

Application-side merit-order-curves for synthetic fuels in the German energy system

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- Efficiency is not enough
- An all electric world? No, synfuels matter!
- How can I create an application-side merit-order curve?
- Synfuel-applications are mostly more expensive, but...
- Why are synfuels definitely being used in the energy system of the future?

Efficiency and sufficiency are not enough...

In order to achieve the ambitious climate goals in a cost-efficient manner, technology-oriented measures to reduce GHGs are required, which, in addition to incremental efficiency and sufficiency, take further disruptive GHG reduction measures into account.

In the sense of different energy and climate political scenarios

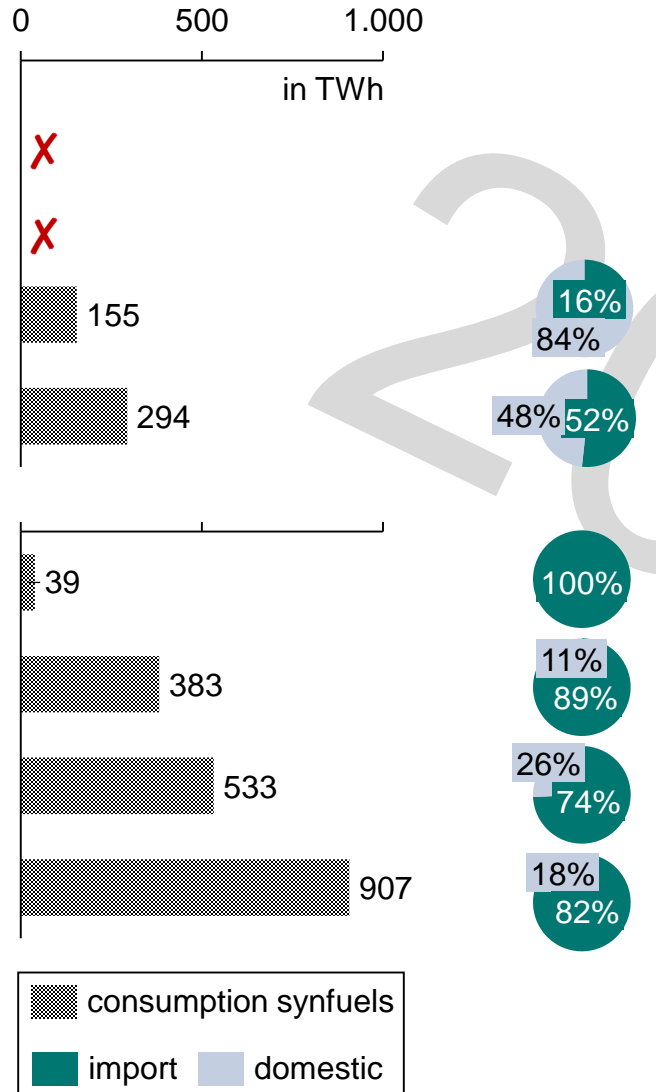
Synfuels

Electrification

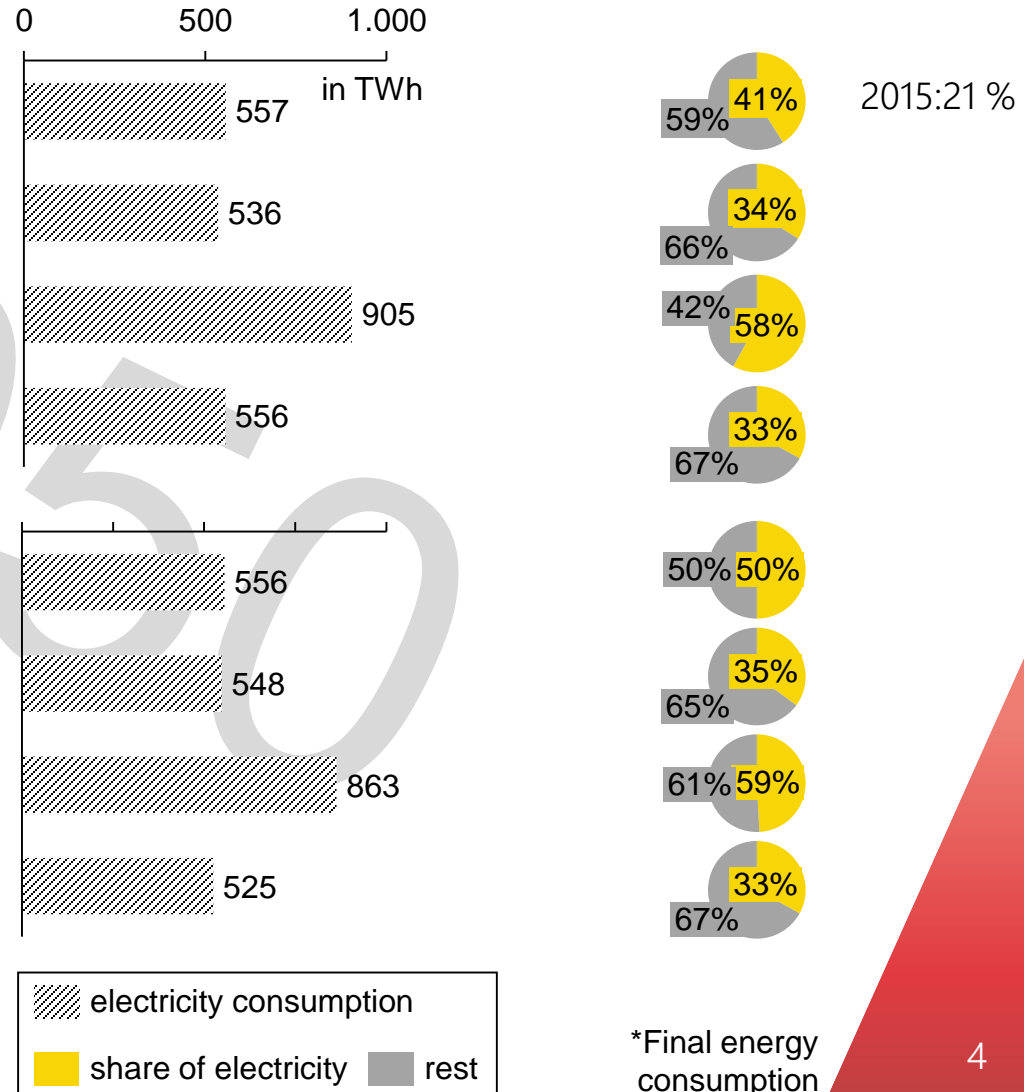


GHG-reduction target	Scenario
At least 80 %	Klimaschutzszenario
	Klimapfade
	Integrierte Energiewende-EL
	Integrierte Energiewende-TM
At least 95 %	Klimaschutzszenario
	Klimapfade
	Integrierte Energiewende-EL
	Integrierte Energiewende-TM

Synfuel consumption Import



Electricity consumption Share of electricity at FEC*



*Final energy consumption

Decarbonization strategies compared

Efficiency and Sufficiency



Electrification

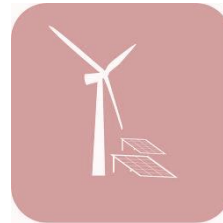
SynFuels

+ electrical applications usually more efficient



+ Maintaining existing applications

+ Direct use of RES electricity leads to less RE expansion



+ Import enables the use of favorable RES potentials worldwide

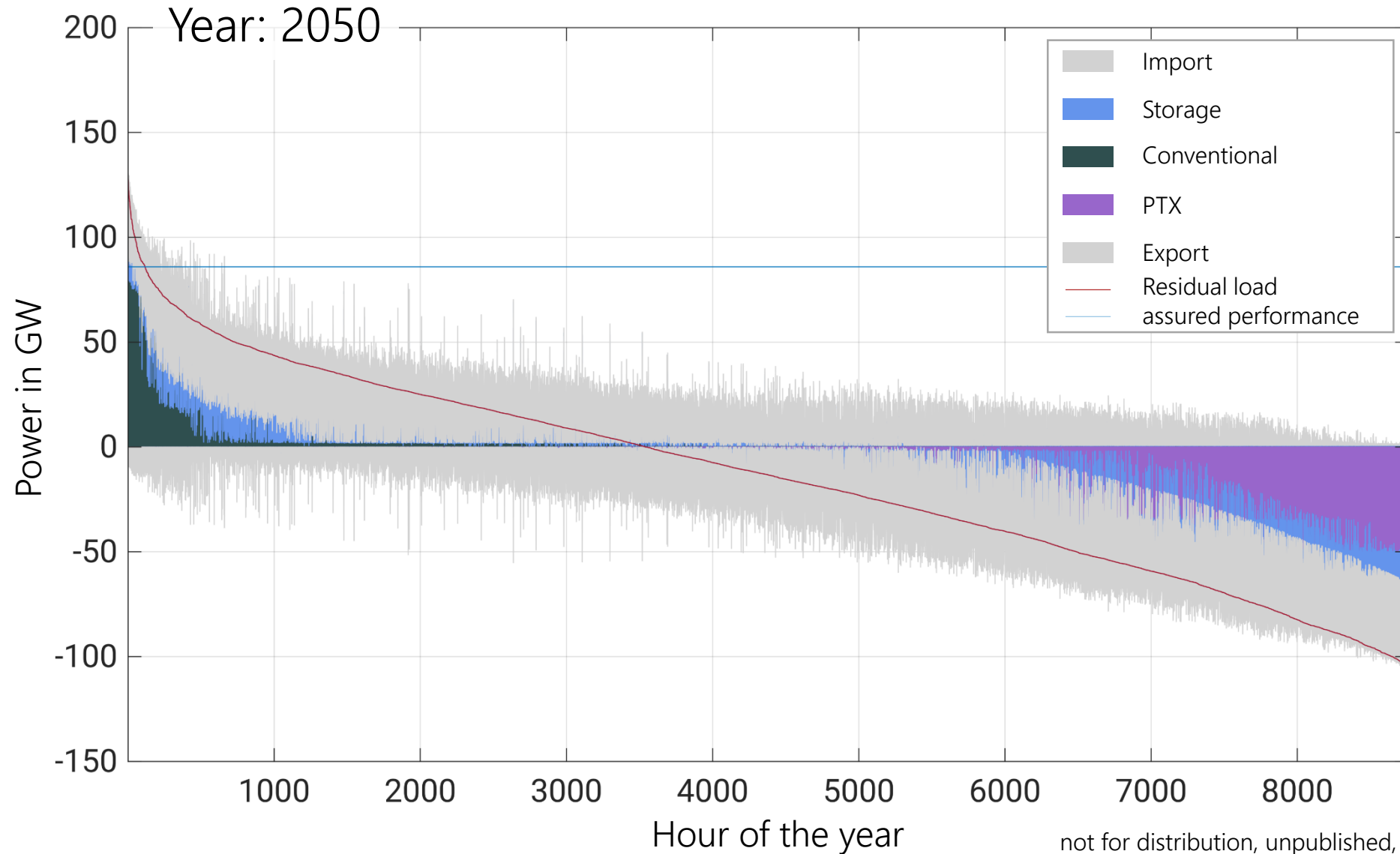
+ Flexibility from the European network



+ more moderate requirements for networks, storage and back-up

In the first step, the advantages of electrification predominate, but...

Residual load - annual duration



SynFuels

How can I create application-side merit-order curve?

1. Do literature review and meta-analysis to collect the necessary input parameters
2. Choose synfuel and reference technology for the comparison
3. Calculating and assorting

$$\Delta \text{ costs} = \frac{(\sum CAPEX_{Syn} + OPEX_{Syn}) - (\sum CAPEX_{Ref} + OPEX_{Ref})}{FEC_{conv}}$$

Syn: Synfuels

CAPEX: Capital Expenditure in €

Ref: Conventional (conv.)/Electric technology

OPEX: Operational Expenditure in €

FEC: Final Energy Demand in kWh

Δ costs : delta costs of synfuel and reference technology

4. Generating Mekko-Diagrams and asses the results

Δ costs in ct/kWh

60

50

40

30

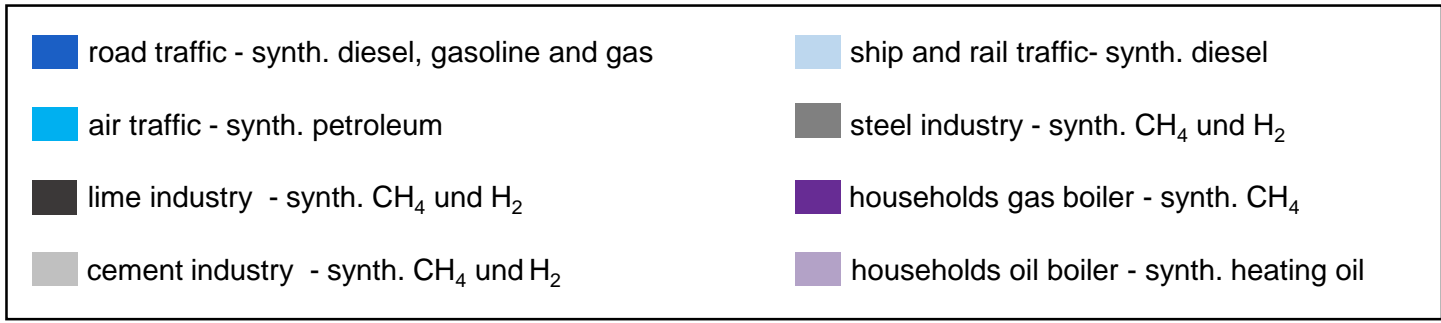
20

10

0

0 100 200 300 400 500 600 700 800 900 1.000 1.100

TWh



Full load hours
electrolysis: 2000 h/a

Private
households

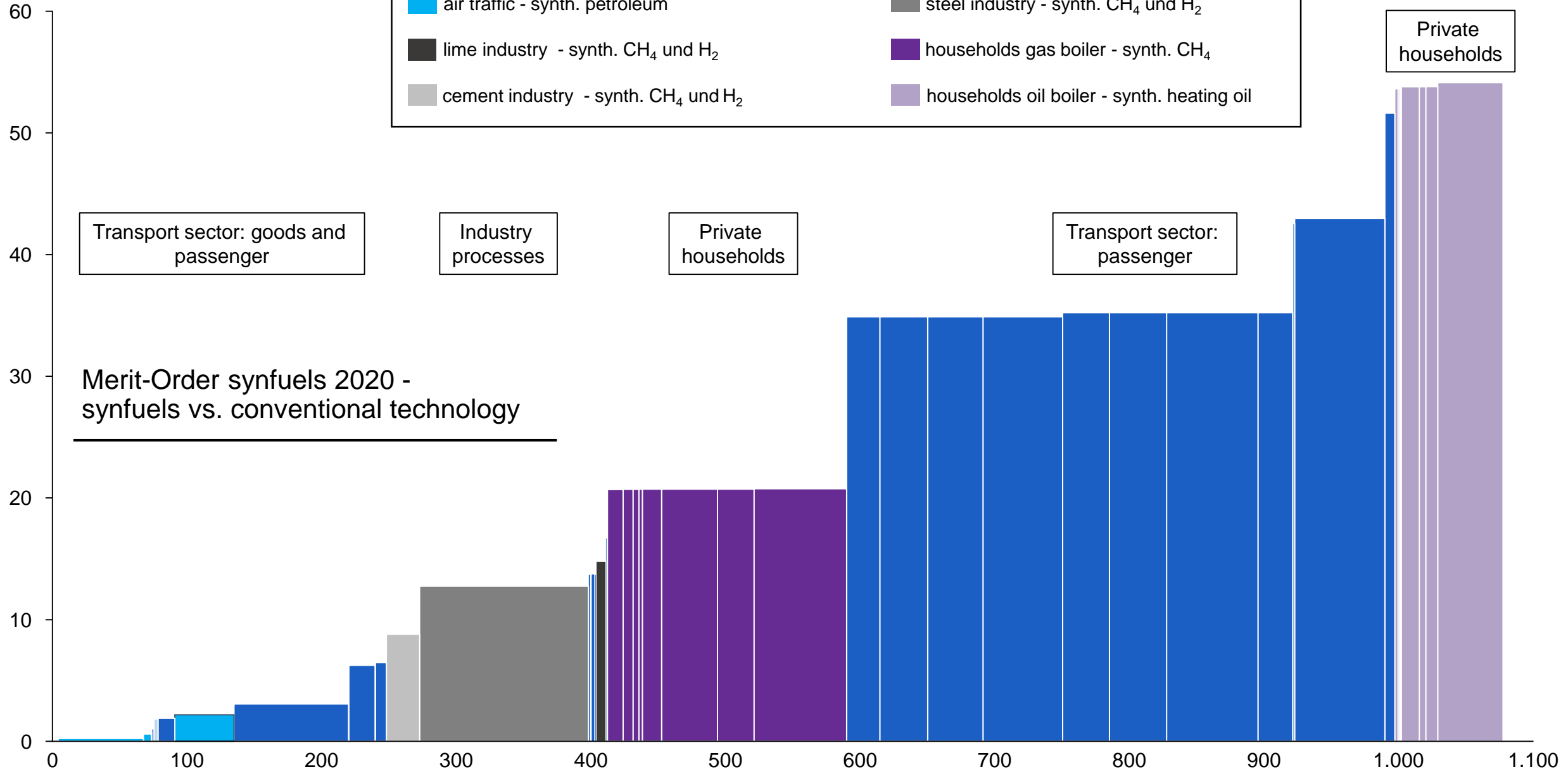
Transport sector: goods and
passenger

Industry
processes

Private
households

Transport sector:
passenger

Merit-Order synfuels 2020 -
synfuels vs. conventional technology



Δ costs in ct/kWh

60

50

40

30

20

10

0

0

100

200

300

400

500

600

700

800

TWh

road traffic - synth. diesel, gasoline and gas

air traffic - synth. petroleum

lime industry - synth. CH₄ und H₂

cement industry - synth. CH₄ und H₂

ship and rail traffic- synth. diesel

steel industry - synth. CH₄ und H₂

households gas boiler - synth. CH₄

households oil boiler - synth. heating oil

Full load hours
electrolysis: 2000 h/a

Private
households

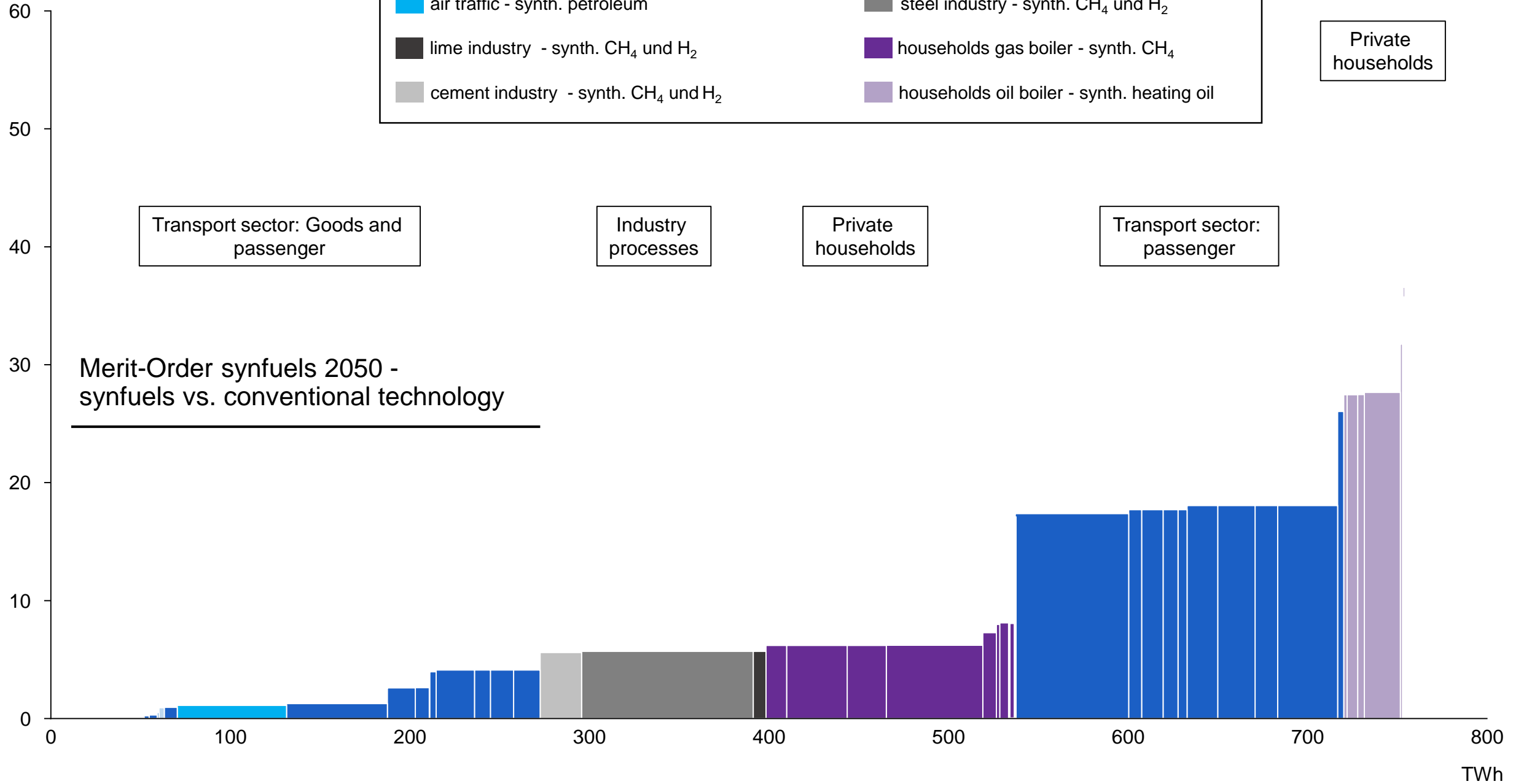
Transport sector: Goods and
passenger

Industry
processes

Private
households

Transport sector:
passenger

Merit-Order synfuels 2050 -
synfuels vs. conventional technology



Δ costs in ct/kWh

60

50

40

30

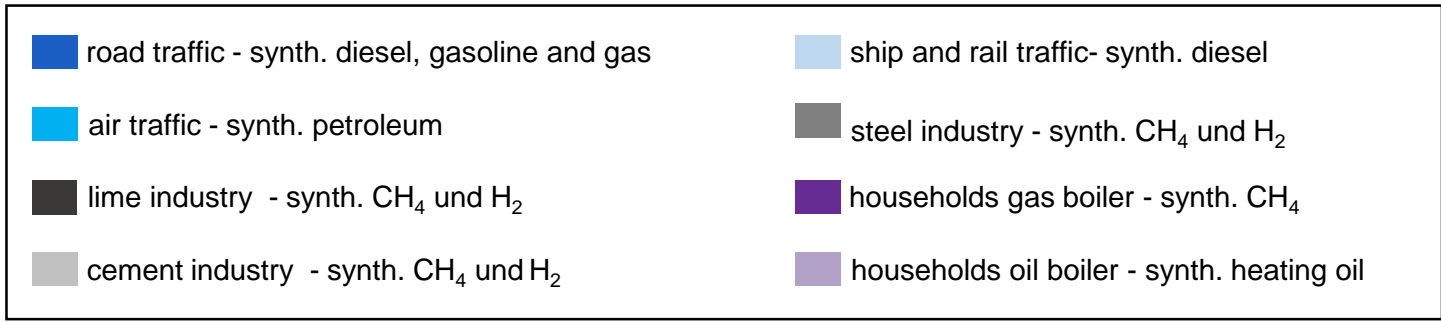
20

10

0

0 100 200 300 400 500 600 700 800

TWh



Full load hours
electrolysis: 8000 h/a

Private
households

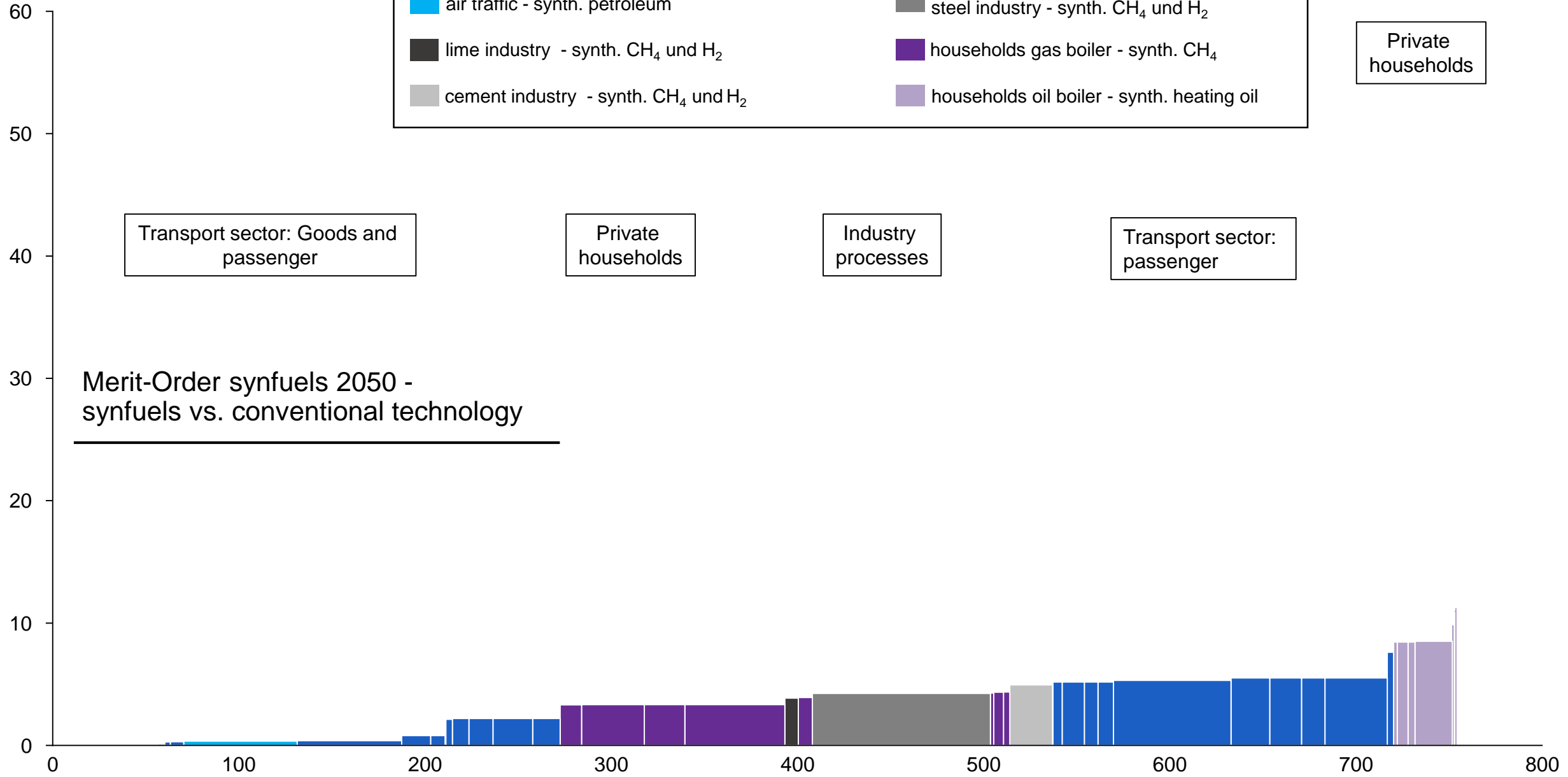
Transport sector: Goods and
passenger

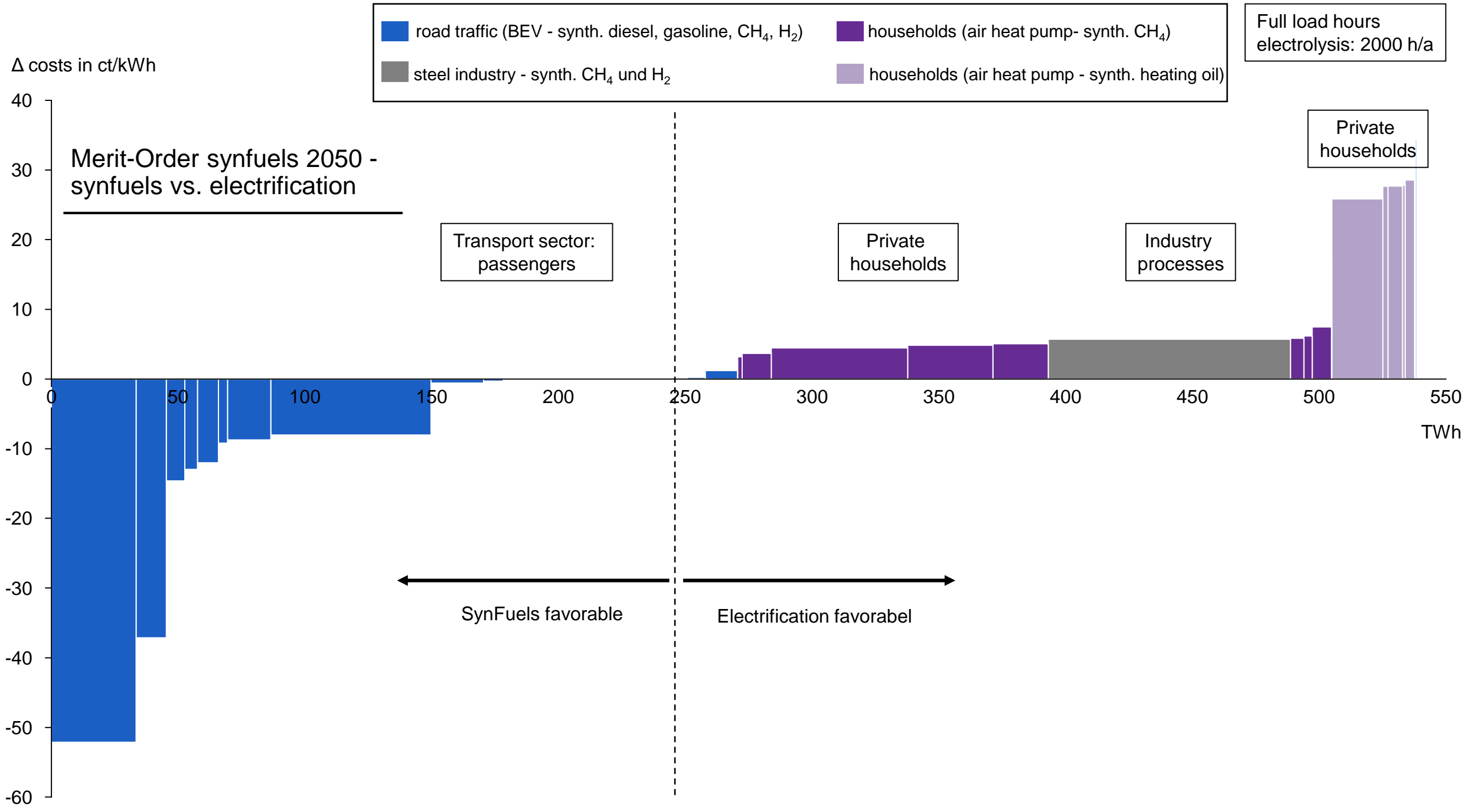
Private
households

Industry
processes

Transport sector:
passenger

Merit-Order synfuels 2050 -
synfuels vs. conventional technology





Conclusion

The application of synfuels depends on...

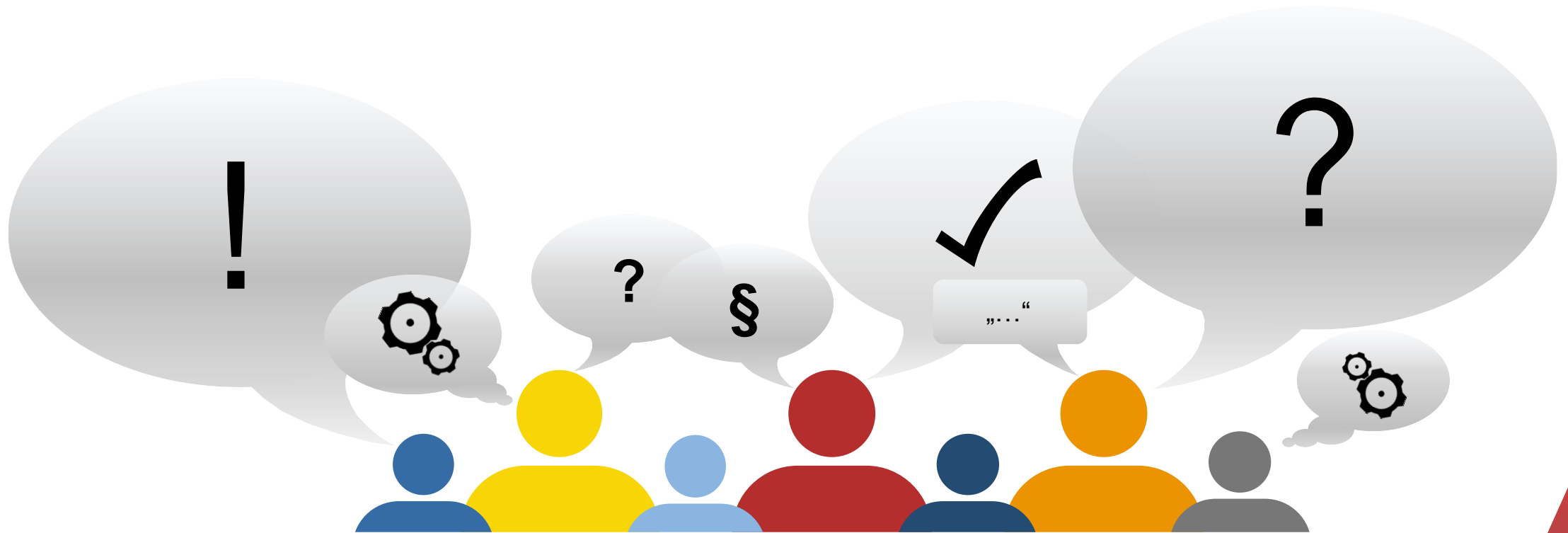
- Costs for the different energy carriers
- Respective application and the opportunity costs (alternative costs)
- the willingness to change/acceptance. Missing acceptance of electrified applications encourage the use of synthetic fuels

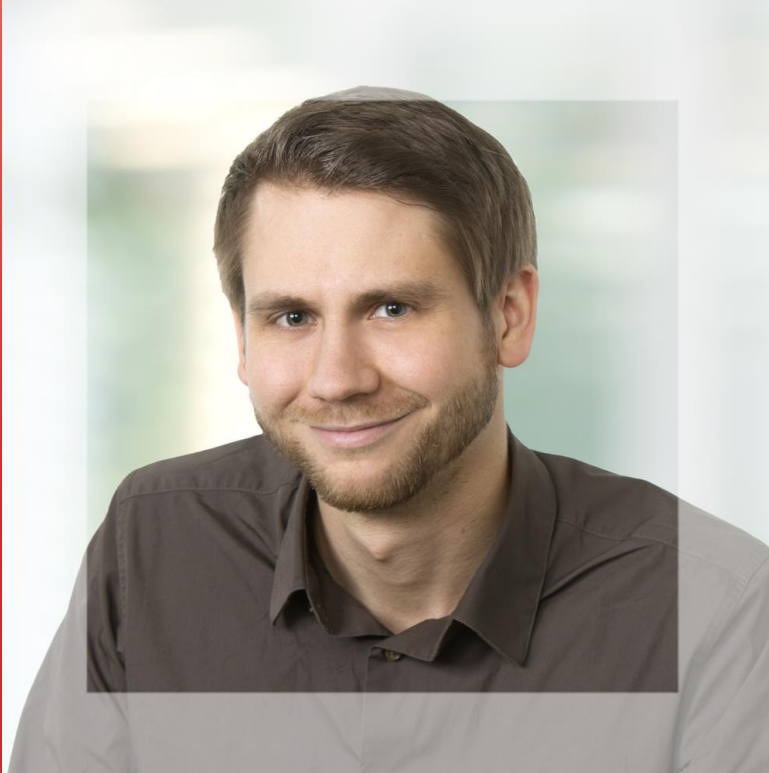
Why are synfuels definitely being used in the energy system of the future?

- For the energy system, the use of synthetic fuels is one way to provide short and long-term flexibility
- There are applications in the transport and industrial sectors that can not be efficiently electrified according to current technology in 2050
- In some applications, synfuels are the more cost efficient way to reduce GHG emissions compared to electrification

If the climate policy goals are adhered to by 2050 (up to 95% GHG-reduction compared with 1990), a massive use of synthetic fuels is to be expected, despite the mostly higher costs

Thanks a lot for your interesting





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