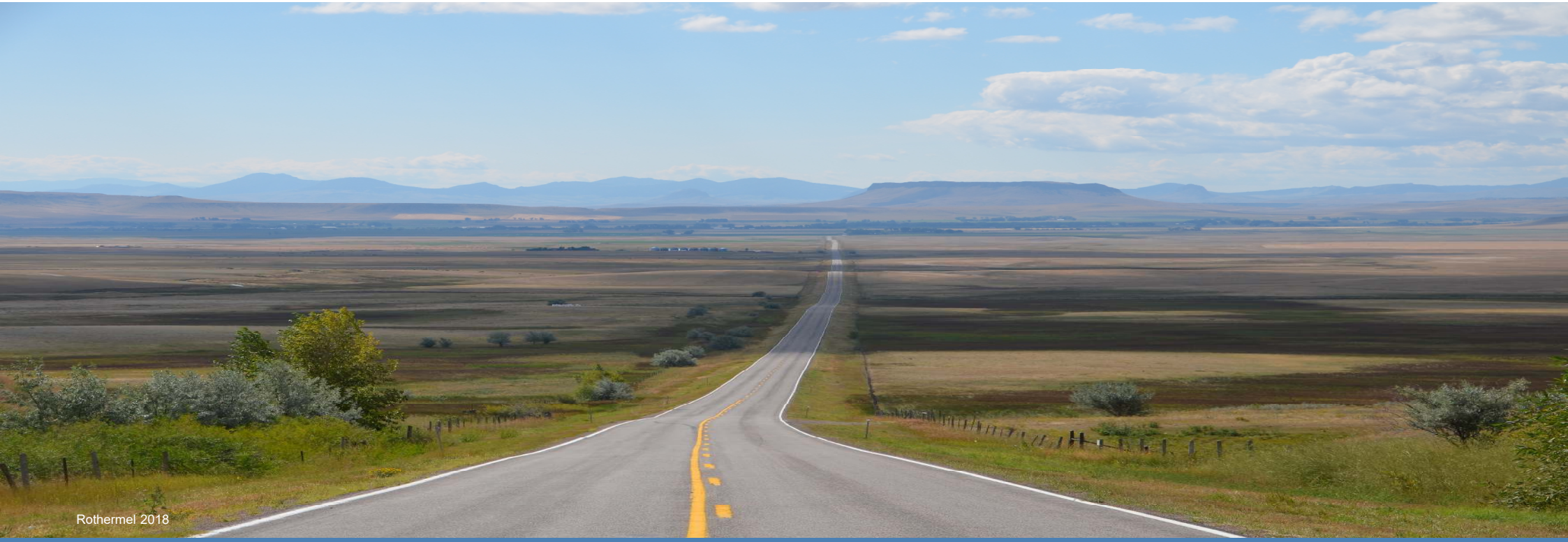

The Chemical Industry – Seeking and offering solutions for a CO_2-neutral future

Dr. Jörg Rothermel, Carbon2Chem 3rd Conference, October 29, 2020

VERBAND DER CHEMISCHEN INDUSTRIE e.V.
WIR GESTALTEN ZUKUNFT.
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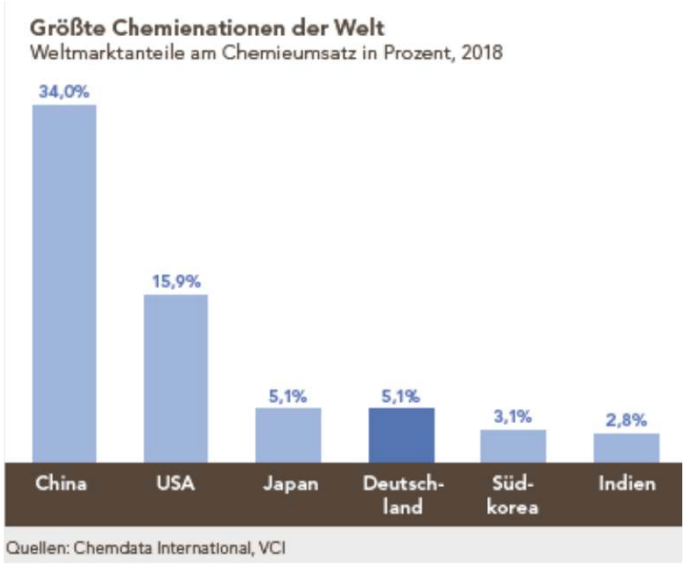
Agenda

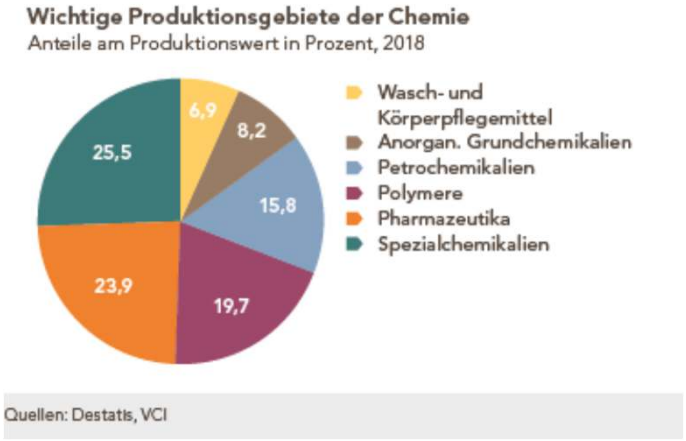
1. Current situation
2. Roadmap 2050
3. Challenges
4. Conclusions

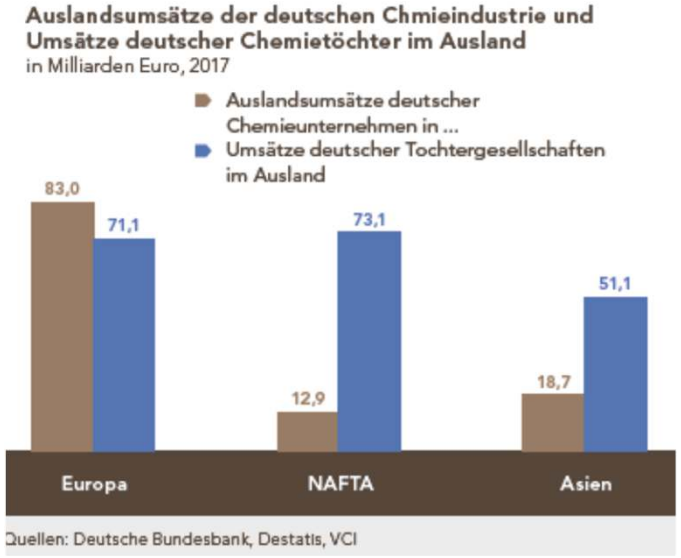
1 Current Situation

Energy Intensive Chemical Industry

Chemical Industry in Germany





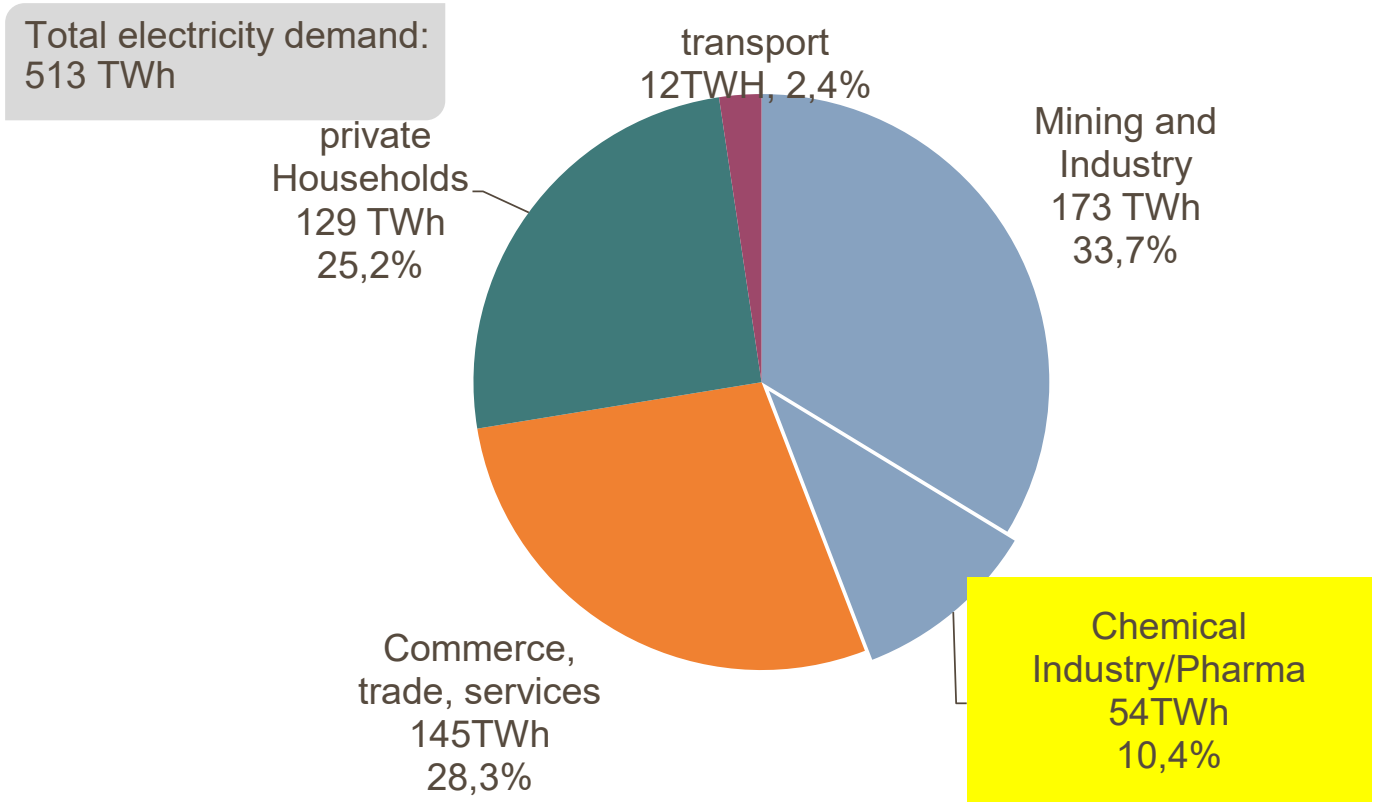


- Biggest producer in Europe
- about 2000 companies
- about 203 bn. € turn over (3rd place)
- about 463 000 employees (6th place)
- 7,2 Mrd. € Investment/year (2nd place behind car induytry)

Energy Intensive Chemical Industry: highest industrial electricity demand

Electricity consumption in different sectors

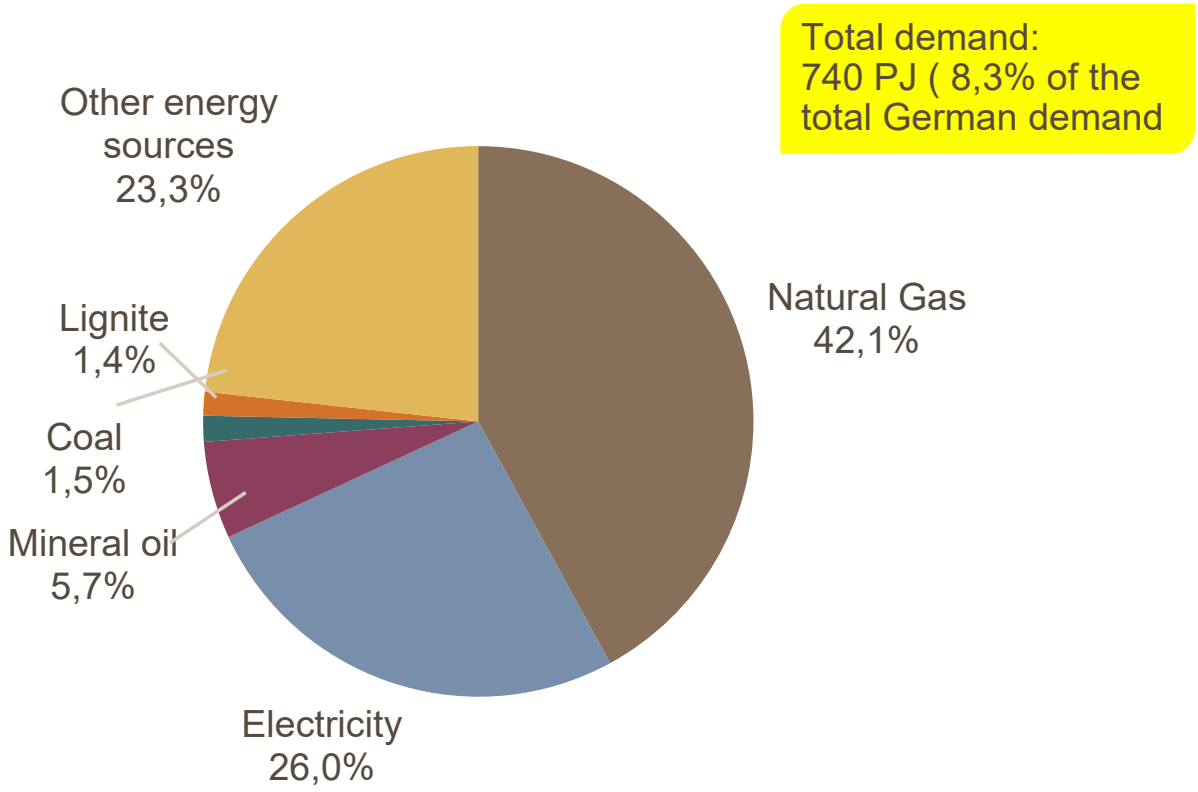
TWh and percentage, 2018



Quellen: Destatis, AG Energiebilanz, VCI

Energy Intensive Chemical Industry: Natural Gas and Electricity most important

Energy demand in the chemical and pharmaceutical Industry in percent, 2018

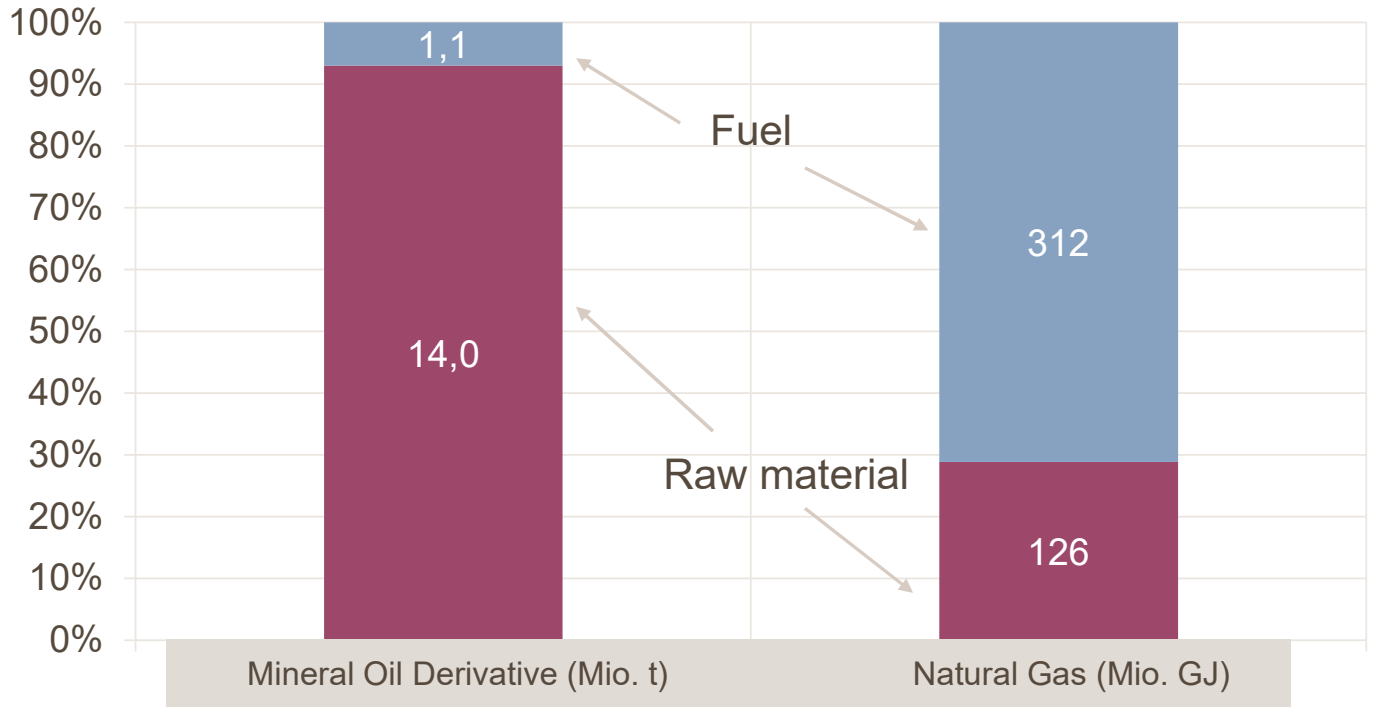


Quellen: Destatis, VCI

Ohne stofflicher Einsatz, Erdgas enthält Stromerzeugung mit Erdgas = Doppelzählungen von Strom

Speciality: Fuels use also as feedstock for production

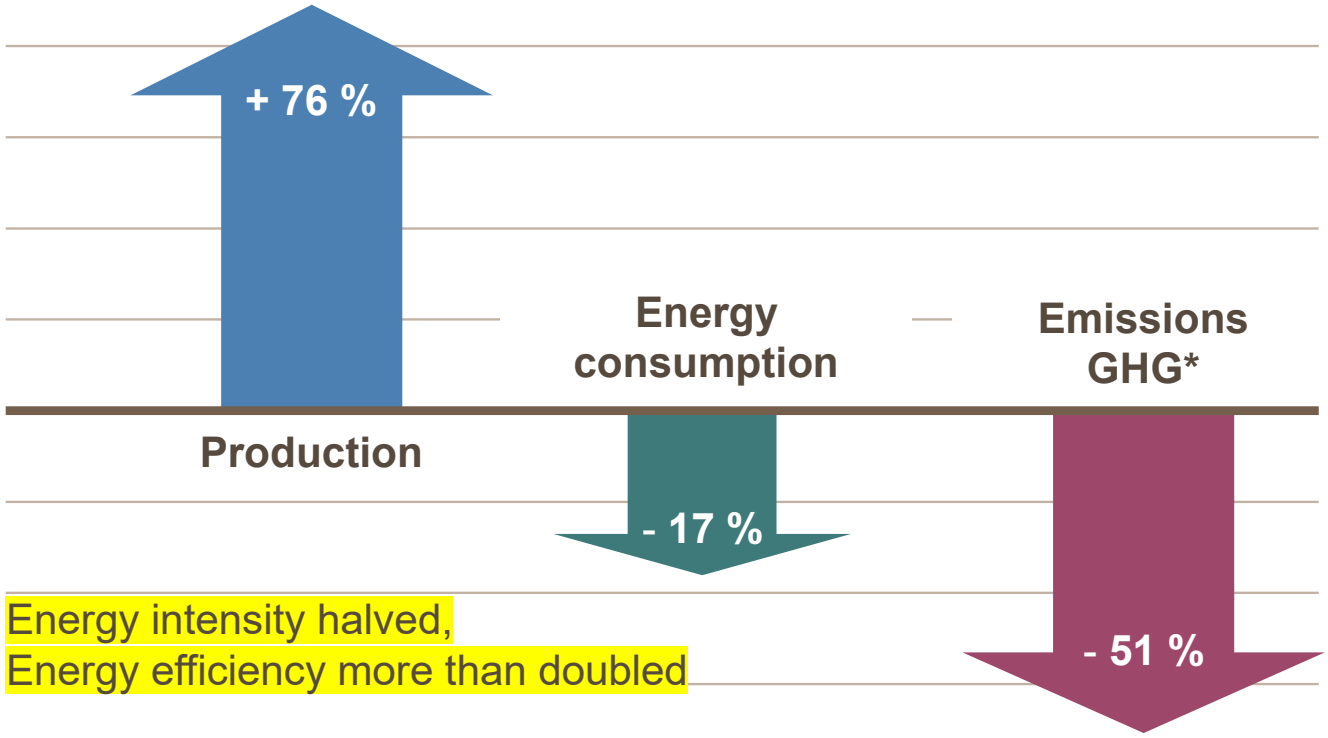
Use of mineral oil derivatives and natural gas as fuel and as raw material, 2018



Quelle: Destatis, VCI

Decreasing Emissions and Growing Production

Development of production, energy consumption ans GHG emissions 1990-2018 in %

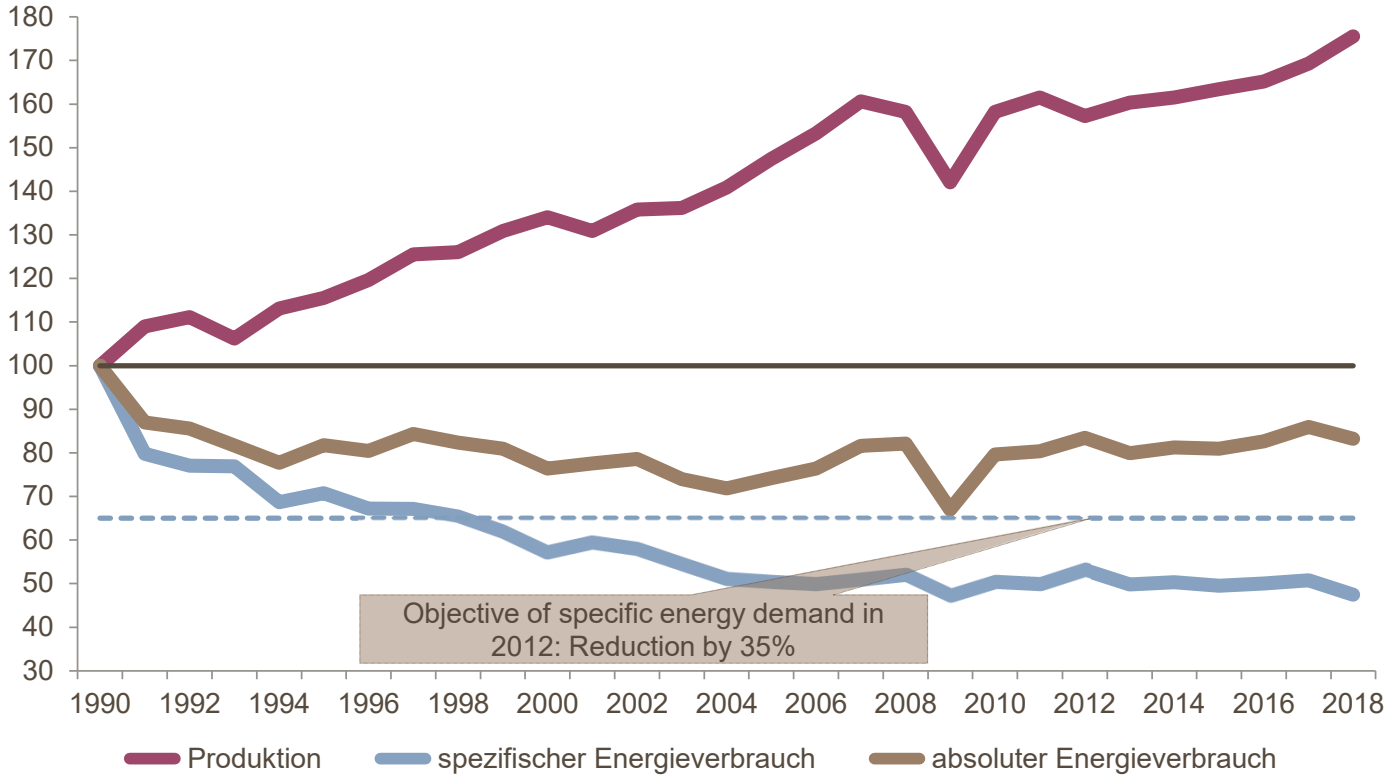


*Treibhausgase: Energiebedingte CO_2-Emissionen und Lachgasemissionen (N_2O)
Quelle: VCI-Berechnungen auf der Grundlage von Daten des Statistischen Bundesamtes, des Umweltbundesamtes und eigener Erhebungen

Development of Energy Consumption

Development of specific energy demand

Development of energy consumption in the chemical industry, Index 1990 = 100

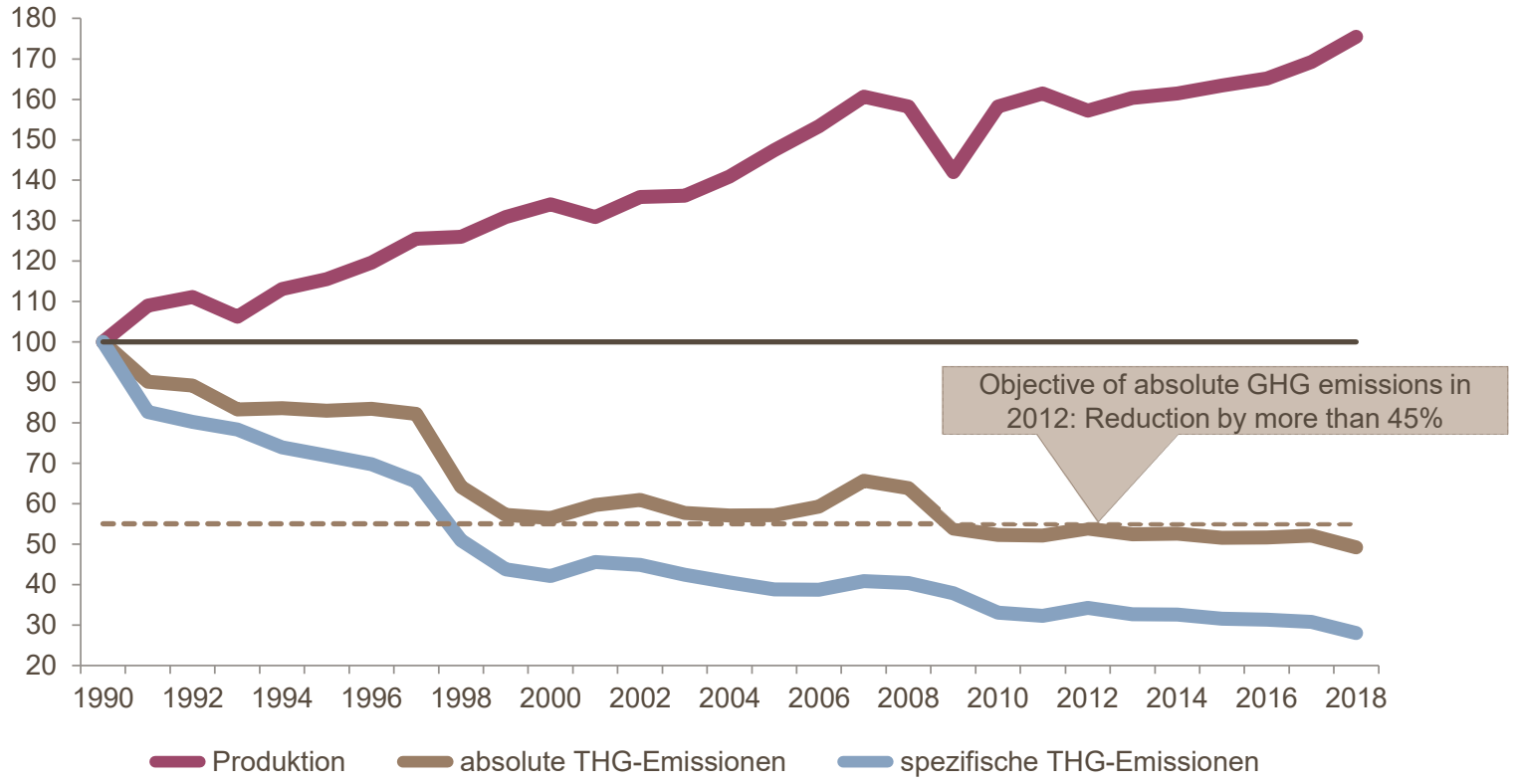


Quelle: VCI-Berechnungen auf der Grundlage von Daten des Statistischen Bundesamtes

Produktion: Chemie- und Pharmaproduktion

Development of Green House Gas Emissions

Index 1990=100, energiebedingte CO_2-Emissionen und N_2O-Emissionen in der Chemie



Quelle: VCI-Berechnungen auf der Grundlage von Daten des Statistischen Bundesamtes, des Umweltbundesamtes und eigener Erhebungen

Produktion: Chemie- und Pharmaproduktion

History: Measures to Improve Energy Efficiency

- Fuels Switch in heat and electricity production: coal to natural gas
- More combined heat and power
- Optimization of production processes
- Improved heat management at integrated sites („Verbundstandorten“)

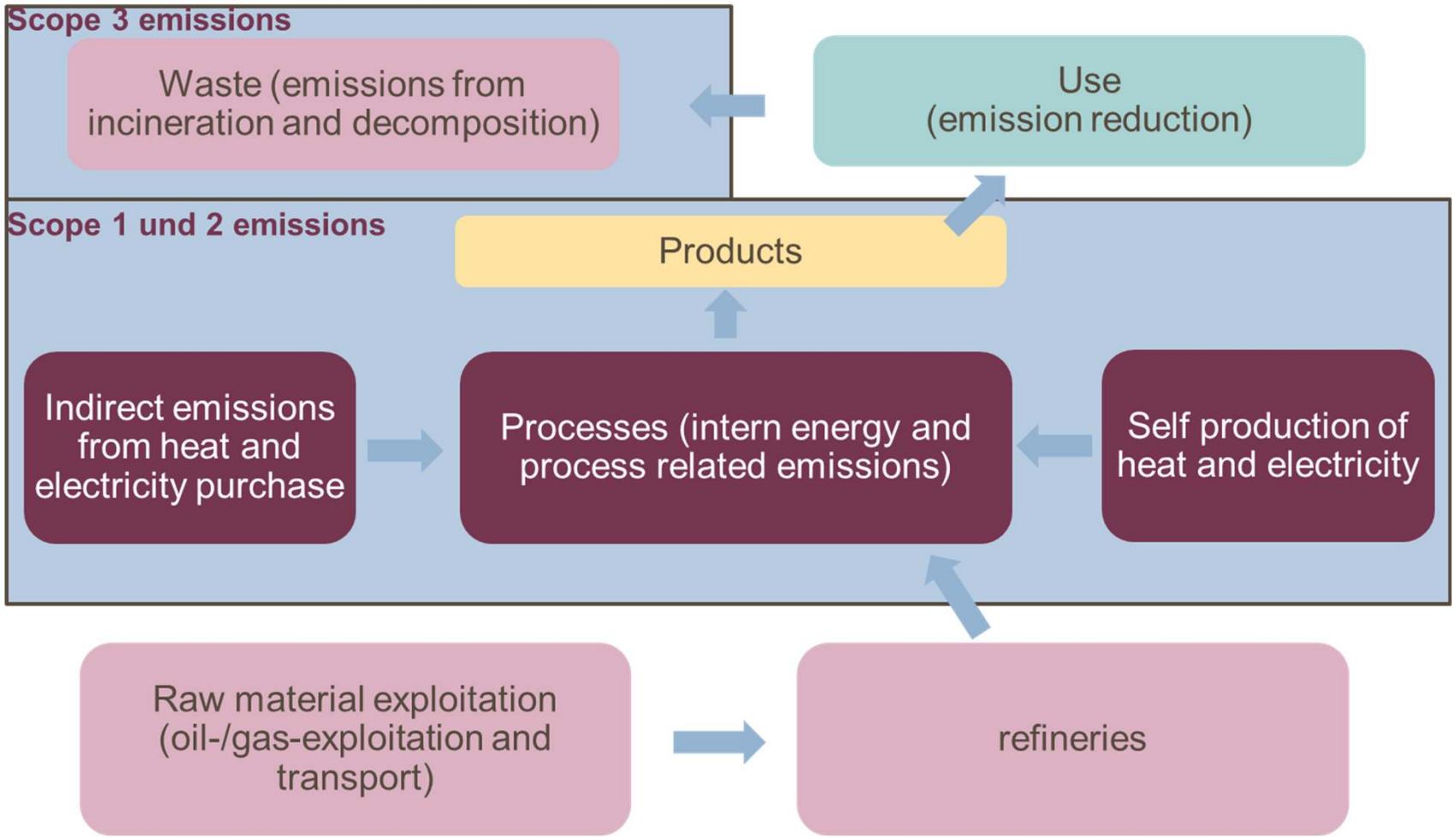
2 Roadmap 2050

Pathways to GHG-Neutrality

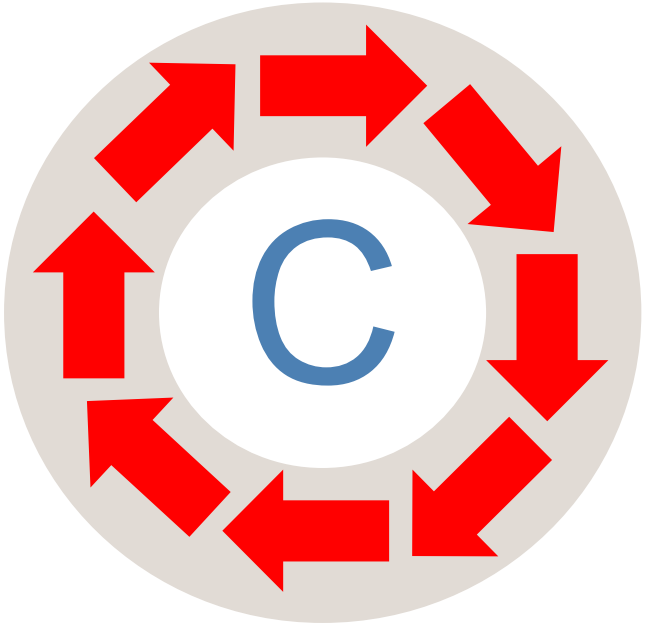
Background

- Chemical industry is providing solutions
- Political target of GHG-neutrality until 2050 in Germany and Europe is fixed
- Chemical industry is responsible for a significant amount of GHG emissions
- Chemical industry is committed to produce in Germany and Eurpe also in the future
- Production in the same range (as today) in 2050 will only be possible if the chemical industry itself will be GHG-neutral
- Questions in the study:
  - Is a GHG-neutral chemical industry (until 2050) technologically possible?
  - What about economy?
  - Which framework is necessary?

Scope of emissions



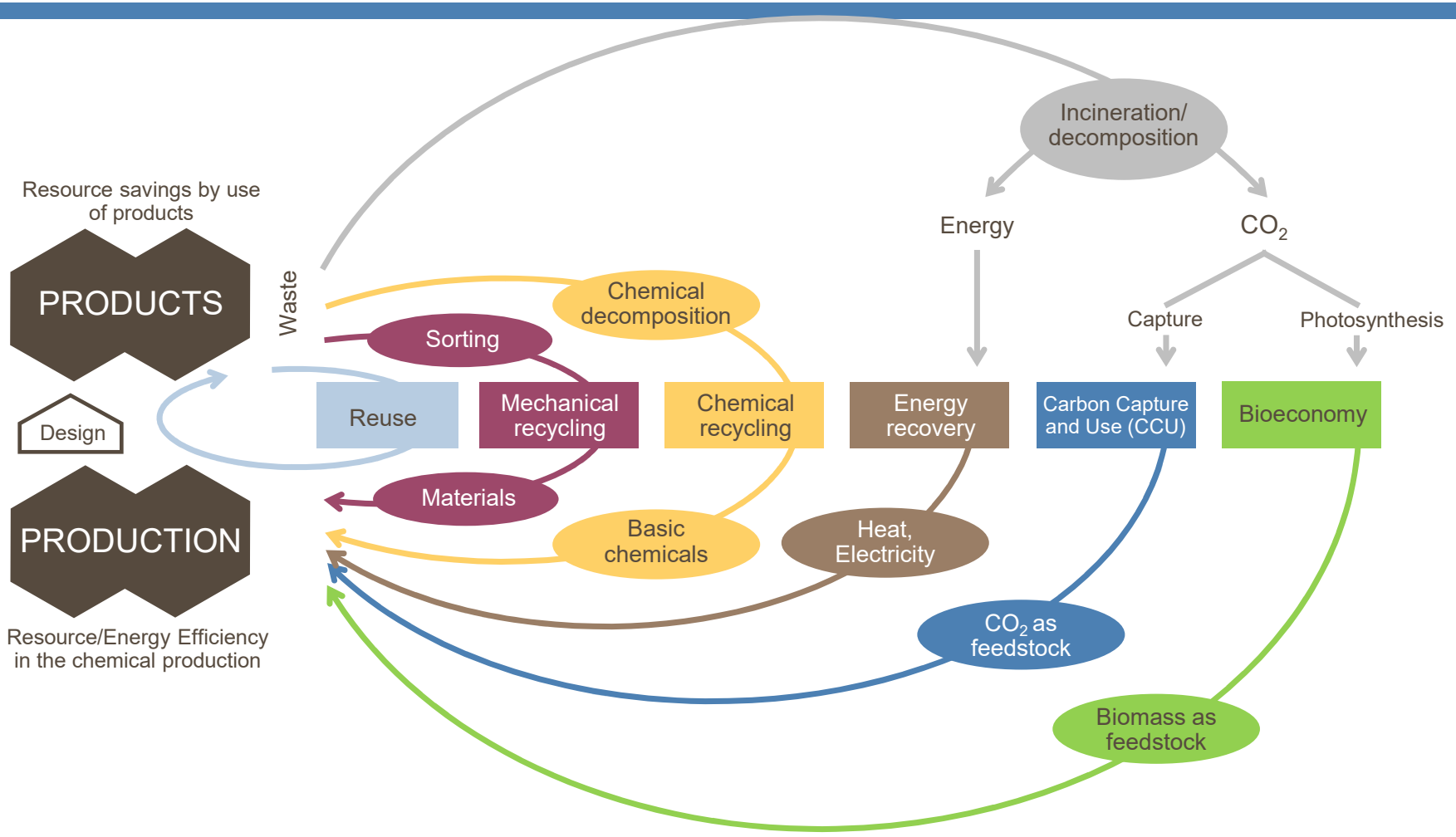
Technologies: Overview



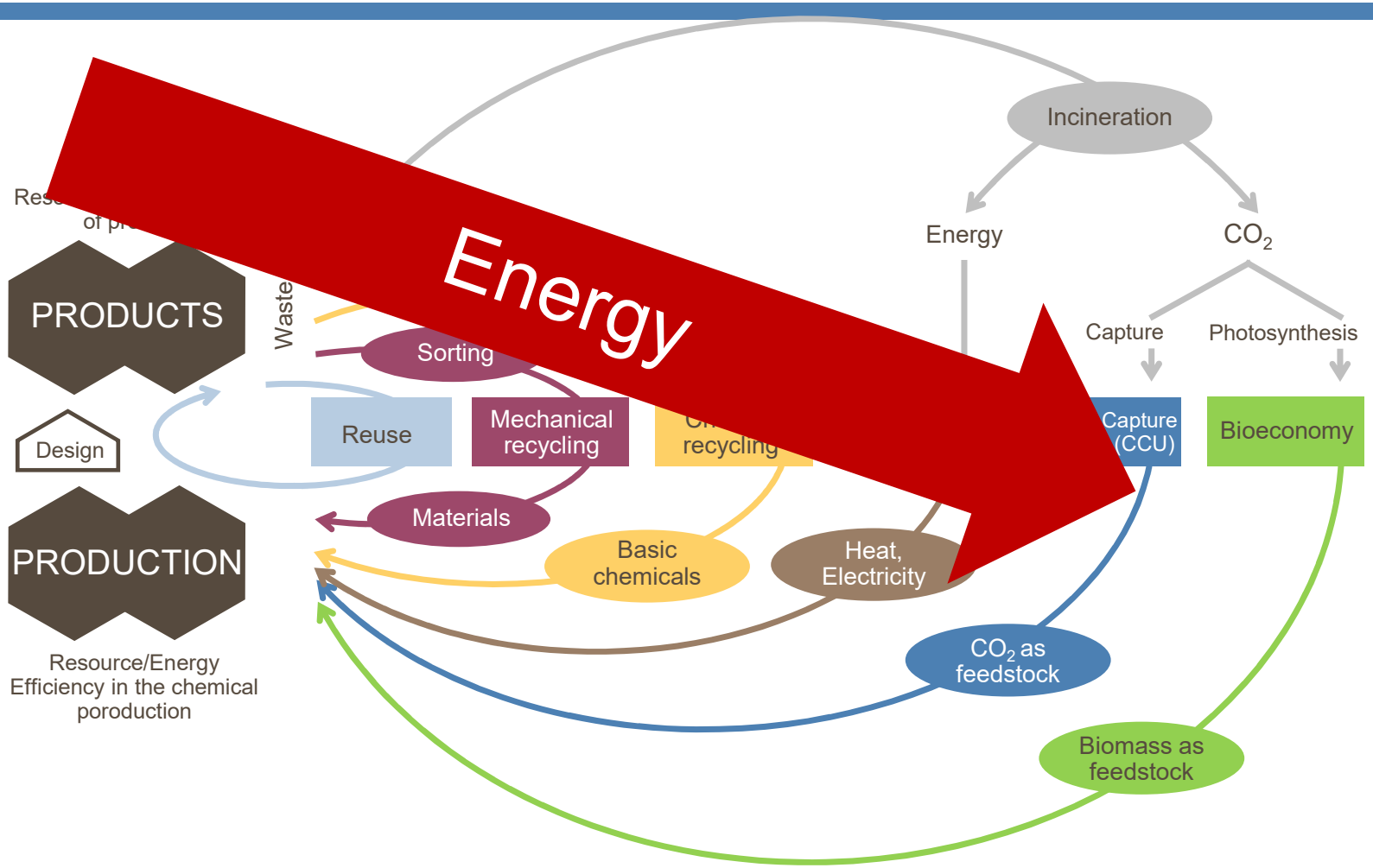
Key role of cicular economy with circulation of Carbon

Electrification and covering of the increased energy demand by renewable electricity

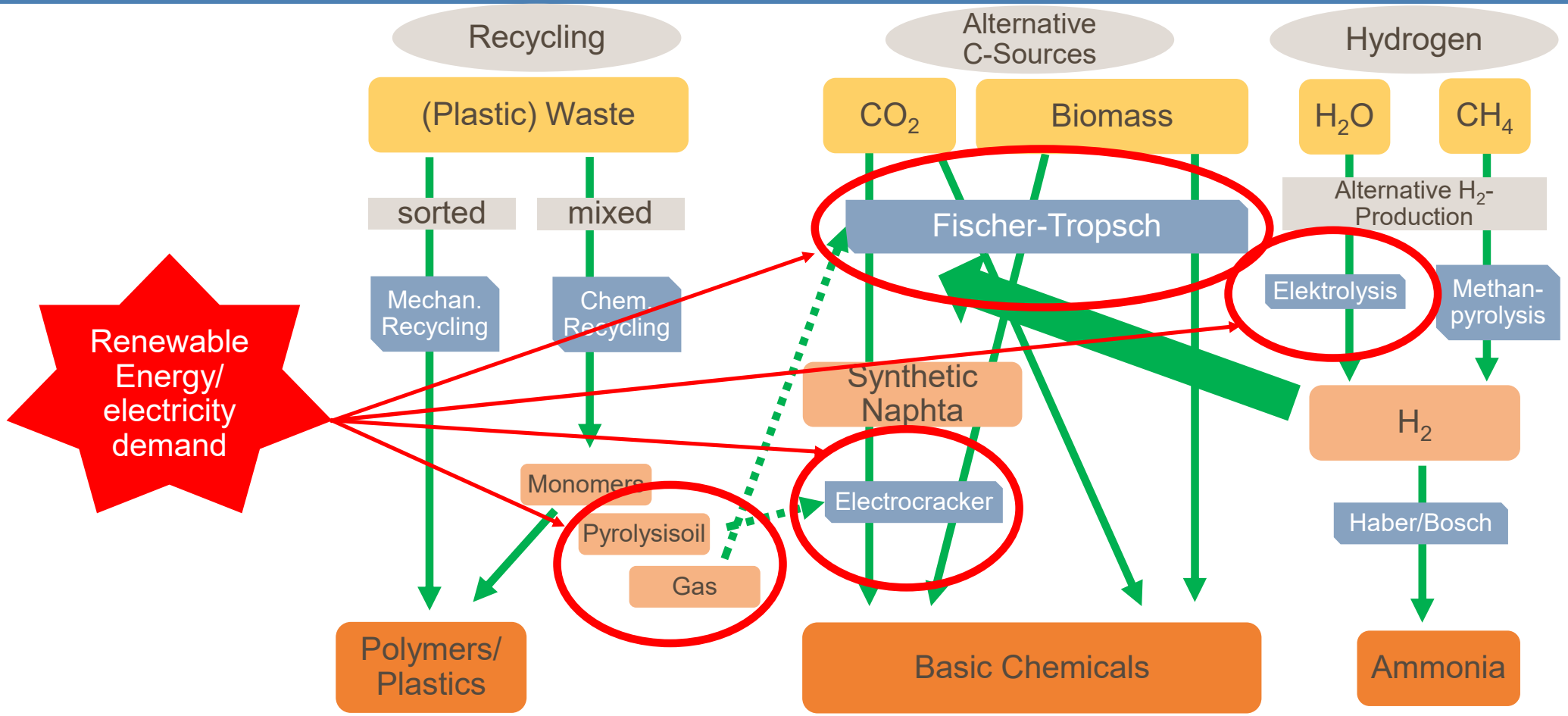
Circular Economy in the Broadest Sense



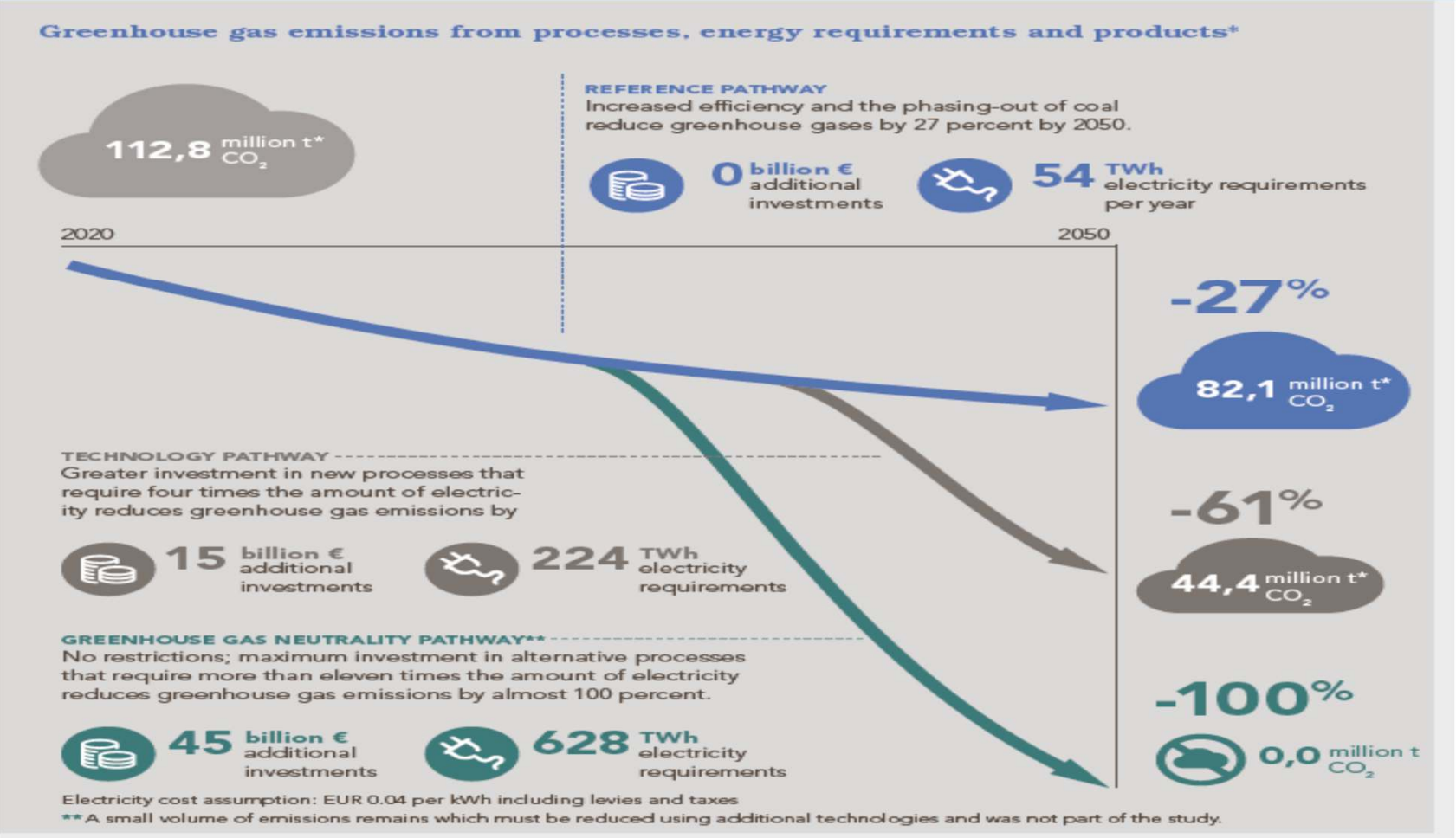
Energy as Key Factor



Technologies



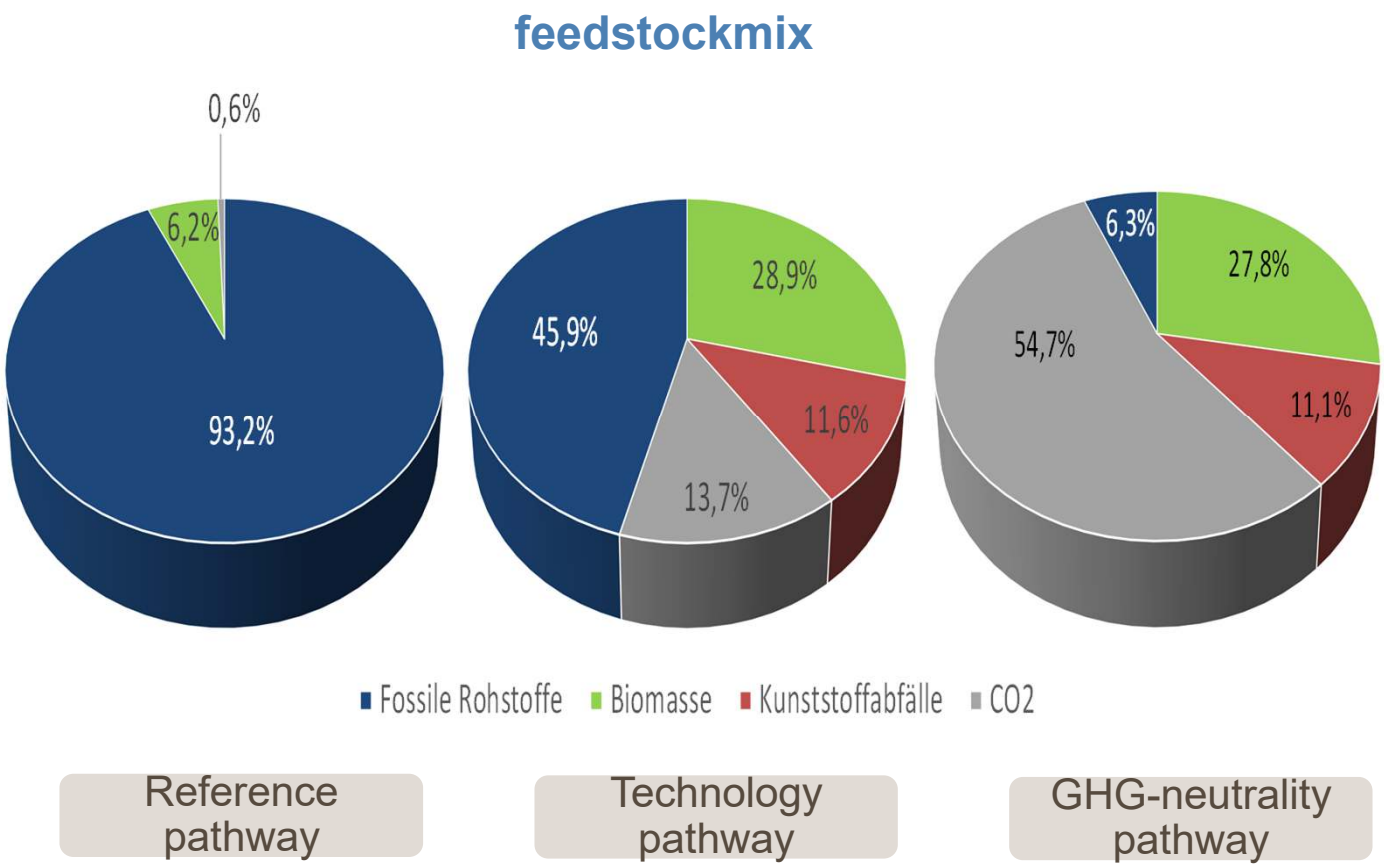
Overview results



Scope of Evaluated Processes: Basic Chemicals cover 80% of GHG-Emissions

- Production volumes and costs of a selection of feedstock-intensive base chemicals :
  - Methanol
  - Ammonia
  - Urea
  - Ethylene, Propylene
  - Chlorine,
  - Aromats: Benzene, Toluene, Xylene
  - Butadien
- Parameter:
  - Costs
  - Emissions of heat and electricity
  - Emissions caused by the C-content of the products are calculated on the C-content of the raw material

General results: feedstock



Challenges

Energy Demand and Investments

Challenges

- The chemical production will become more energy intensive:
  - Demand of renewable energy will increase dramatically (> 600 TWh)
  - A big part is needed for hydrogen production (mainly by electrolysis)
- Competitiveness of new processes only will be realized by a competitive hydrogen price which only can be realized by an very low electricity price (of around 4 Cent/KWh)
- The transfer will be expensive:
  - Investments (about 45 bn. Euro only for basic chemicals) in new installations for the new technologies must be „supported“)
- Most important technology will be the „circulation of carbon“:
  - Needs an effective circular economy for carbon which only can be realized together with the whole value chain and by social acceptance
- Timeline: Transformation will not inevitably follow the ambitious reduction pathway until 2050 of the European Green Deal or national regulations

World of hydrogen

- Hydogen will be **the(!)** technical solution to become greenhousegas neutral in different sectors:
  - energy sector: storage for volatile renewable production, heat production
  - transport sector: fuel cells, synthetic fuels
  - buildings: heat production substitution of natural gas
  - industry:
    - Chemical industry 7 Mio. t demand for ammonia production and CO_2-use as carbon source
    - Steel industry: „hydrogen-steel“

- Important: Green hous gas neutral production of hydrogen
  - Totally free by water electrolysis with renewable electricity („green“)
  - Nearly free by methan pyrolosis („turqouise“)
  - Neutral by steam reforming and CCS („blue“)

3 Conclusions

GHG-Neutrality is possible

Conclusions

- GHG neutral production of the chemical industry is no longer science fiction but (technically) possible
- Necessary new technologies, especially to produce basic chemicals will be technically available within the next 10 to 15 years
- CO_2 als new feedstock will play an important role in the transformation
- Economical availability will be a big challenge and depending on different framework conditions:
  - Availability of sufficient renewable energy/electricity at very low prices
  - Availability of hydrogen at very low prices
  - Financial support as long as there is no global level playing field

- Chemical Industry will try to find answers to all the questions behind by following a stakeholder discussion process on a new plattform „Chemistry4Climate“

C4 Chemistry Climate

VCI

VCI / Thomas Koculak

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