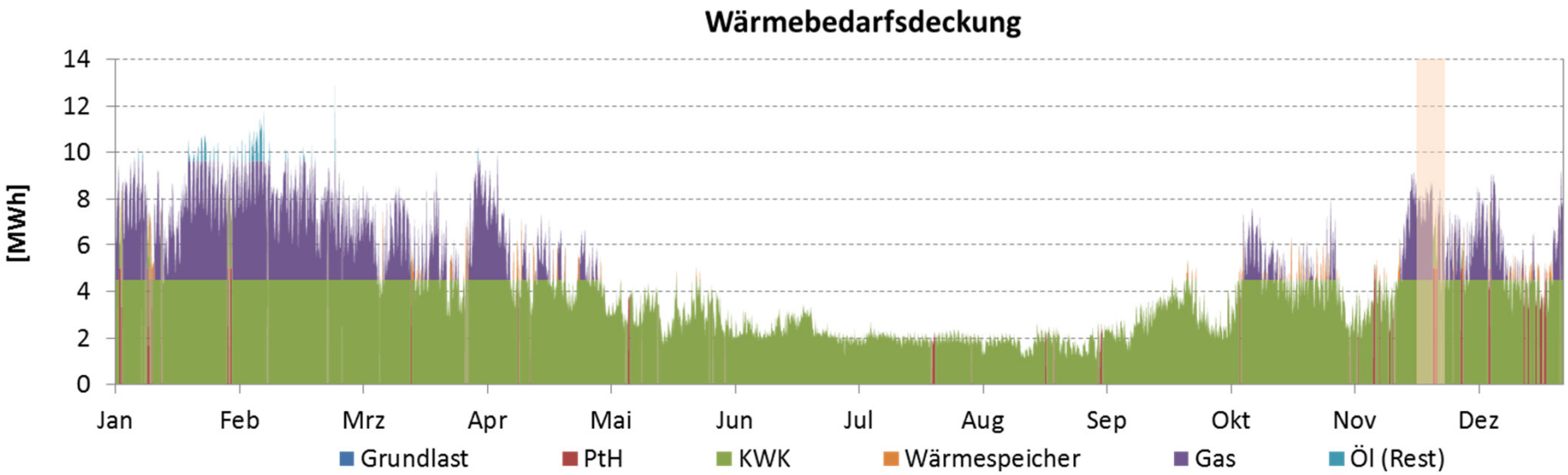
- Framework and methodology :
  - Hourly simulation of PtH applications for a given heat demand curve
  - Scenarios over 20a with various energy scenarios
  - NPV calculations on cash flow basis
  - WACC: 4%

- Sensitivity analysis subject to
  - scenario framework → renewable share high / medium / low
  - Grid fees → full / reduced / no
  - EEG/StromSt → full / no
  - Control energy → yes / no

Case studies - Example

Case study 2: local heat grid with 40 GWh yearly heat demand

- Typical medium-sized heat grid situation
  - 40 GWh grid feed-in ca. 12 MW thermal peak load
  - Heat Production with 30% CPH and gas-fired boiler
- Implementation of an PtH application with
  - 5 MW el/th. Power, investment ca. 750.000 EUR
  - PtH use in case of low wholesale prices or request for control energy



Case studies

Case study 2: sensitivites small scale PtH (5 MW)

Case studies

summary

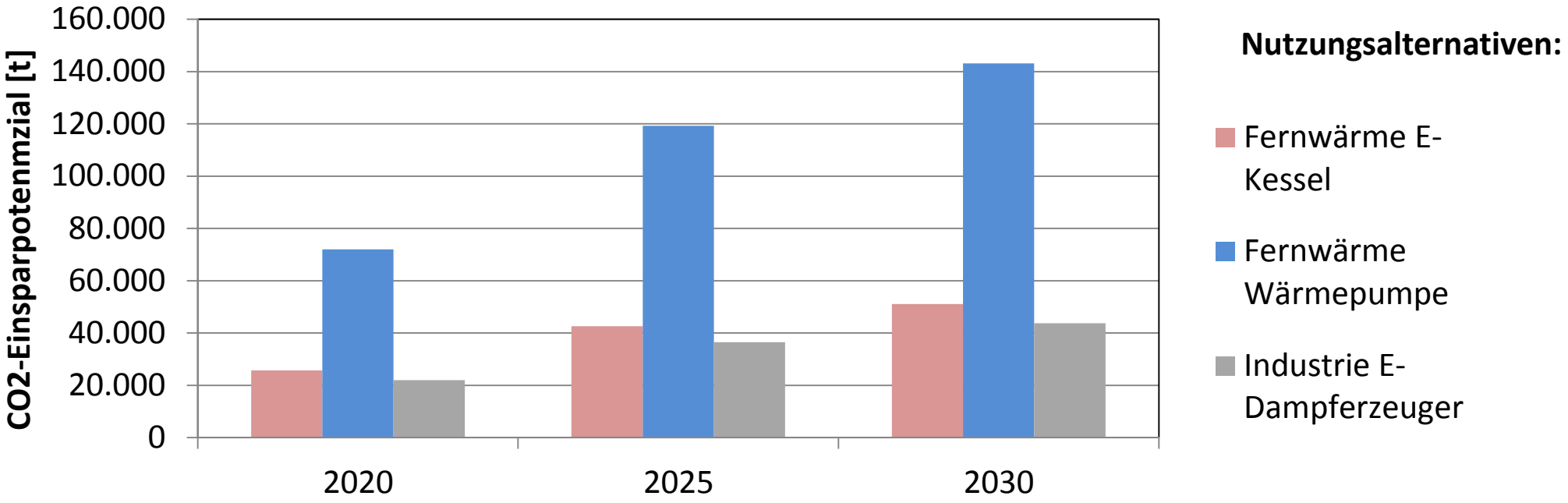
	Heat sink	Thermal power	Operating times	CO_2 savings	Profitability
Large scale PtH	Heat grid (500 GWh)	30 MW	100-600 h/a	2-6%	Only, if grid fees and EEG/taxes are not applied
Small scale PtH	Heat grid (40 GWh)	5 MW	120-850 h/a	2-10%	Only, if grid fees and EEG/taxes are not applied
Heat pump	Heat grid (40 GWh)	5 MW	200-6.000 h/a	Bis zu 15%	Only, if grid fees and EEG/taxes are not applied
PtH steam (industrial use)	Industry, steam supply	50 MW	1.000 h/a	Rd. 7%	-

- Current regulatory framework affects profitability to a large extend and prevents break-through in all cases

Case study: federal state level of Sachsen-Anhalt

CO_2 Savings by use of excess power in the heat market

- Only additional amounts of renewable power were taken into account
- Maximum savings of 120 000 t/a until 2025 in high scenario – but only, if heat pumps are used as PtH devices
  - …is equivalent to 1,5% of CO2-emissions of households and commercial sector
  - …is equivalent to 0,5% of total CO2-emissions in Sachsen-Anhalt



Federal state level of Sachsen-Anhalt

Valuation and comparison of PtH induced CO_2 savings

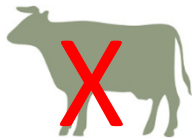
- Savings of up to **120 000 t/a**

- To achieve the same effect,
  - **100.000 e-cars** must replace gasoline engines –
    => increase by factor of 300 compared to 2017 !
  - or 7 Mio. Lightings devices must be replaced by LED –
    => **all households i**n Sachsen-Anhalt!
  - or **1.5 Mio. People must become vegetarian**
    => every other in Sachsen-Anhalt !

100.000

7 Mio.

1,5 Mio .



→ **120 000 t savings are of relevance!**

Agenda

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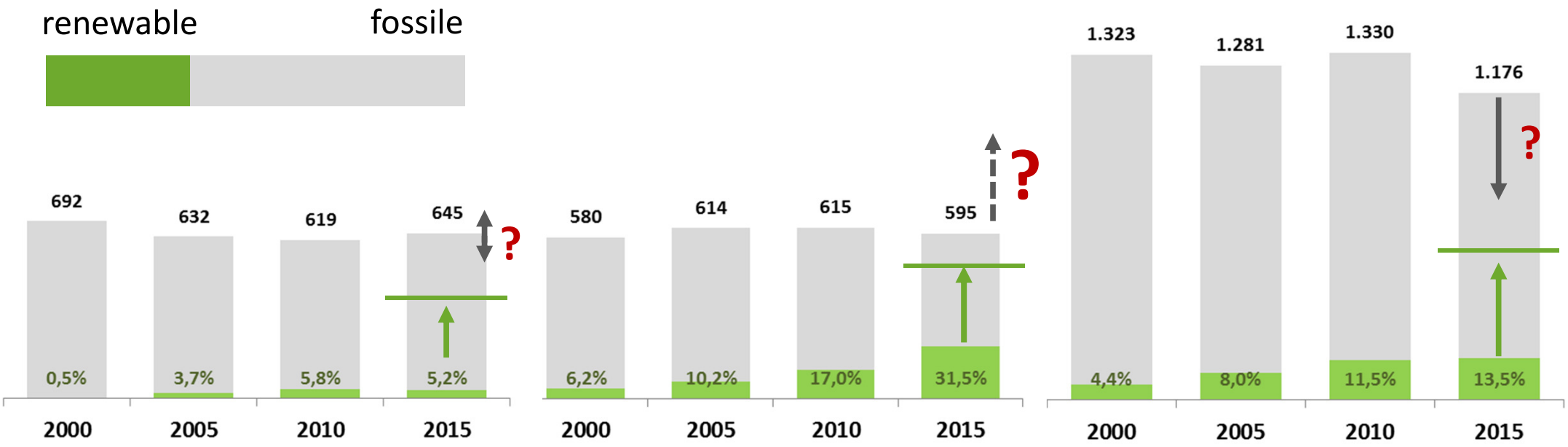
Recommendations and outlook

- Heat by PtH devices competes with fuels with significantly lower taxes and fees (in Germany by factor of 10) => transition from electricity to heat sector is nearly impossible
- „Energiewende“ related taxes and fees prevent a flexible and economical use of large scale PtH – even when it is highly flexible and grid compatible or in case of negative power prices
- Fixed primary energy factors are not helpful – dynamic quality indicators are necessary as incentive instrument
- grid fees as well as taxes and EEG must become more dynamic and regional
- a broad electrification of the heat market towards an “all electric society” requires heat pumps instead of E-boilers

→ sector coupling needs its own market role …
… without creating new misbalances concerning fees and taxes !

Outlook: full picture of demand sectors in Germany

Sectoral final energy demand in TWh



mobility
Aim 2050: ~60%

X 3

Power
Aim 2050: 80%

X 3

Heat
Aim 2050: ~60%

Quelle: Zeitreihen zur Entwicklung der Erneuerbaren Energien in Deutschland, BMWI

- Share of REN in power sectors has increased significantly since 2000
- Mobility and heat sector stay way behind
- **We still stand – after 15 years of EEG –at the beginning of a transformation process!**

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14.03.2018

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