Renewable Raw Materials in the EU Chemical Industry

(Dr. Jörg Rothermel, VCI)

The use of renewable raw materials in the European chemical industry has a long tradition: Natural based carbohydrates coming from sugars and starches are used in the production of specialty chemicals like enzymes, vitamins, organic acids, amino acids, polymers and thickeners for a variety of industries - ranging from advanced materials to the pharmaceutical and food/feed industries. Animal fats and vegetable oils are used in the production of specialty surfactants for the detergents and coatings industries. Extracts of natural products are used as additives in the personal care and cosmetics industry.

A recent study of the European chemical industry association (CEFIC) shows that a total of 8.6 million tonnes per year of renewable raw materials is used in European chemical production. Vegetable oils and animal fats, carbohydrates (sugar and starch), and bioethanol account for almost 2/3 of the quantities. Other important materials are natural rubber, chemical pulp, and glycerol. Others include a variety of vegetable waxes, natural resins, tanning agents, proteins, and medicinal plants. A detailed breakdown of renewable raw materials quantities will be presented.

The presentation will also focus on the chances and limitations of renewable raw materials use in the European chemical industry: Renewable raw materials are holding their own or are prevailing in applications where they bring technical and economic advantages over fossil raw materials – by benefiting from the synthesis of nature or by taking new routes of synthesis, e.g. in biotechnology. Basically, those raw materials which serve as a carbon source for chemistry are interchangeable. However, this presupposes technical and economic feasibility and a contribution being made to sustainable development. Frequently, this combination of prerequisites is not yet given for renewable raw materials. Therefore, a broader raw material base is an important R&D goal of the chemical industry.

Unlike in the early days of promotion for renewables, today‘s policy challenge is no longer about generating sales opportunities for surplus biomass. Now the challenge is to use scarce biomass as efficiently as possible – with the use as food and feedstuff being the priority. Sound and acceptable concepts need to be elaborated to balance food production and the industrial use of biomass.

In the chemical value chains, further and major R&D efforts are needed to open up new fields of application for renewables. The chemical industry actively works on broadening its raw material base and increasingly uses renewables where this is technically feasible and makes sense from economic, ecological and social aspects. The presentation will give an overview about the feedstock situation for the organic chemical industry and will try to identify the special role of renewable raw materials in the context of diversifying the raw materials base in the chemical industry.

18 June 2015

Renewable raw materials in the EU chemical industry

Dr. Jörg Rothermel, Frankfurt am Main, 18 June 2015

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Agenda

- Raw materials in the chemical industry
- Renewable raw materials
  - Data on current use
  - Drivers and limits of renewables use
  - Political strategies
- Perspectives on future use
  - Supply and demand
  - Evolution of the raw materials mix
- Concluding messages

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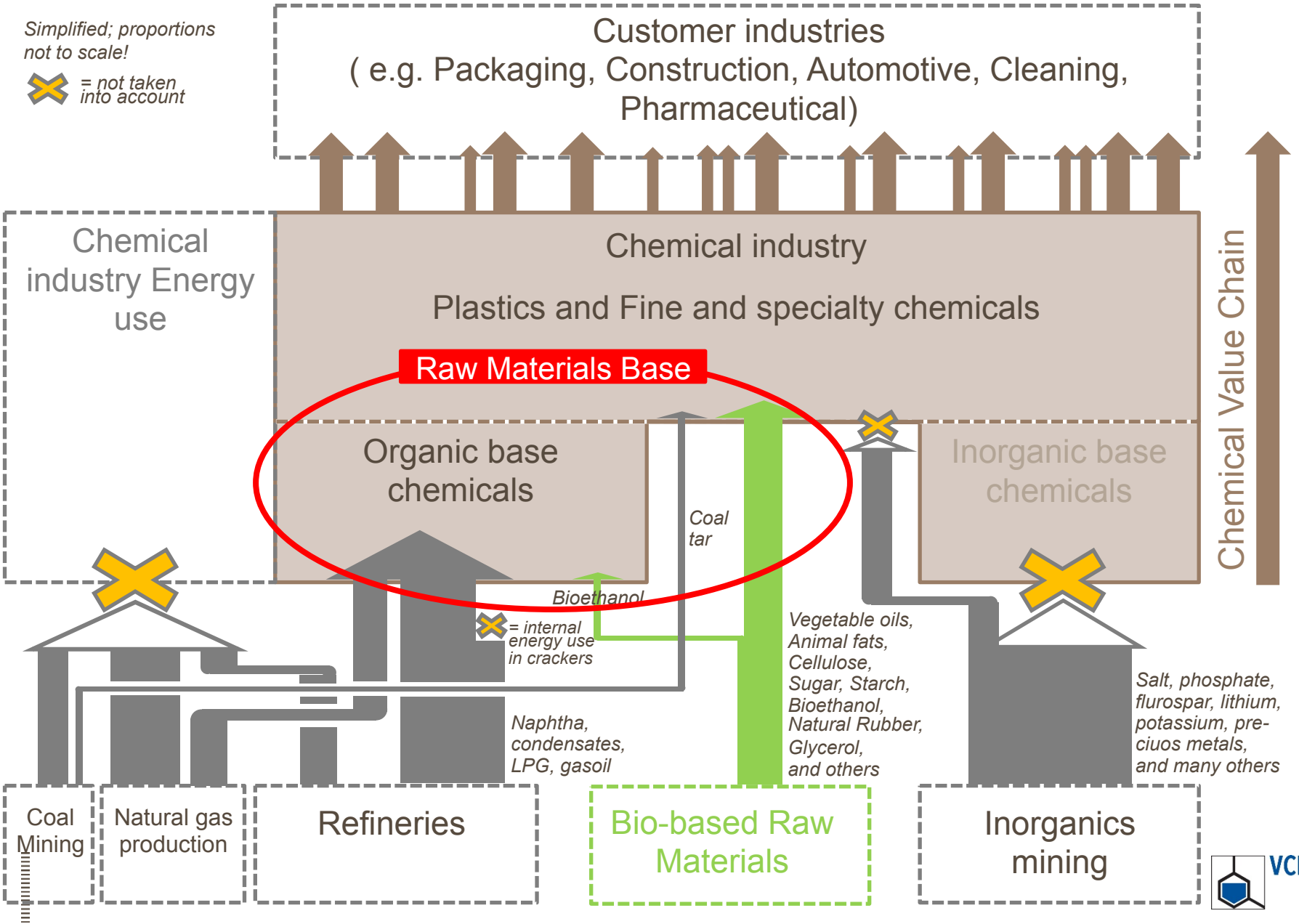
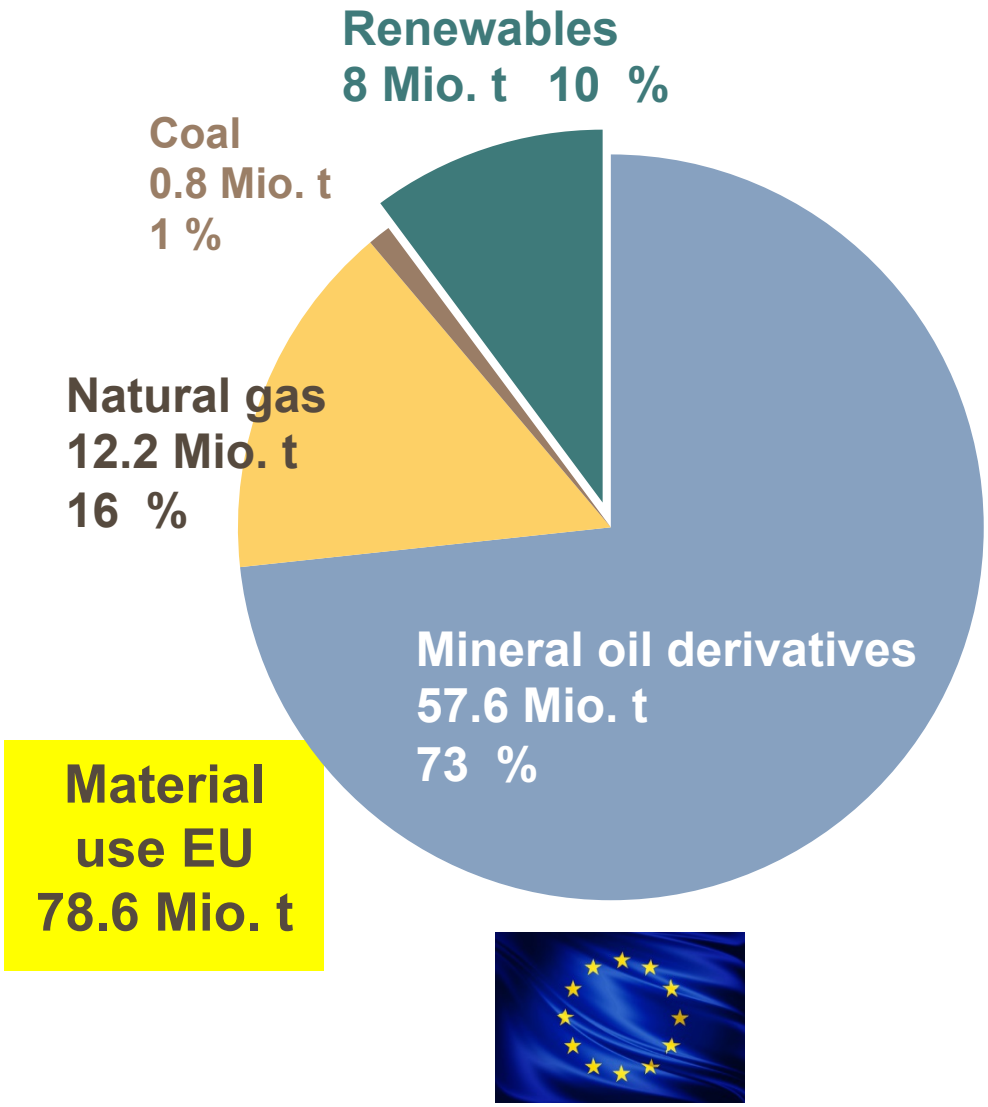
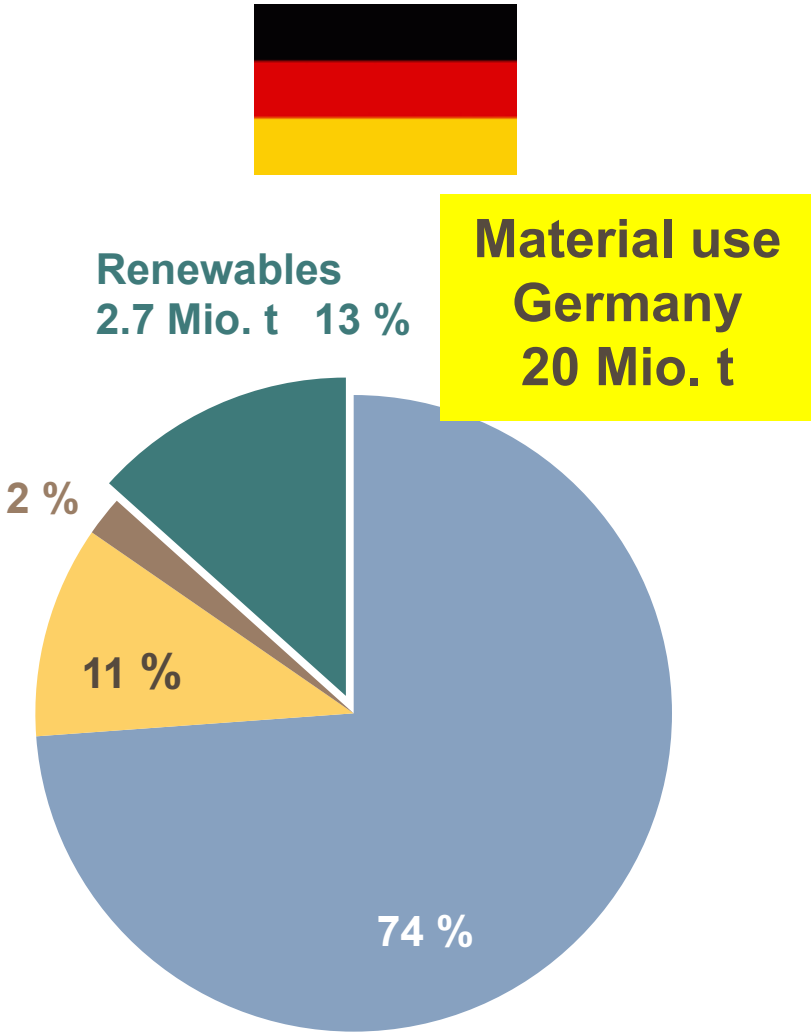
How do we define our „raw materials base“?



Feedstock mix in organic chemicals production
EU and Germany, 2013





Data sources: Cefic, VCI, FNR.
Calculation base: Raw materials weight in tonnes

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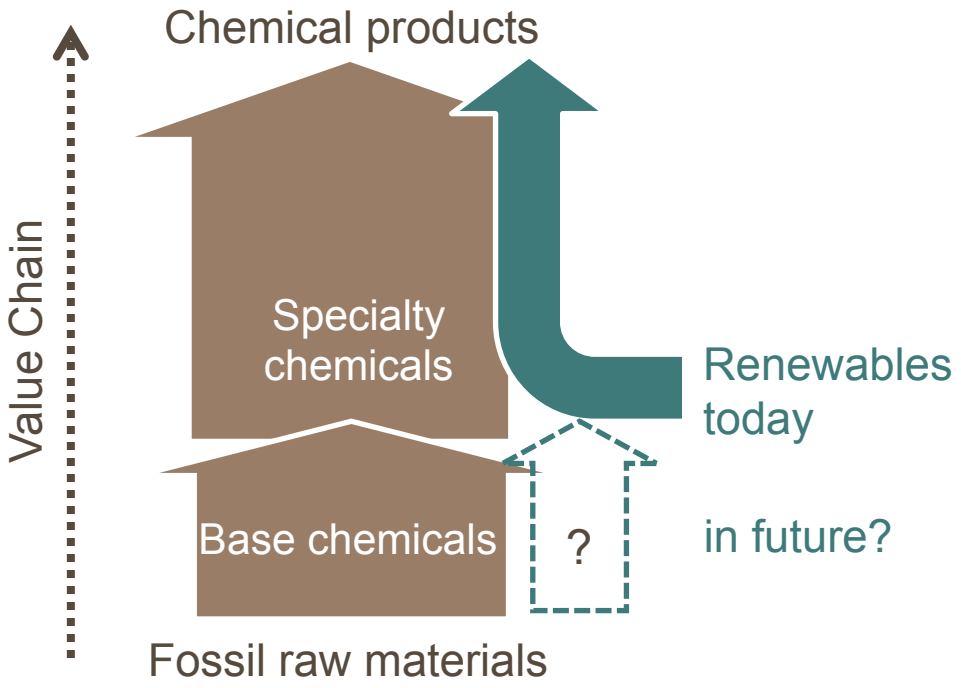
Raw Materials in organic chemicals production

- Complex chemical value chains with more than 100,000 different products
- Starting point is a limited number of base chemicals based on fossil raw materials
- Renewables are mostly used in special applications for production of fine and speciality chemicals



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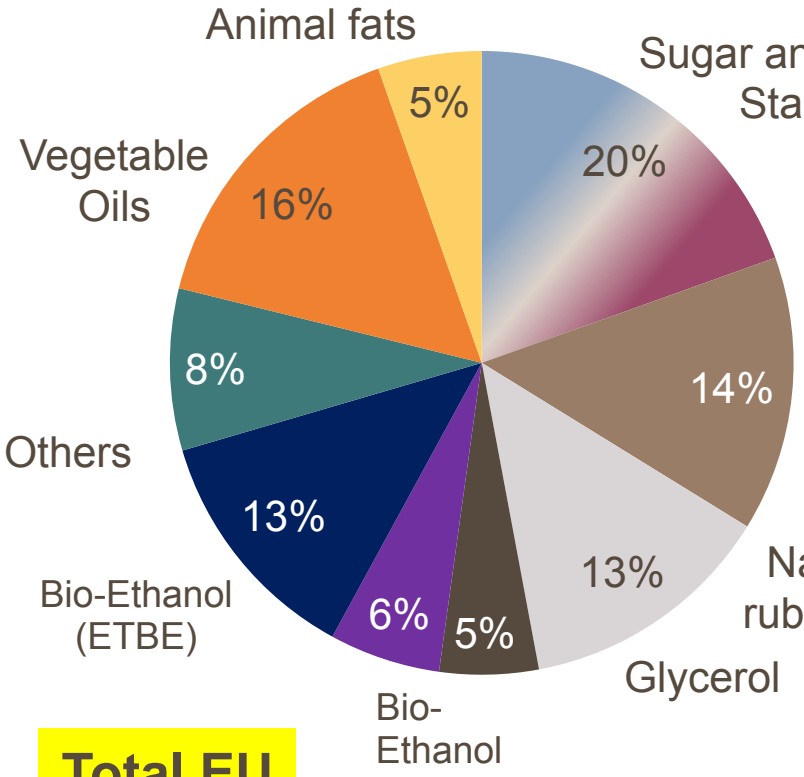
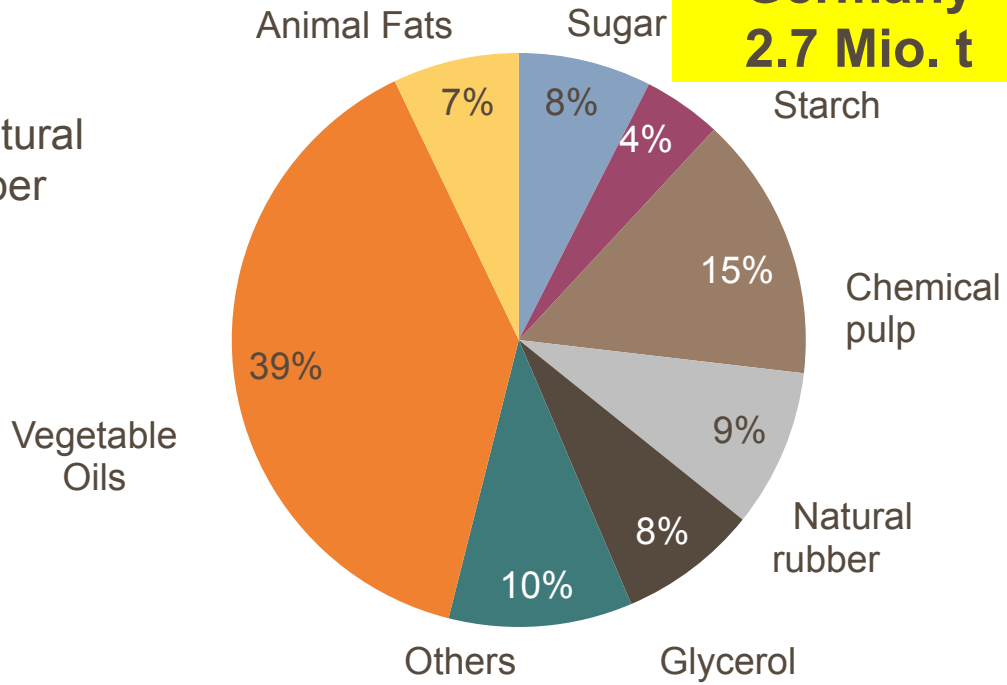
Renewable feedstocks in the EU and in Germany
Chemical Industry, 2013



Total EU 8 Mio. t

Total Germany 2.7 Mio. t



Data sources: Cefic, VCI, FNR
Others include: Vegetable waxes, natural resins, tanning agents, proteins, medicinal plants

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Focus on the market:
Current and future demand determine the feedstock mix

Demand for products and applications from the market


Manufacturing of products in best processes



Choice of best raw materials


- Chemical industry focuses on business opportunities
- The best available raw materials are used
- Economic considerations (price and availability), but recently a broader perspectiv on sustainability

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Motivation for the use of renewable raw materials in the chemical industry

- New and innovative products
  - Novel features and applications
  - Basis for industrial biotechnology
- Alternative carbon source
  - Diversification of raw materials base
  - Possible price advantage
- Renewable raw materials
  - Only renewable carbon source (apart from CO_2)
  - Positive impact on products‘ greenhouse gas balance

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Further motivation: answer to decarbonization strategy

- G7-decision in Elmau to decarbonize the global economy:

> … „we emphasize that deep cuts in global greenhouse gas emissions are required with a decarbonisation of the global economy over the course of this century.”

- Focus on energy production based on fossile carbon as >90% of CO_2-emissions are energy bound
- But raw material supply of the chemcial industry is strongly connected to the energy production by fossile fuels :
  - naphta as feeedstock for European crackers as by product of fuel production
  - higher hydrocarbons as feedstock for US crackers as a by product of the shalegas production
- Consequences of a decarbonization strategy on feedstock supply for chemical industry are still open but have to be evaluated in an long term strategy of raw material supply

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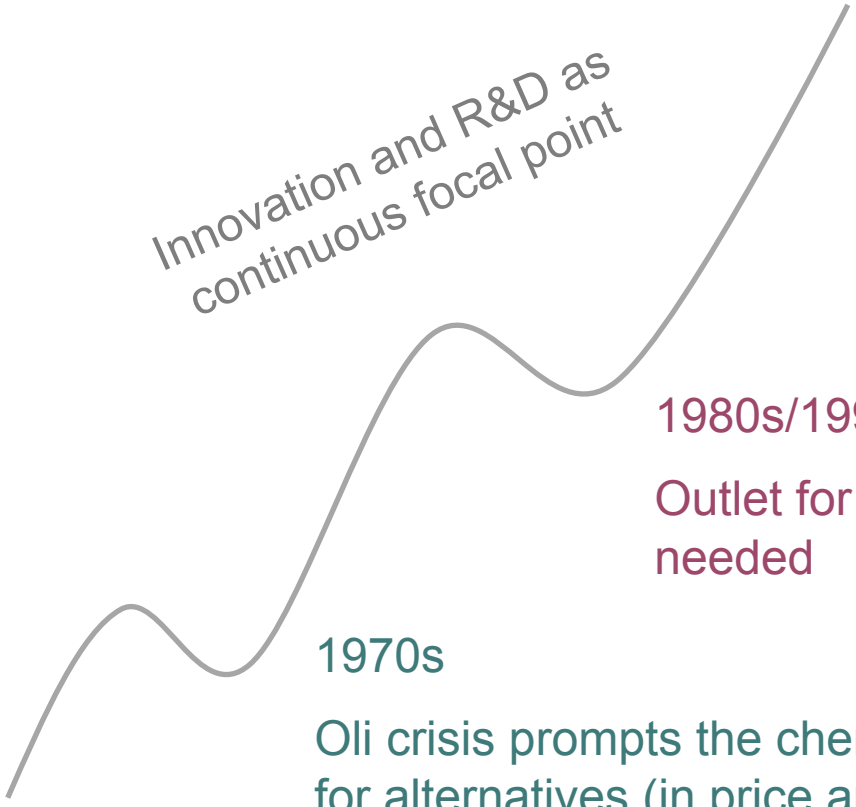
Sustainability and resource efficiency of raw materials use

- Feedstocks that are used as carbon source are, in principle, interchangeable
- Optimal resource efficiency should be the guiding principle:
  - solutions for the most efficient and economical use of the different feedstocks are needed
- Differences in
  - Technical feasibility
  - Processing efficiency
  - Environmental impact, e. g. GHG balance
  - Product quality and properties
  - Last, not least: Cost
- Individual comparative analyses necessary !

Perspectives on broadening the use of renewable raw materials in the chemical industry



2000s/2010s

- Biomass increasingly scarce
- Sustainability concerns
- Politcal strategies and initiatives aim for a „bio-economy“

1980s/1990s

Outlet for surplus agricultural production needed

1970s

Oli crisis prompts the chemical industry to look for alternatives (in price and availability)

1960s

Petrochemical feedstocks replace coal and renewables in most applications

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Broadening the scope: Bioeconomy strategies and the perspective of chemical industry

Missing link: Resource efficiency as guiding principle

- Resources of any kind should be used as efficiently as possible
- Biomass use should not be seen as an end in itself:
  - Biomass is also limited because of limited land

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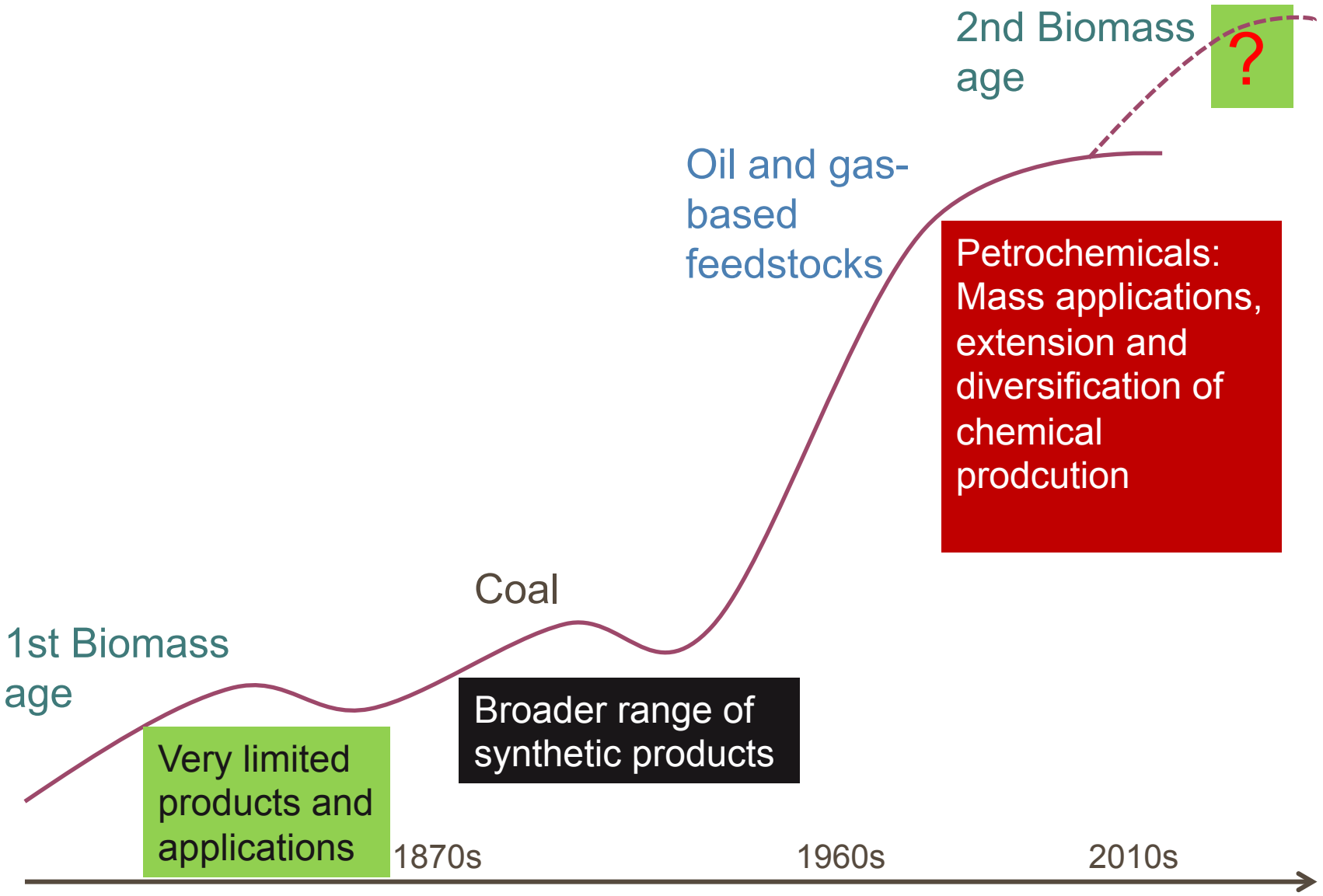
A historical perspective: Supply determines feedstock use



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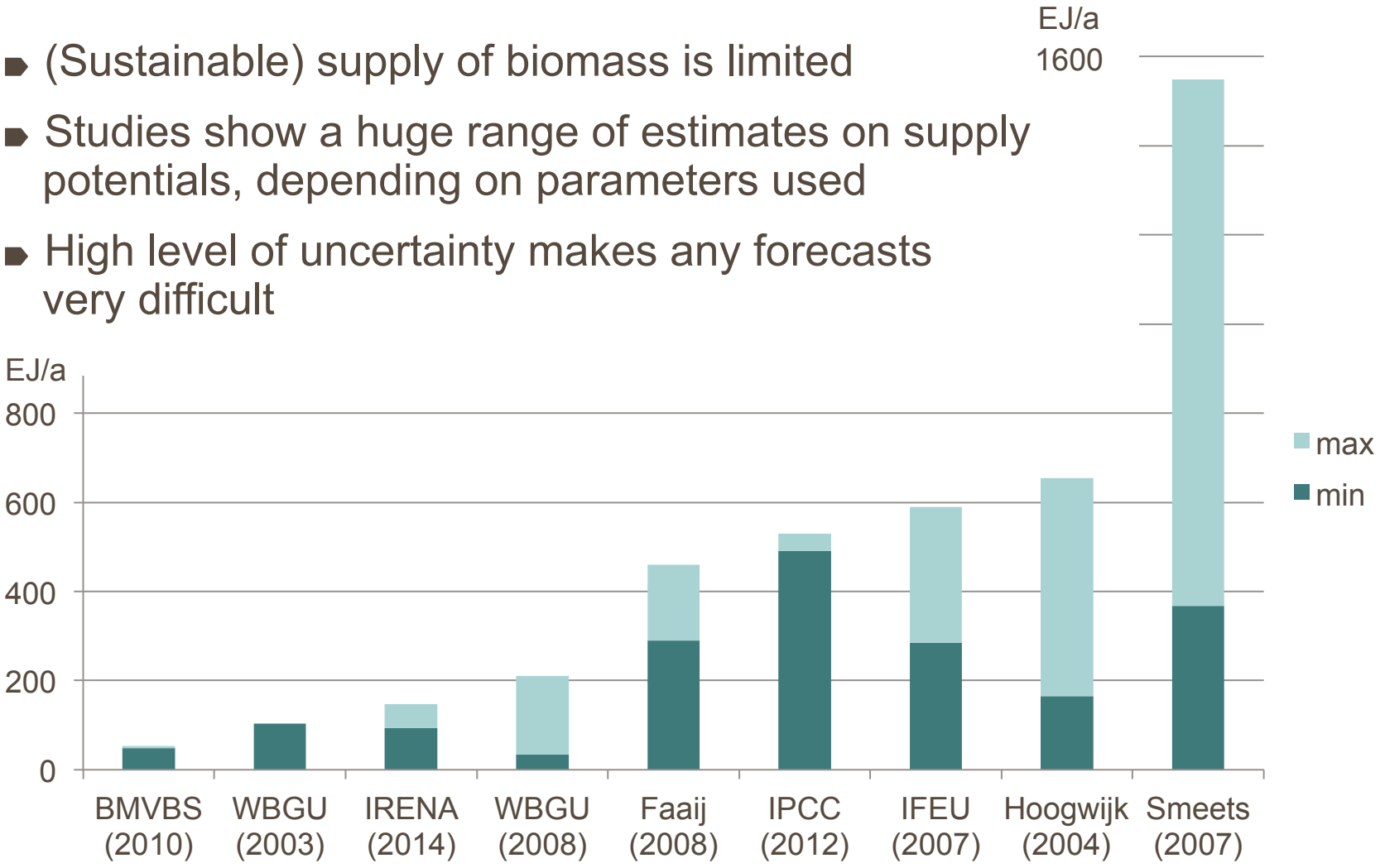
What are the supply potentials for biomass?

- (Sustainable) supply of biomass is limited
- Studies show a huge range of estimates on supply potentials, depending on parameters used
- High level of uncertainty makes any forecasts very difficult



Biomass from arable land and other sources
Source: Zeddies/Schönleber (2014): Literaturstudie „Biomasse - Flächen- und Energiepotenziale“

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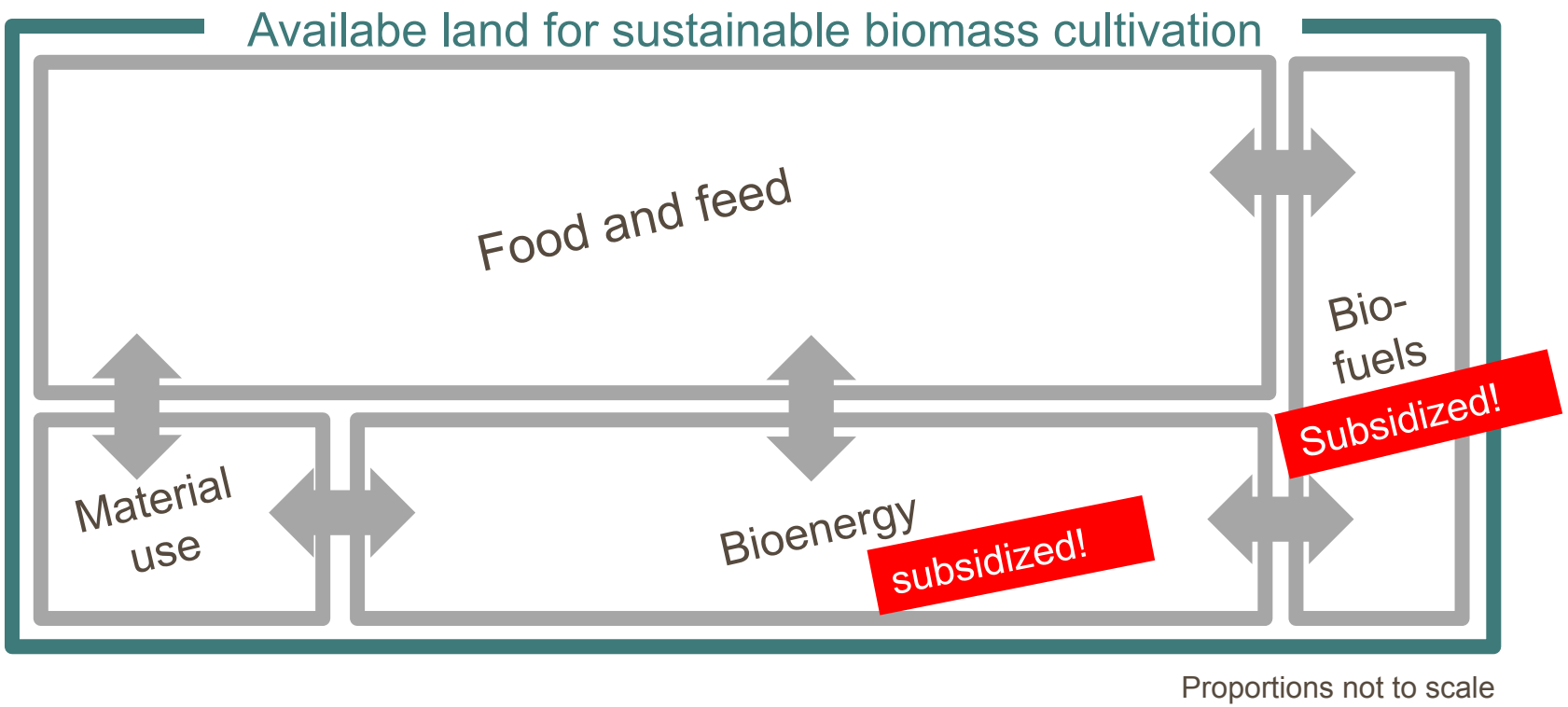
Sustainability of renewable raw materials



Proportions not to scale

- In practice, biomass availability is limited:
  - Available land for sustainable cultivation (land use change)
  - Rising competition between different uses of biomass (food vs. fuel)
- Certification schemes as possible solution (e. g. RSPO, ISCC…)

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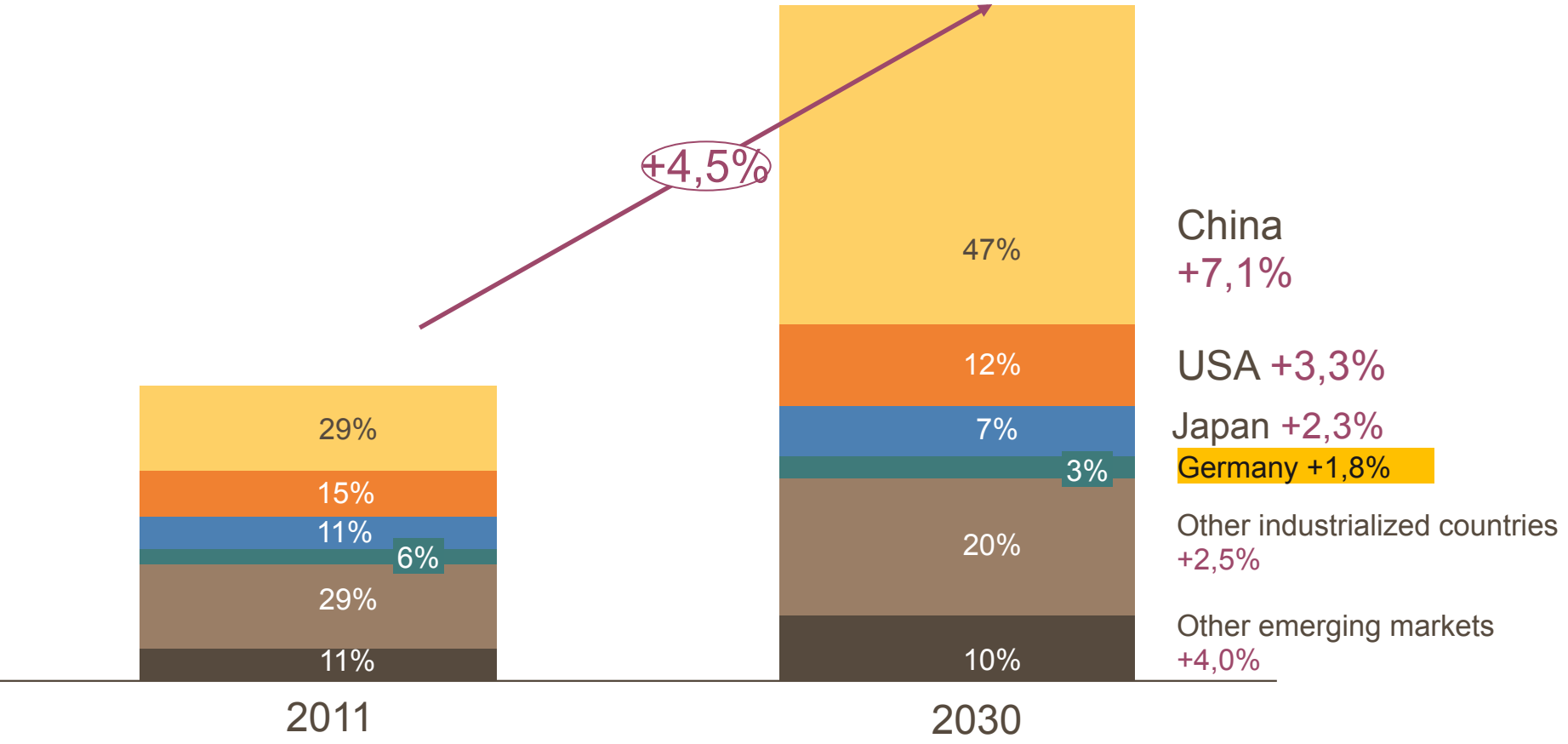
A glance into the future: Overall growth in the demand for chemicals, shift in regional growth centers

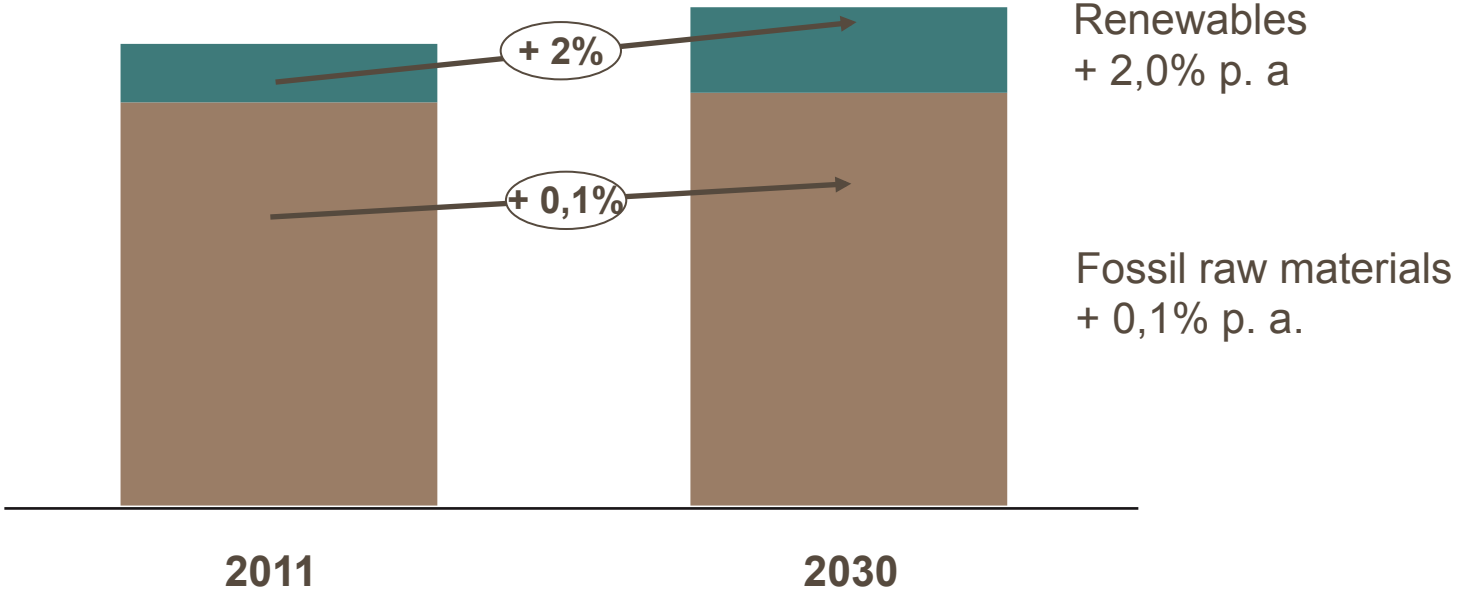
Annual growth of world chemicasl production and shares of countries in percent, 2011–2030



Source: VCI-Porgnos study„The German chemical industry in 2030“, figure 18

Implications of growth on the feedstock demand in Germany

Feedstock mix in German chemical industry; annual growth rates 2011 - 2030



Source: VCI Prognos study, chart # 29

- Growth in specialty chemicals *without* substitution of fossil raw materials leads to a growth in renewables use of 50% until 2030
- Base chemicals production continues to be dominated by petro-chemical raw materials, possible growth of other fossil raw materials (natural gas, coal)

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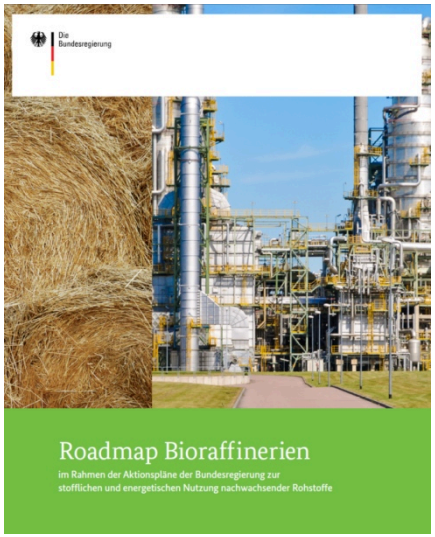
Drivers for an increased use of renewable raw materials: Biorefineries as key



German federal government‘s Biorefinery roadmaop

Biorefineries

- Aim: Fullest possible use of all raw material components as objective
- Challenge: Up-scaling from laboratory to industrial scale
- Substantial need for R&D along the value chain

- **Integration in existing value chains / sites as factor of success**
- Example: Fraunhofer CBP at Leuna chemical site

Fraunhofer Center for Chemical-Biotechnological Processes

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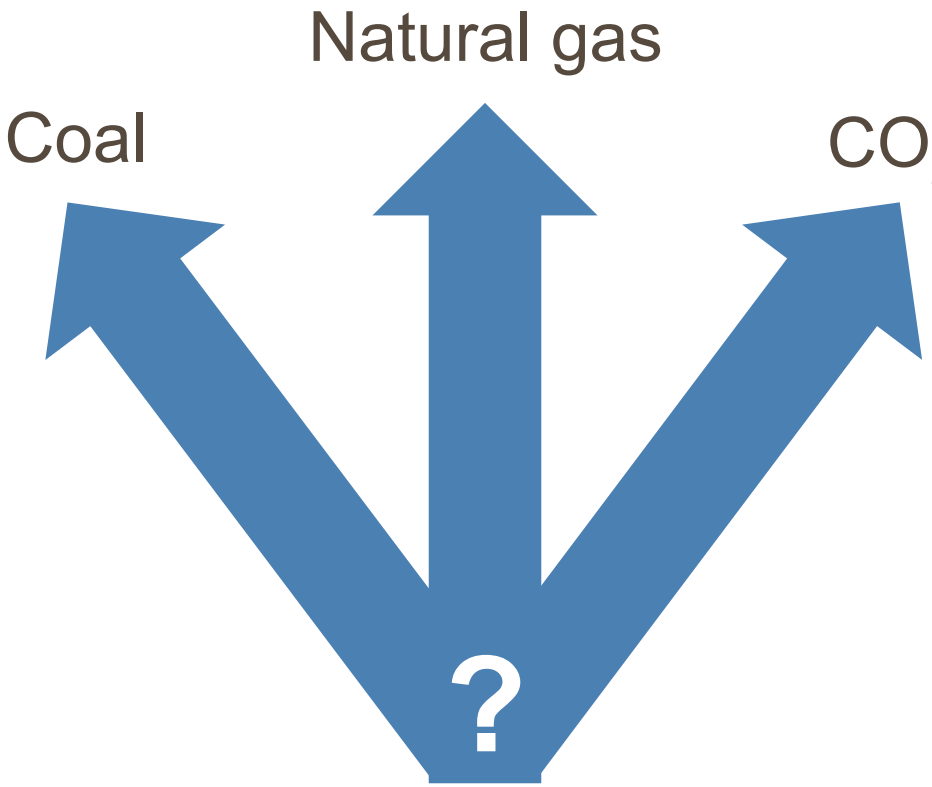
Broadening the raw materials base
Further (fossil) alternatives to petrochemical feedstock



- Carbon capture and use
- Furnace gas

Depending on

- Supply and (relative) price
- Conversion technologies
- Political framework conditions (e. g. emissions trading, shale gas…)

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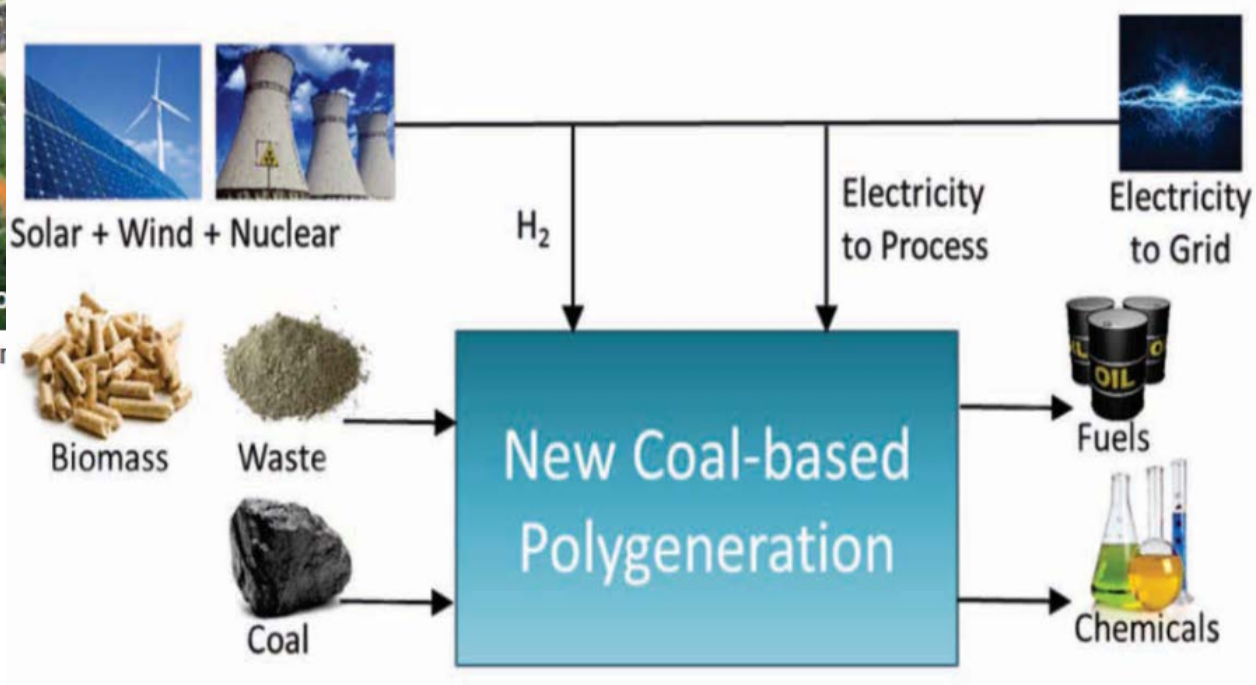
Coal to Chemistry projects in China (Shenhua)

http://gcep.stanford.edu/pdfs/wR5Mezr

„Shift from Fuel to a Combination of Fuel and Feedstock“



Quelle: WCA-Publikation *Cornerstone* Autumn 2013

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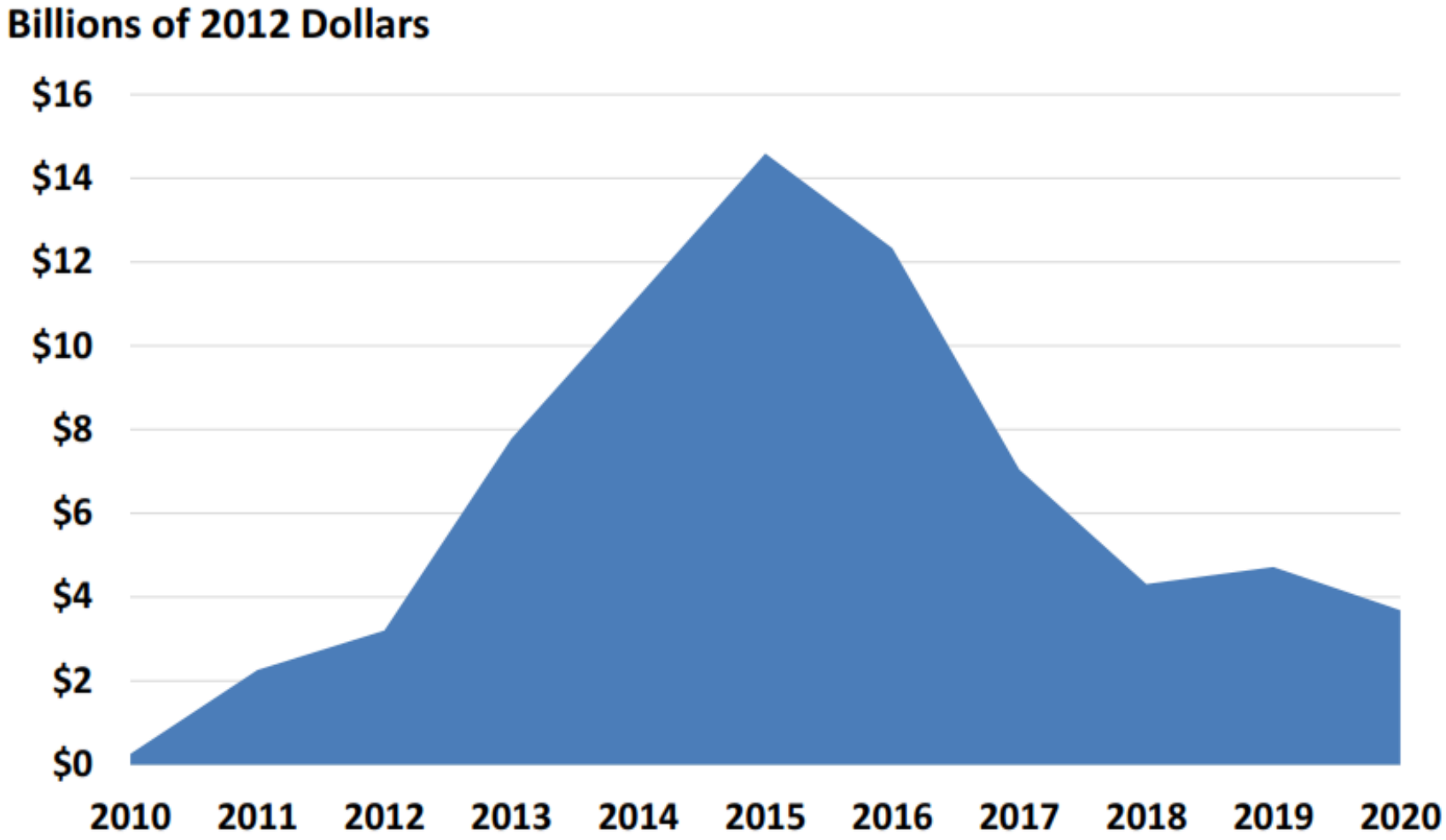
Natural gas: Shale gas boosts investments in the US chemical industry

FIGURE 13
INCREMENTAL SHALE-RELATED US CHEMICAL INDUSTRY CAPITAL EXPENDITURES THROUGH 2020



Source: American Chemistry Council, May 2013: “Shale Gas, Competitiveness, and New US Chemical Industry Investment: An Analysis Based on Announced Projects”

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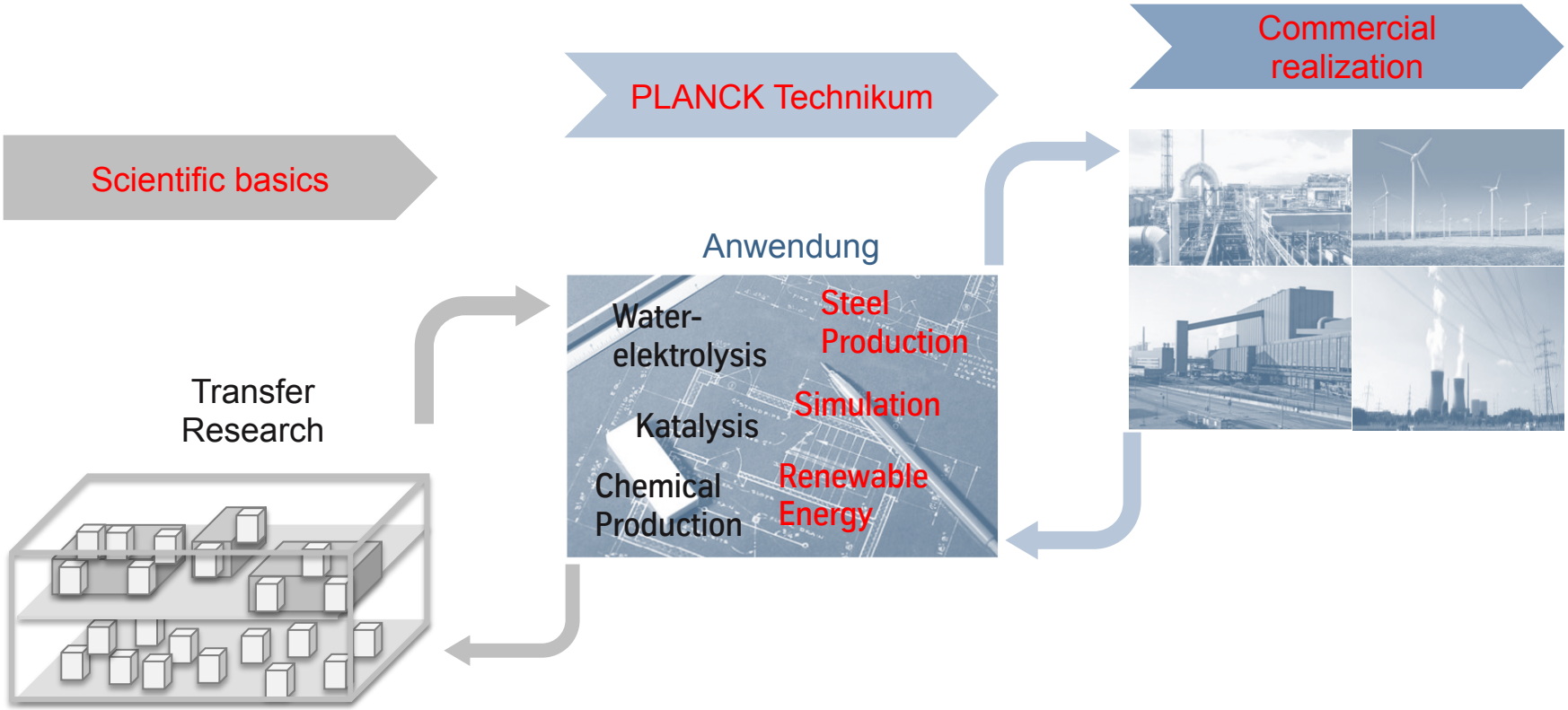
Cross-industry Network

„Carbon2Chem“: from the idea to the industrial realization

Use of furnace gas as feedstock for the chemical industry



Source: ThyssenKrupp

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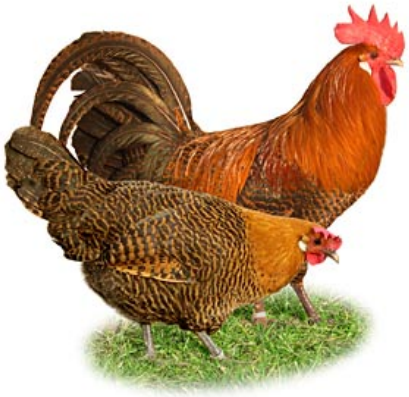
More renwables in the chemical industry: A chicken end egg problem?



?

< Philospohical challenge

Practical challenge >

Competitive supply of renewable raw materials

?

Market demand for bio-based products

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Concluding messages

- Renewables have a considerable share, but fossiles still dominate and will dominate for further time
- Decarbonization strategy of the global economy has to be considered
- Renewables **can be advantageous**, but **are** not per se.
- Challenges
  - Competitiveness
  - Technology gaps and R&D
  - Sustainable supply
- Bio-based products need to grow **under market conditions:**
  - **No support schemes** for the material use of biomass.
  - Continue to focus on **support for R&D**.
  - **Eliminate trade obstacles** in order to allow access to renewable raw materials at competitive world market prices.

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