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# HOW RELEVANT IS THE NATURAL GAS DISTRIBUTION GRID IN COMPARISON TO THE ELECTRICITY DISTRIBUTION GRID AND HEATING GRID?

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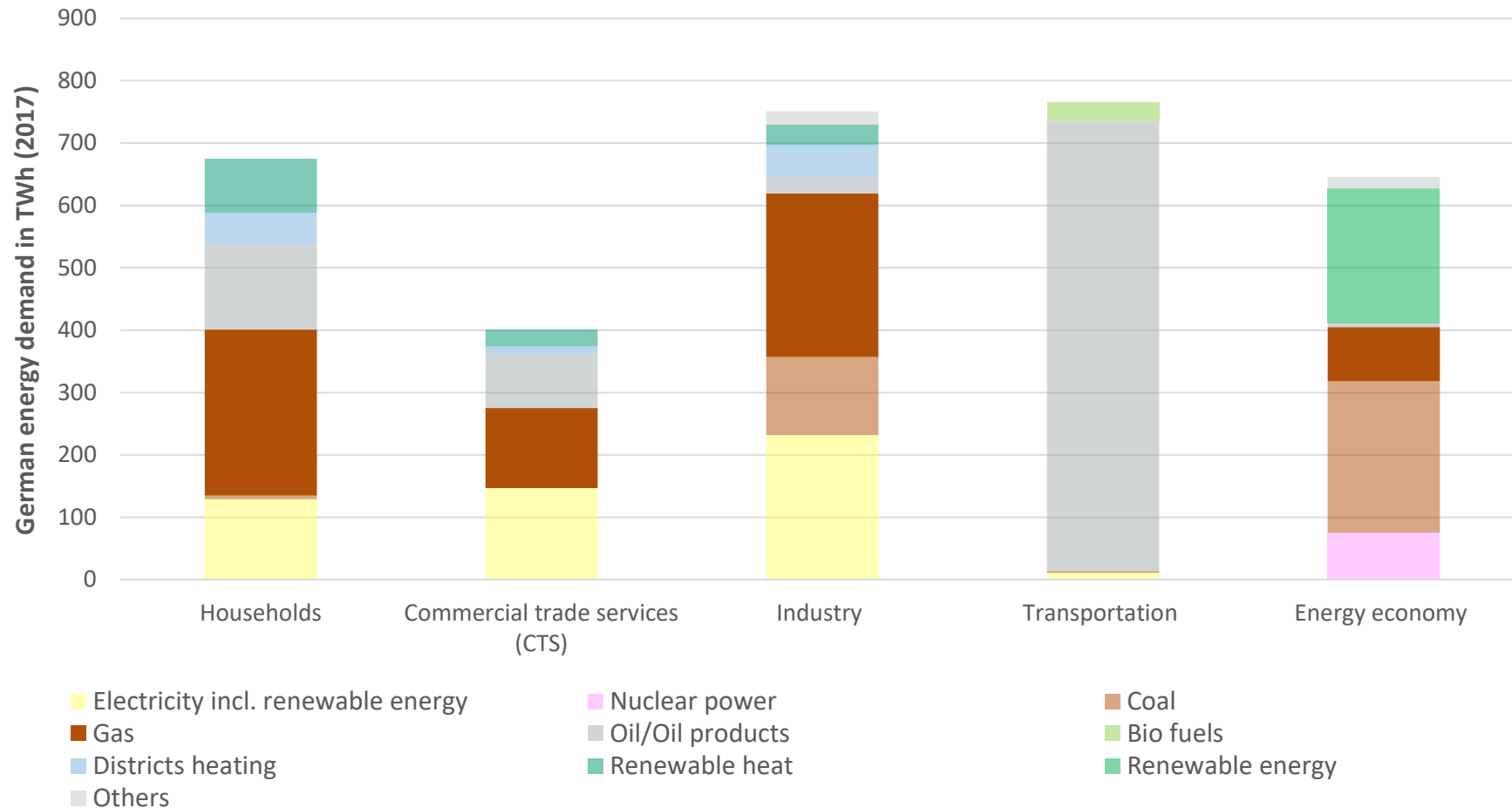
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# CONTENT

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- Current situation and research question
- Development of the final energy demands
- Techno-economic analysis of the heating grids, gas and electricity distribution grids in Germany
  - Economical: Comparison of the economical parameters for Germany in 2017
  - Technical: Synergies and competition between heating grids, gas and electricity distribution grids
  - Exemplary comparison of the competition in the building sector
- Summary/Conclusion

# Status quo – natural gas currently second most important primary energy carrier in Germany

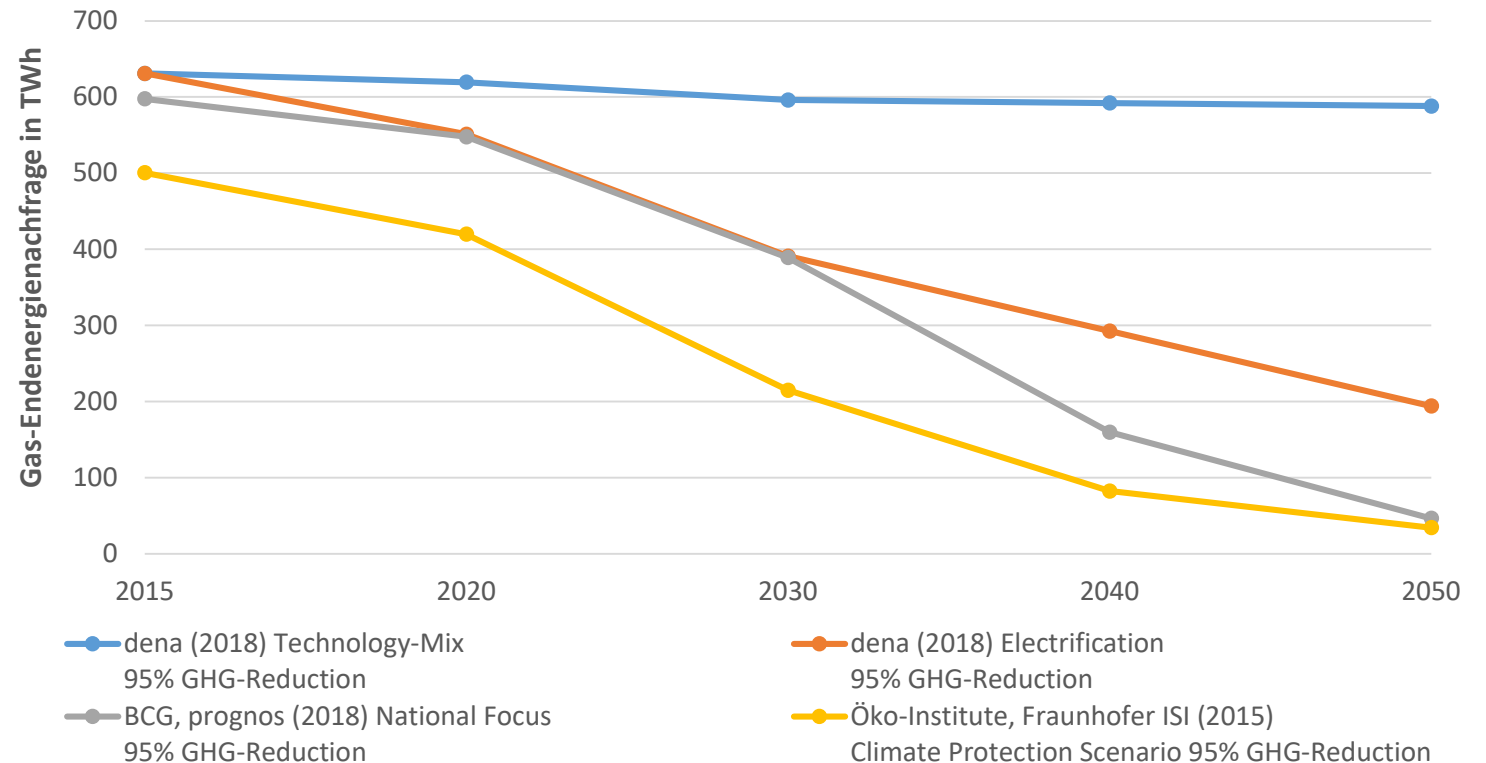


- Natural gas currently second most important primary energy carrier in Germany (23,8% in 2017) (AGEB 2018)
- In the long term new competitors in the demand sectors lead to a decrease in natural gas demand

# Problem definition - decreasing natural gas demand in the long term

## ■ In the long term decrease in natural gas demand

- With approximately the same length of distribution grid this will lead to rising specific operating costs
- Economic feasibility of gas distribution grids becomes questionable
- Higher demand in sectors like transportation might increase economic feasibility of the gas distribution grid



→ How relevant is the natural gas distribution grid compared to electricity distribution grids and heating grids in the building sector (in 2050)?

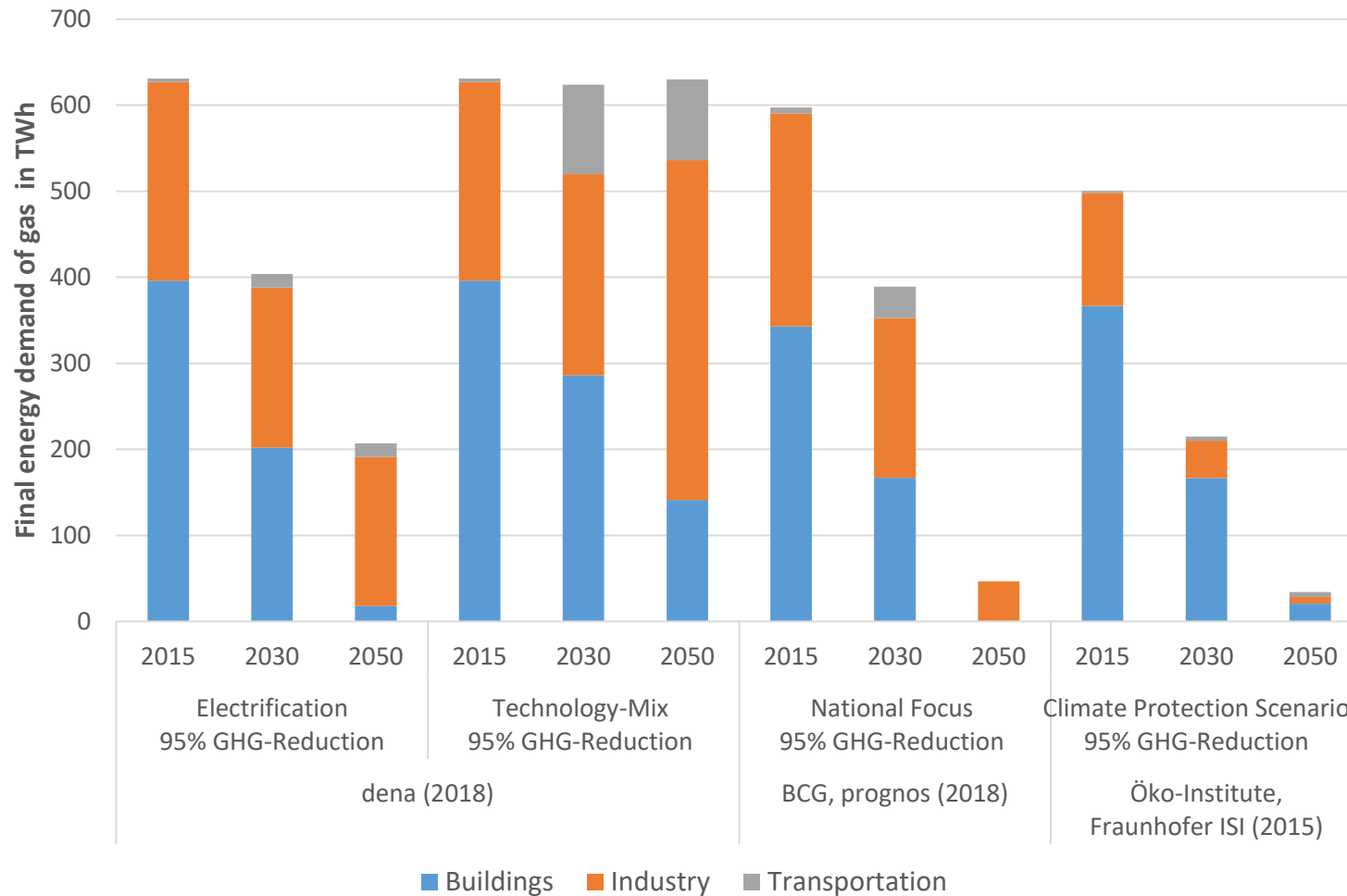
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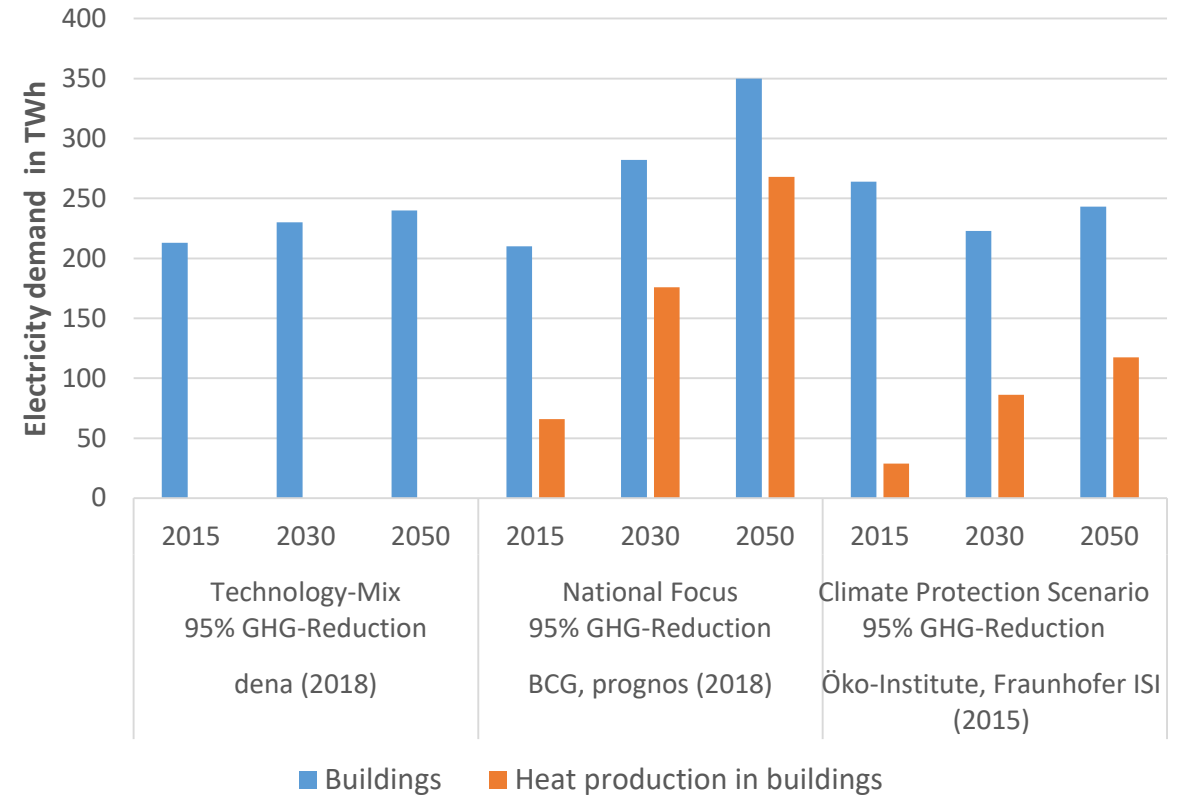
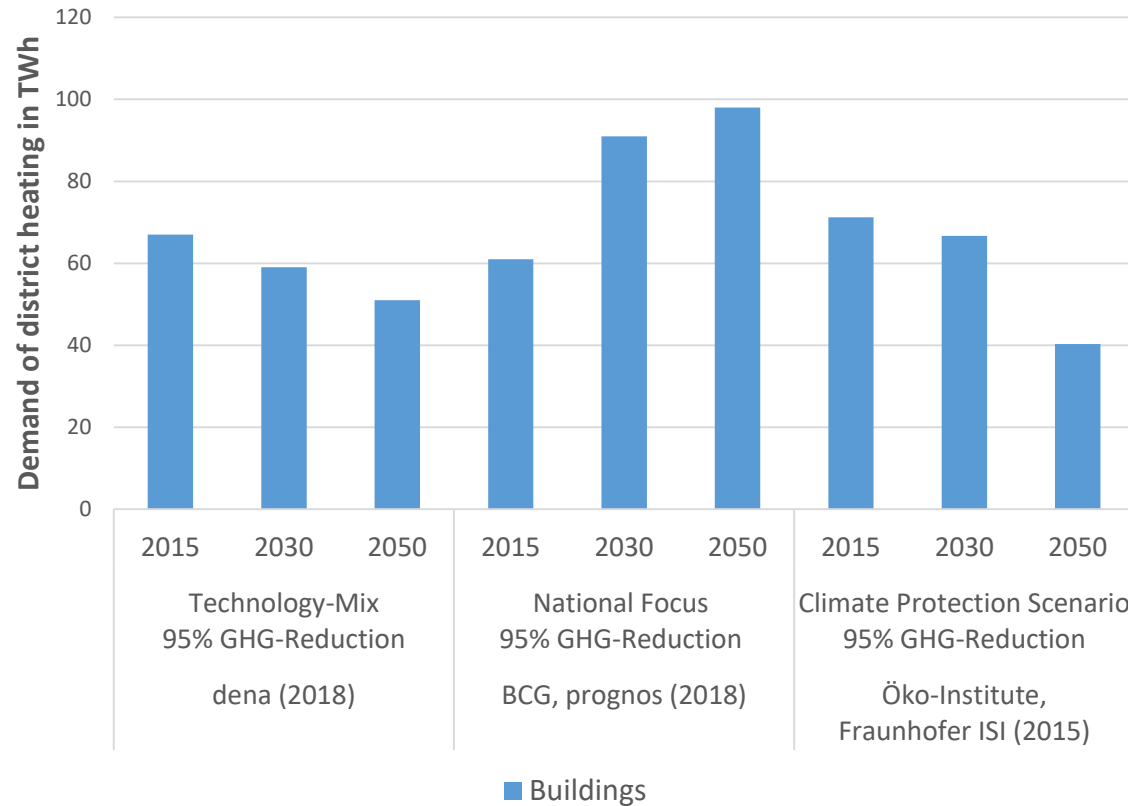
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# Development of the natural gas demand in studies for Germany



- Majority of the studies show significant decrease in gas demand
- Even in Technology-Mix-Scenario gas demand in buildings decrease significantly

# Final energy demand for heat and electricity in buildings in studies for Germany



- Demand of electricity-based heat production is increasing
- Studies see different trends for district heating

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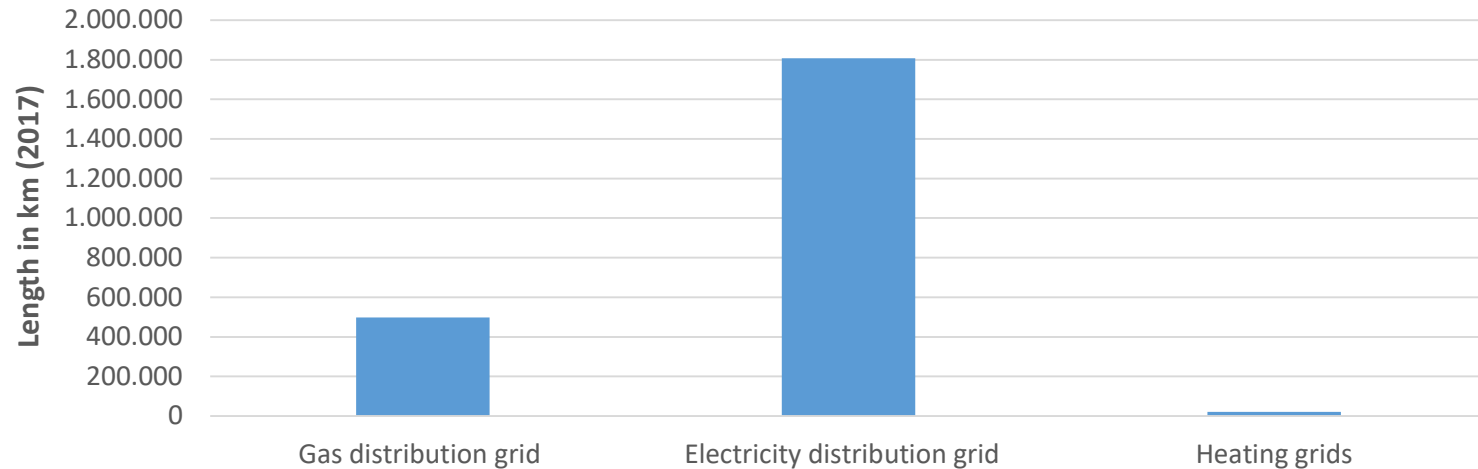
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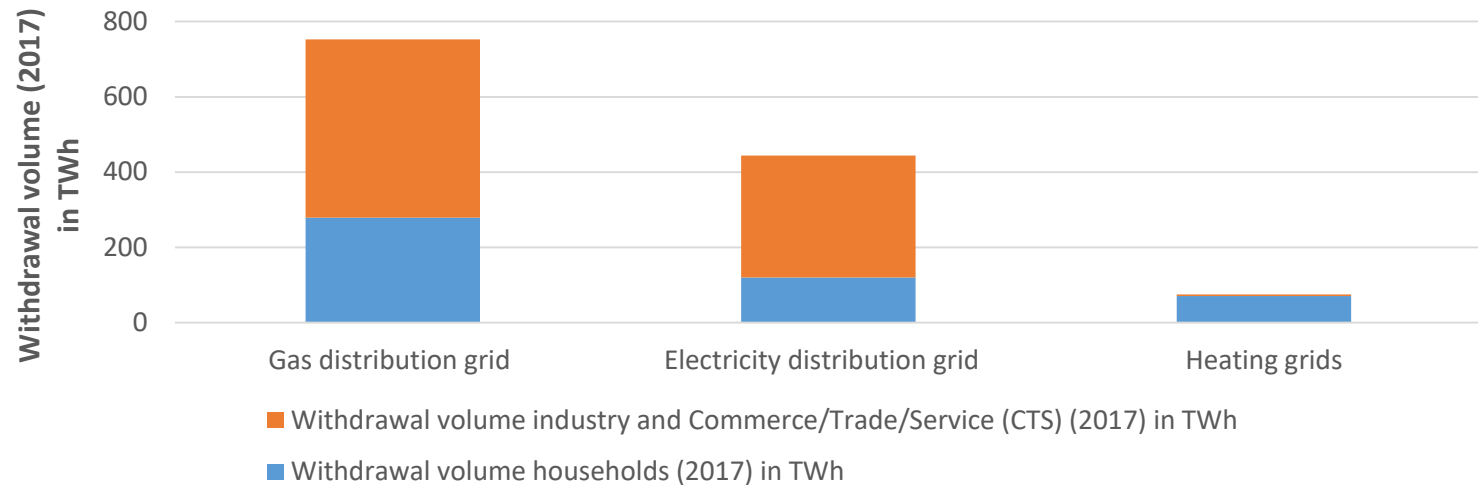
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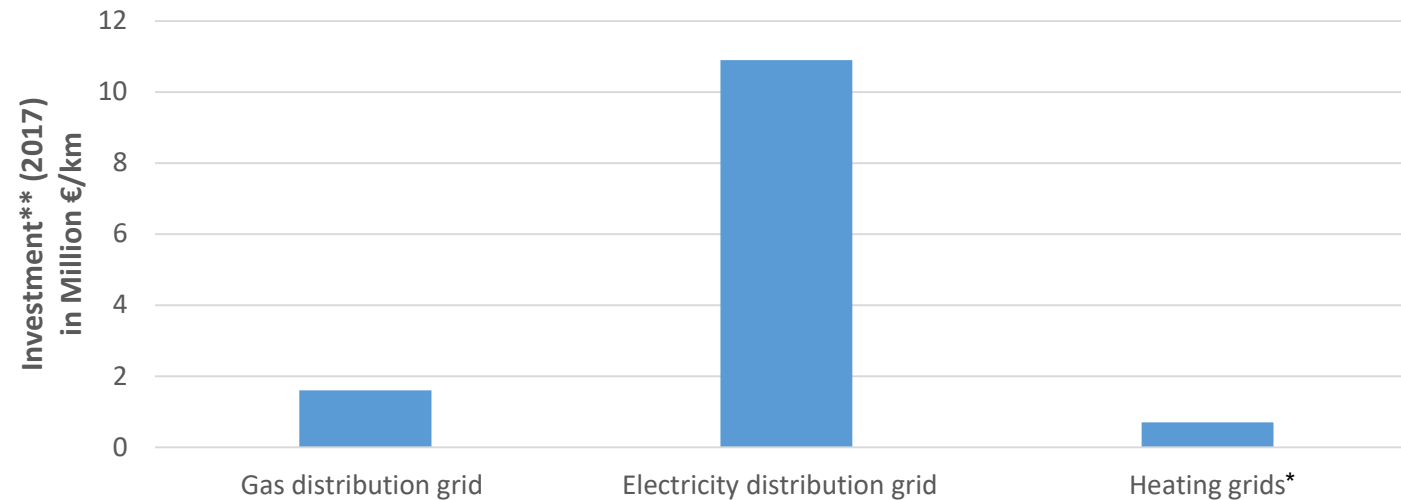
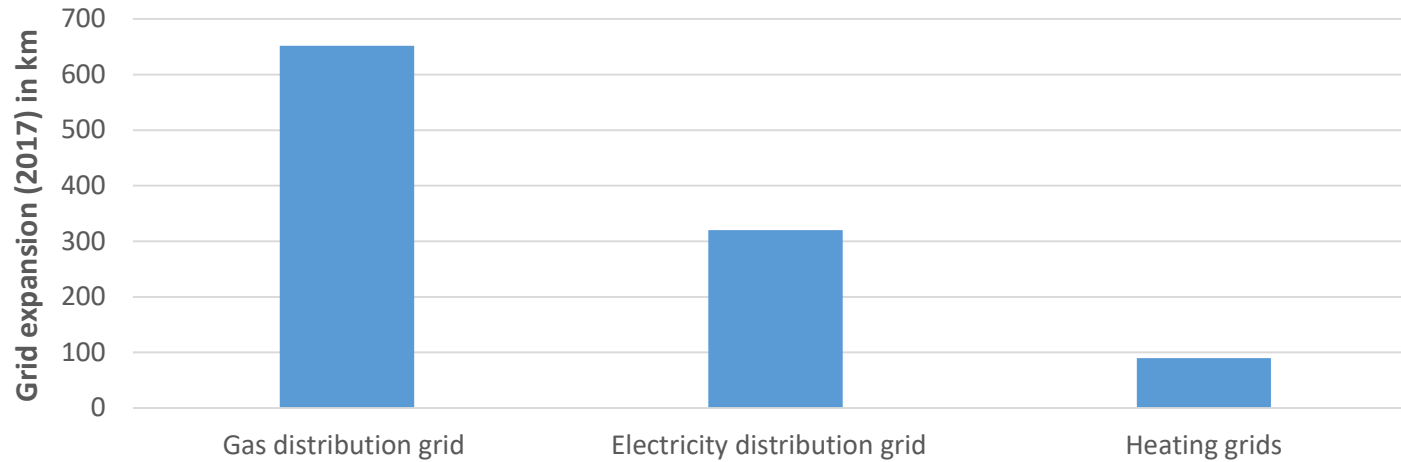
# Economical: Electricity distribution grid is the longest; Gas distribution grid transports highest amount of energy



- Electricity distribution grid is the longest
- Gas distribution grid has the highest withdrawal volume in total and in the different sectors
- Heating grids smaller local grids, without a national wide connecting grid

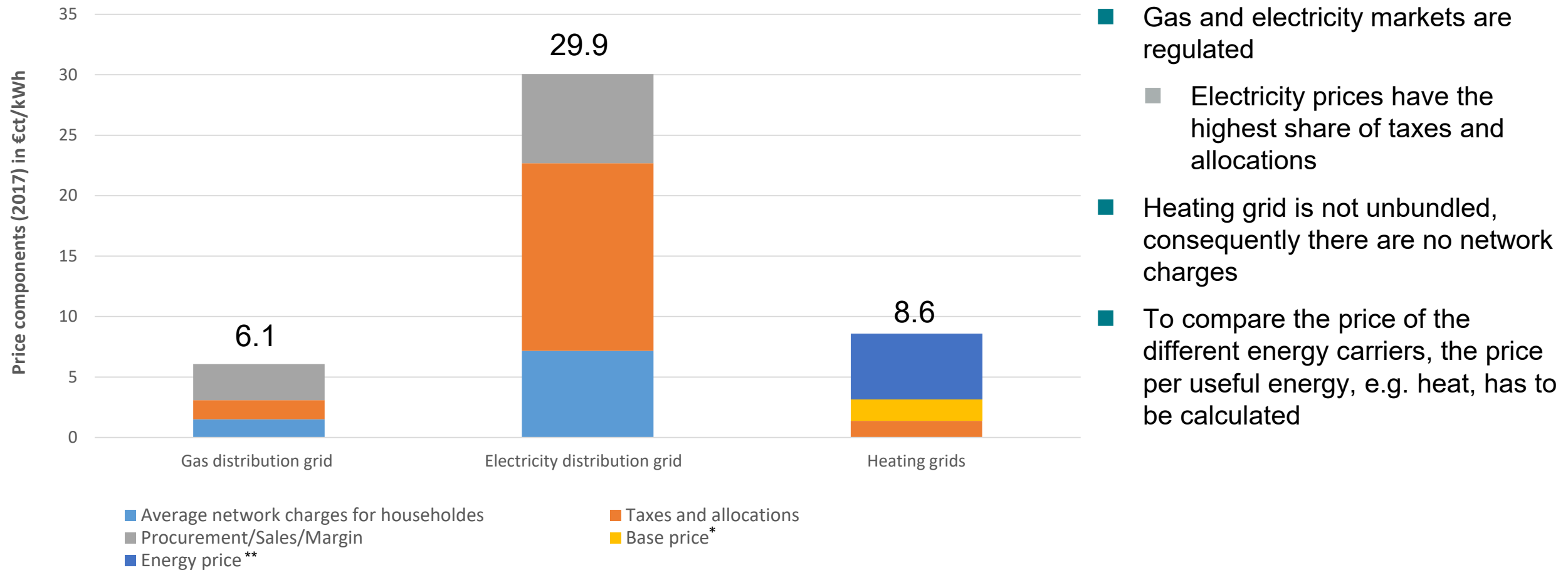


# Economical: Biggest grid expansion in the gas distribution grid; Highest investment in electricity distribution grid



- Biggest grid expansion in the gas distribution grid
- Highest investment in grid expansion in the electricity distribution grid
- Expanding electricity distribution grid seems to be more expensive than expanding gas distribution grid
- Investment of heating grid not directly comparable to gas and electricity grid, because it includes heat production

# Economical: Electricity prices have the highest share of taxes and allocations



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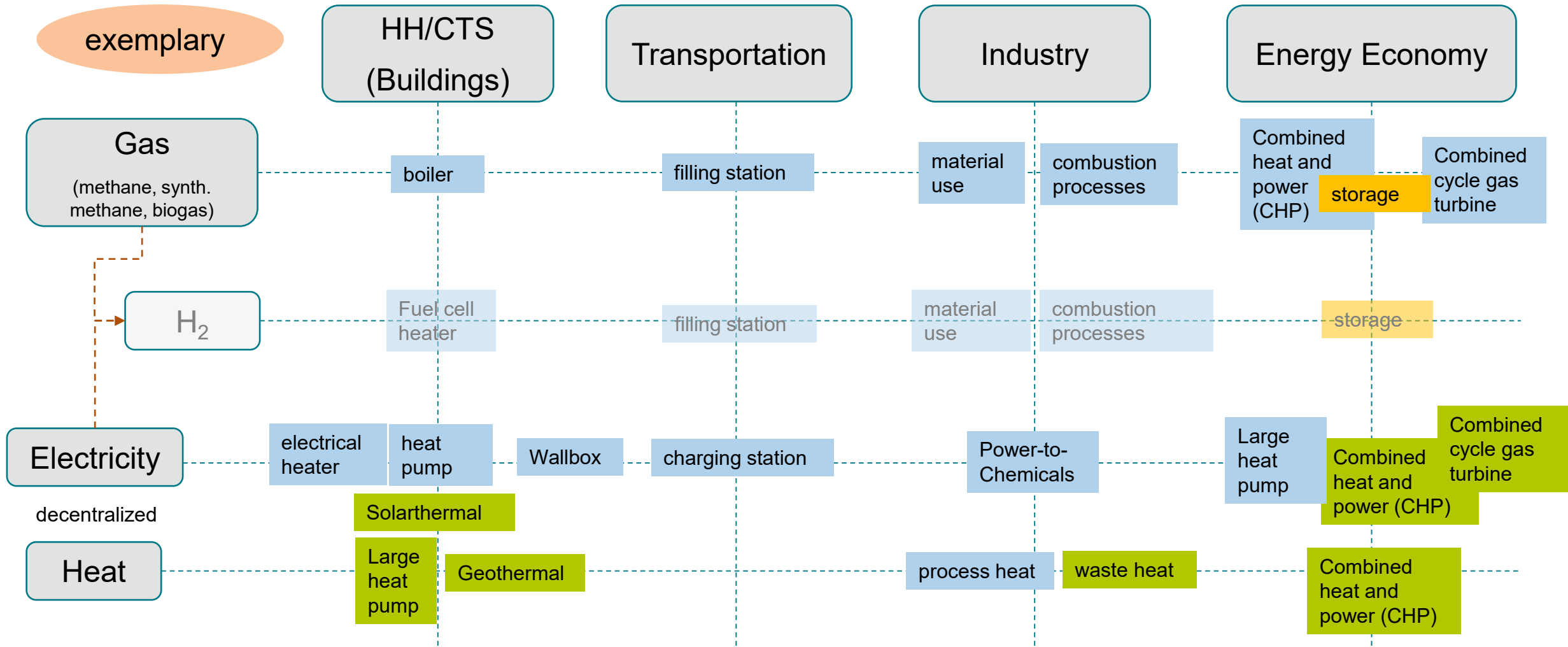
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# Technical: Synergies and competition between heating grids, gas and electricity distribution grids

■ demand / withdrawer    
 ■ production / feed-in    
 ■ withdrawer and feed-in

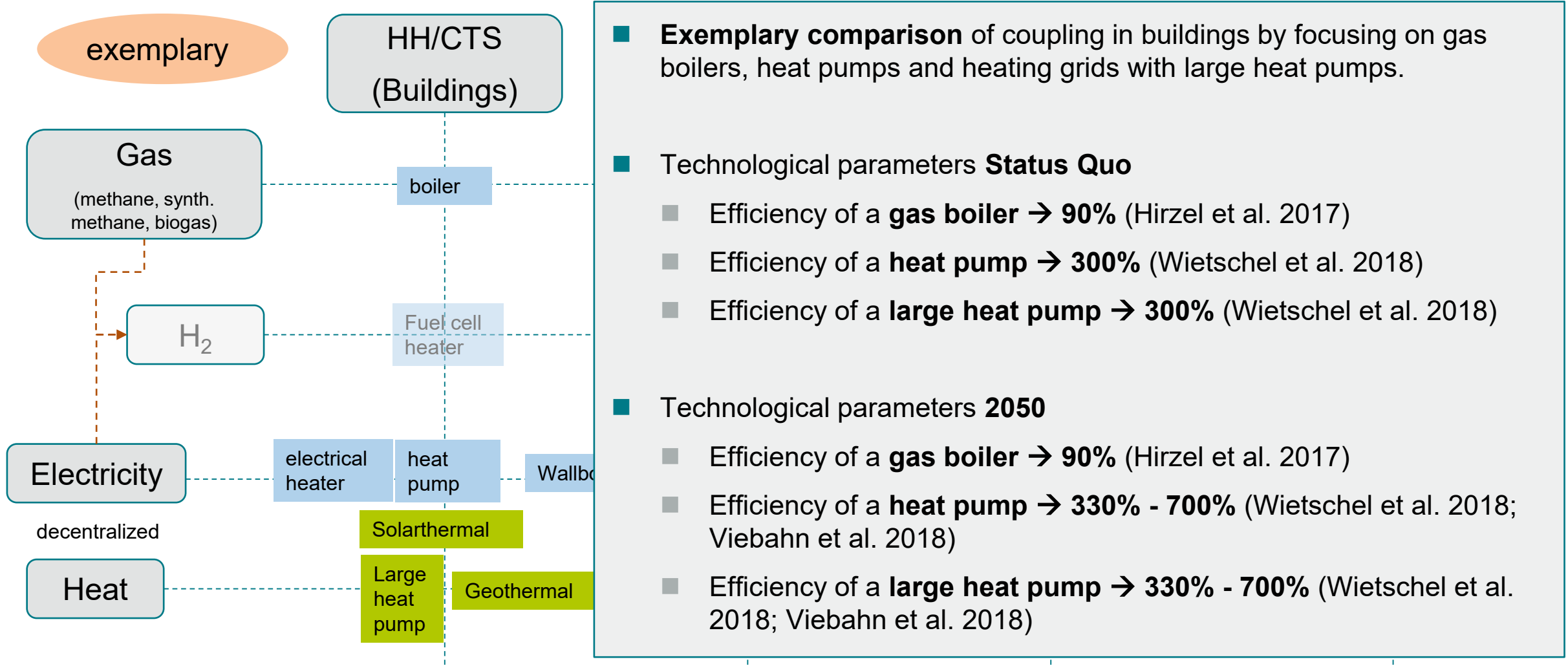


# Technical: Synergies and competition between heating grids, gas and electricity distribution grids

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# Exemplary comparison of grid relevance in the building sector – Status quo

Status quo (2018)	Natural Gas/ Gas boiler	Electricity/ Heat pump*	District heating**
Average price for households incl. taxes in €ct/kWh	6.1	21.7 (29.9)	8.6
Efficiency in %	90	300	100
Price for useful energy (heat) incl. taxes in €ct/kWh	6.8	7.2 (10.0)	8.6

- Reduced electricity price for supplying heat pumps
  - Consequently, district heating slightly more expensive
  - Heat production by gas boiler cheapest option
- With regular electricity price; heat supply by electricity most expensive option



# Exemplary comparison of grid-based coupling in the building sector – 2050

Status quo (2050)	Natural Gas/ Gas boiler	Electricity/ Heat pump	District heating*
Price for households in €/ct/kWh (based on different studies)	7.2 – 9.1	27.0 – 29.9	8.6
Efficiency in %	90	400 – 700	100
Price for useful energy (heat) in €/ct/kWh	8.0 – 10.1	3.9 – 7.5	8.6

- Different studies assume an increase in gas price and a slight decrease in electricity price until 2050
- No subsidy for electricity used to supply heat pumps
- Projections about the development of heat price are not given, so that a constant price is assumed
  - Heat supply of district heating not based on natural gas
- Different studies assume an increase in efficiency for heat pumps
- Slightly till strong decrease in heat expenses for households by using heat pumps

# Exemplary comparison of grid relevance in the building sector – Status quo without taxes and allocations

Status quo (2018)	Natural Gas/ Gas boiler	Electricity/ Heat pump*	District heating**
Average price for households incl. taxes in €ct/kWh	4.5	10.6 (14.6)	7.2
Efficiency in %	90	300	100
Price for useful energy (heat) incl. taxes in €ct/kWh	5.0	3.5 (4.9)	7.2

- Energy prices without taxes and allocation but constant share of network charges
- Electricity price for heat production slightly lower than for heat production with natural gas

# Exemplary comparison of grid-based coupling in the building sector – 2050 without taxes and allocations

Status quo (2050)	Natural Gas/ Gas boiler	Electricity/ Heat pump	District heating*
Price for households in €ct/kWh (based on different studies)	5.3 – 6.8	13.1 – 14.6	7.2
Efficiency in %	90	400 – 700	100
Price for useful energy (heat) in €ct/kWh	5.9 – 7.6	1.9 – 3.7	7.2

- Energy prices without taxes and allocation but constant share of network charges
- Price of heat production by heat pumps decreases further
- Price of heat supply by district heating on a similar level as heat production by gas boiler

# Exemplary comparison of grid-based coupling in the building sector – 2050 imported synthetic methane from North Africa

Status quo (2050)	Synthetic methane/ Gas boiler	Electricity/ Heat pump	District heating*
Price for households in €ct/kWh (based on different studies)	10.8 – 22.3	13.1 – 14.6	7.2
Efficiency in %	90	400 – 700	100
Price for useful energy (heat) in €ct/kWh	12.0 – 24.8	1.9 – 3.7	7.2

- Energy prices without taxes and allocation but constant share of network charges
- Price of synthetic methane includes 0,43 €ct/kWh for sales and 10% share of margin
- Price of heat production with gas boiler using synthetic methane significantly higher than producing heat by heat pumps or supplying heat by district heating

# Summary of the exemplary comparison

		Gas distribution grid	Electricity distribution grid	District heating
Network charges share of household price for energy carrier in %	Today	24.9 %	24.0 %	-
Price for useful energy incl. taxes in €ct/kWh	Today	6.8	7.2 (10.0)	8.6
	2050	8.0 – 10.1	3.9 – 7.5	8.6
Price for useful energy excl. taxes in €ct/kWh	Today	5.0	3.5 (4.9)	7.2
	2050	5.9 – 7.6	1.9 – 3.7	7.2
Price for useful energy excl. taxes with synth. methane in €ct/kWh	2050	12.8 – 24.8	1.9 – 3.7	7.2

# Summary of the exemplary comparison

		Gas distribution grid	Electricity distribution grid	District heating
Network charges share of household price for energy carrier in %	Today	Although the investment per km for electricity grid expansion is considerably higher than the expansion of the natural gas grid, the network charges share of the prices are on a similar level.		
Price for useful energy incl. taxes in €ct/kWh	Today 2050	Even though different shares of taxes and allocations, nowadays price per useful energy on similar levels. In 2050 heat production by heat pumps cheapest option.		
Price for useful energy excl. taxes in €ct/kWh	Today 2050	Without taxes and allocations, nowadays electricity price per useful energy significant cheaper than natural gas and district heating. In 2050 natural gas is more expensive, so that heat supply by gas boilers and district heating are nearly on the same level.		
Price for useful energy excl. taxes with synth. methane in €ct/kWh	2050	For an ambitious decarbonisation scenario natural gas will not be in the system in 2050. Due to the higher price for synthetic methane heat production by gas boiler becomes the least attractive option.		

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# Summary/Conclusion

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- Strong decrease in natural gas demand until 2050, especially in the building sector
- Shift towards electrification in heat production for buildings until 2050
- In the building sector all three grid-based energy carriers on a similar grid level
- Comparison based on network charges or price difficult because of different market structures
- Comparison based on price for useful energy shows that heat production supplied by the electricity grid is already competitive to natural gas distribution grid.
- Due to the fuel switch until 2050 (synth. methane) supplying heat in buildings by gas boilers becomes the least attractive solution.

**→ Natural gas distribution grid will become the least relevant grid for supplying heat in buildings in 2050**



# Critical reflection/Outlook

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- Strong decrease in natural gas demand might lead to higher network charges in the natural gas grid → considering a constant share of network charges neglects this development
- Projection of price developments and efficiency changes include high uncertainties
- Analysis only gives a first insight into the different components influencing the different grids without the claim to be complete
  - Therefore, further more detailed analysis is necessary to give insights about the effects on the natural gas distribution grid developments until 2050

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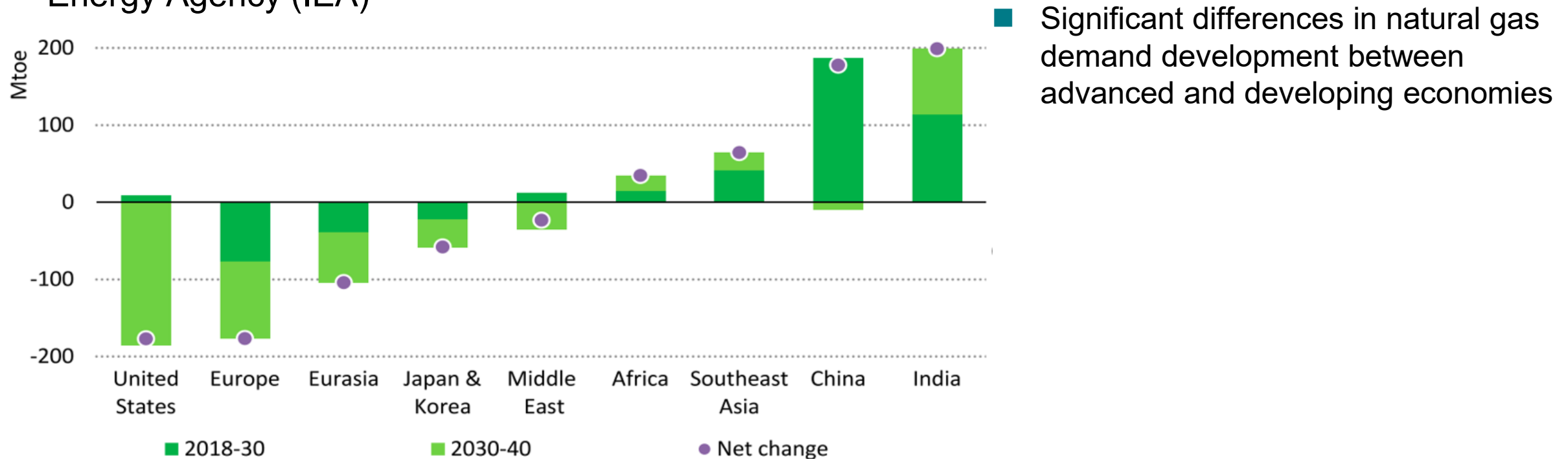
# Thank you for your attention!

## Questions?

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# International perspective of natural gas demand development

## Sustainable Development Scenario of the International Energy Agency (IEA)



Sustainable Development Scenario meets global climate goals in line with Paris Agreement