

Science For A Better Life

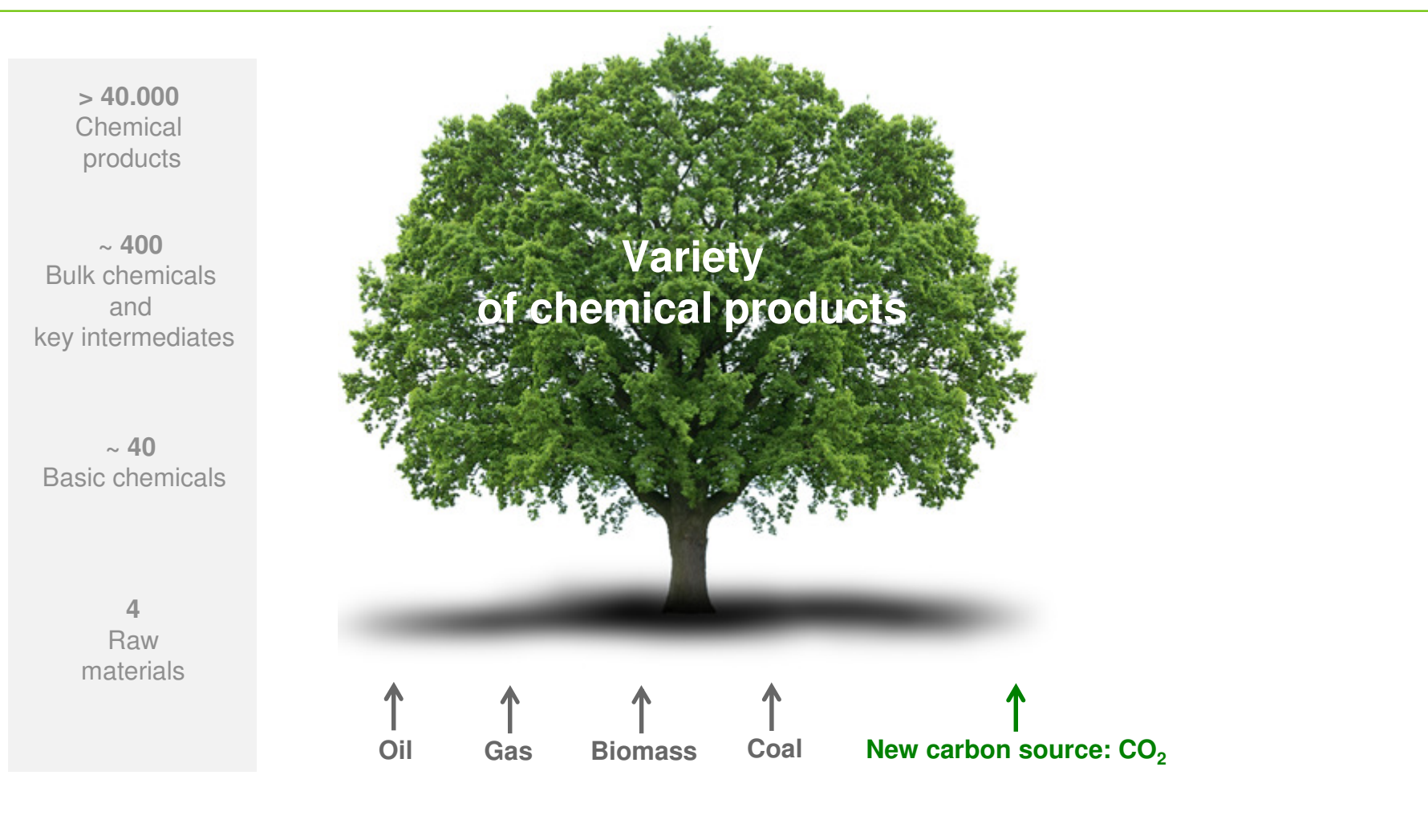
Perspectives of the material use of CO₂

Brussels, Ecofys/DG Climate

2012-10-24

Dr. Christoph Gürtler

Fossil raw materials – Feedstock for the chemical industry



Alternative feedstock CO₂ – Motivation for chemical utilization



Sustainability

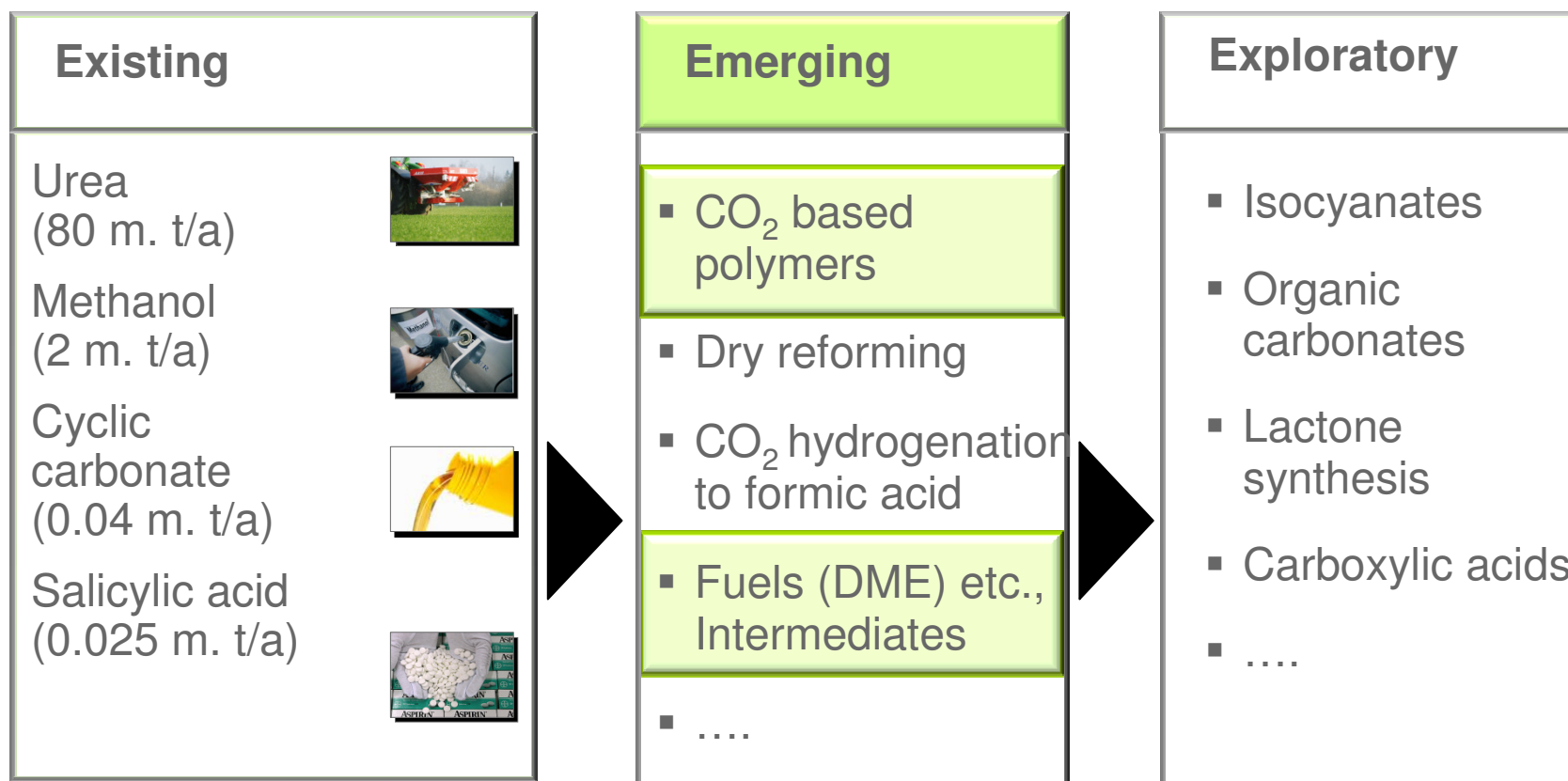
- Resource efficiency
- Climate protection



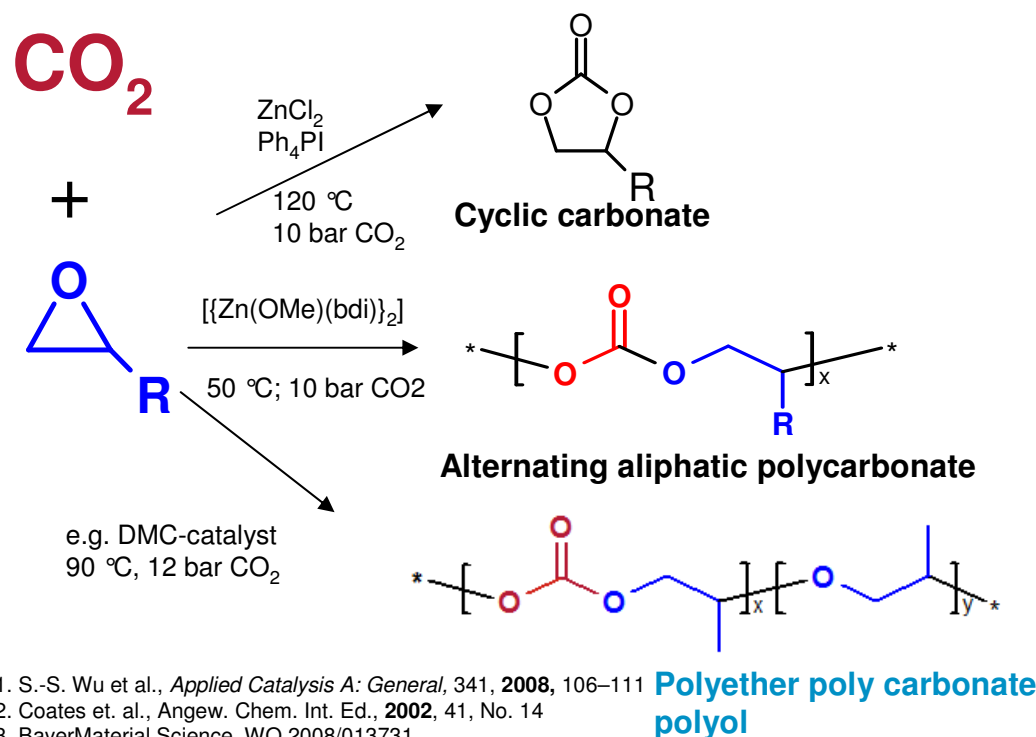
Industrial value creation

- Process improvement
- Market needs
- International competitiveness

Strategies for CO₂ conversion and utilization



Industrial application of epoxide/CO₂ chemistry for carbonate syntheses



- Green solvent
- Synthesis of dimethyl carbonate

- High molecular weight
- Binders for ceramics
- Biodegradable/compostable polymers

- Low molecular weight
- Terminal **OH-functionalities** yields polyols for polyurethanes synthesis

1. S.-S. Wu et al., *Applied Catalysis A: General*, 341, **2008**, 106–111
2. Coates et. al., *Angew. Chem. Int. Ed.*, **2002**, 41, No. 14
3. BayerMaterial Science, WO 2008/013731

- Selectivity is strongly influenced by the catalyst /competing reaction
- Up to 43 wt% incorporation of CO₂ (R = CH₃) possible
- Homogenous and heterogeneous catalyst suitable

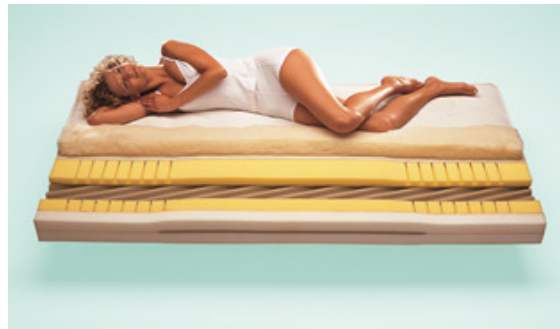
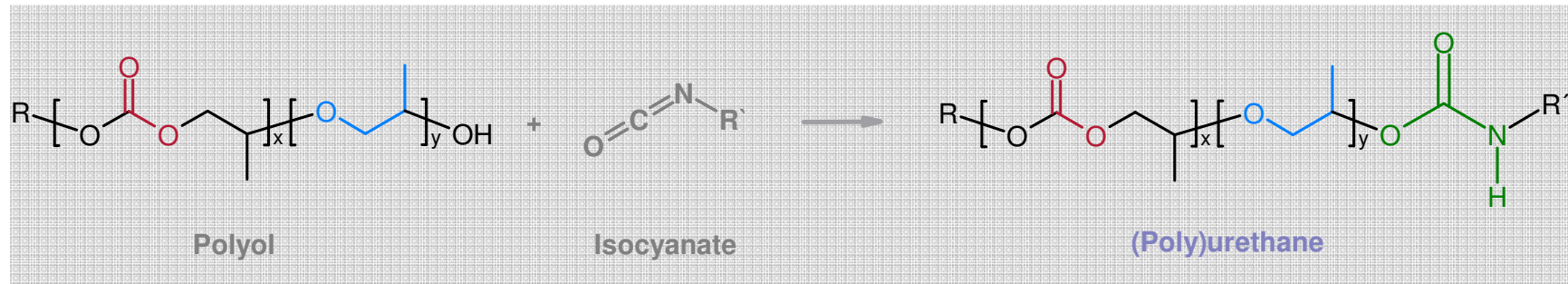
Dream Production – Covering the value chain



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Target product Polyurethane – A multi qualities plastic

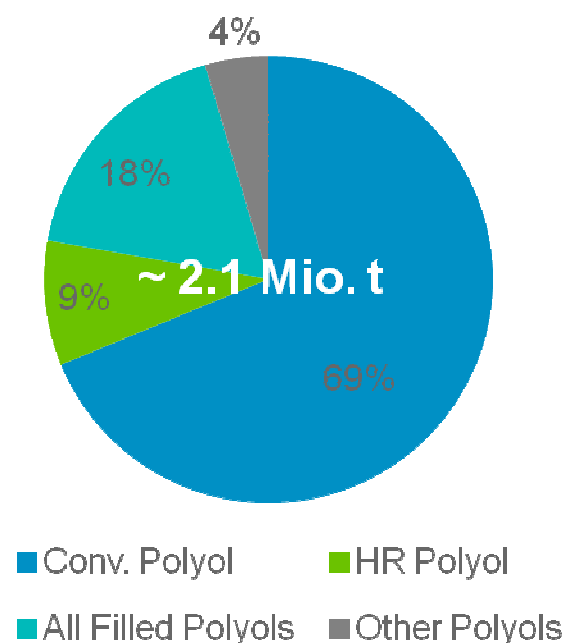


► Lower carbon footprint materials and chemicals will contribute to sustainability

New CO₂-based polyols

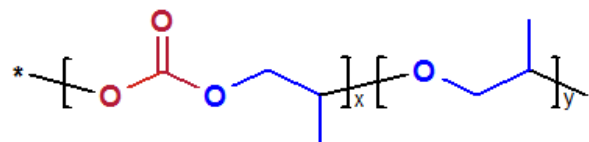
Targeting the largest market segment

Global Slabstock
Polyol Market 2009*



* Estimate based on IAL studies

- Current feedstock for flexible foam raw materials is based on petrochemicals
 - Propylene oxide**
 - Ethylene oxide
 - Styrene & acrylonitrile
 - Acids & polyalcohols
- BMS is working to expand the raw material base by introducing **carbon dioxide** – creating a new class of products: **polycarbonate-polyether-polyols**



- Key market for the next generation polyol class:
Conventional foam market

CO₂ - Based Polyols:

A New Product Class for the Flexible Foam Market



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Status:

- 2006 – 2010: „Proof of chemical principle“
- Q1/2011: Successful pilot plant start-up

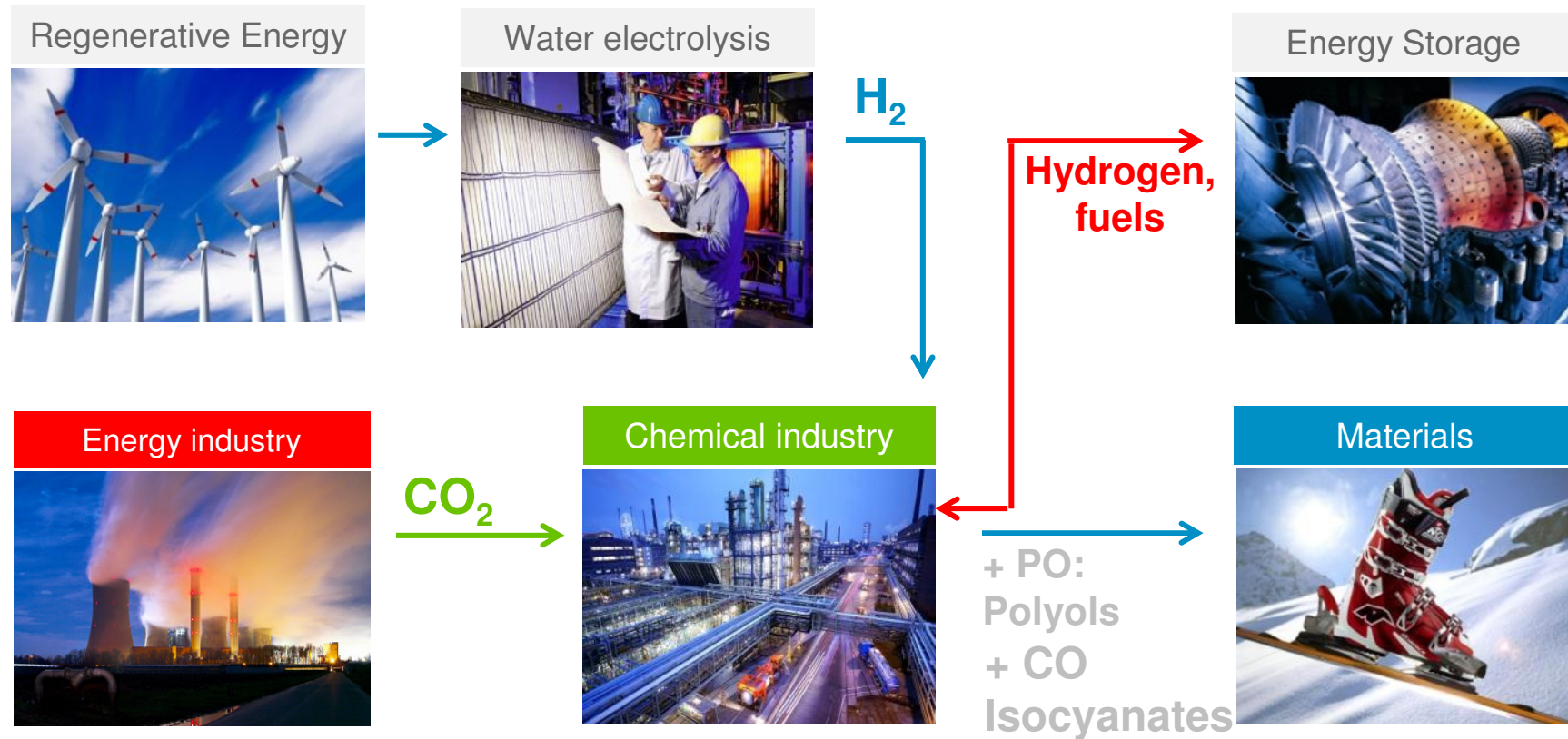
Path Forward:

- Further process & product development is needed in order to optimize yield and explore achievable product ranges
- Commercial production of CO₂-Polyol is expected to start by the 2nd half this decade



Dream Production - CO₂rrect

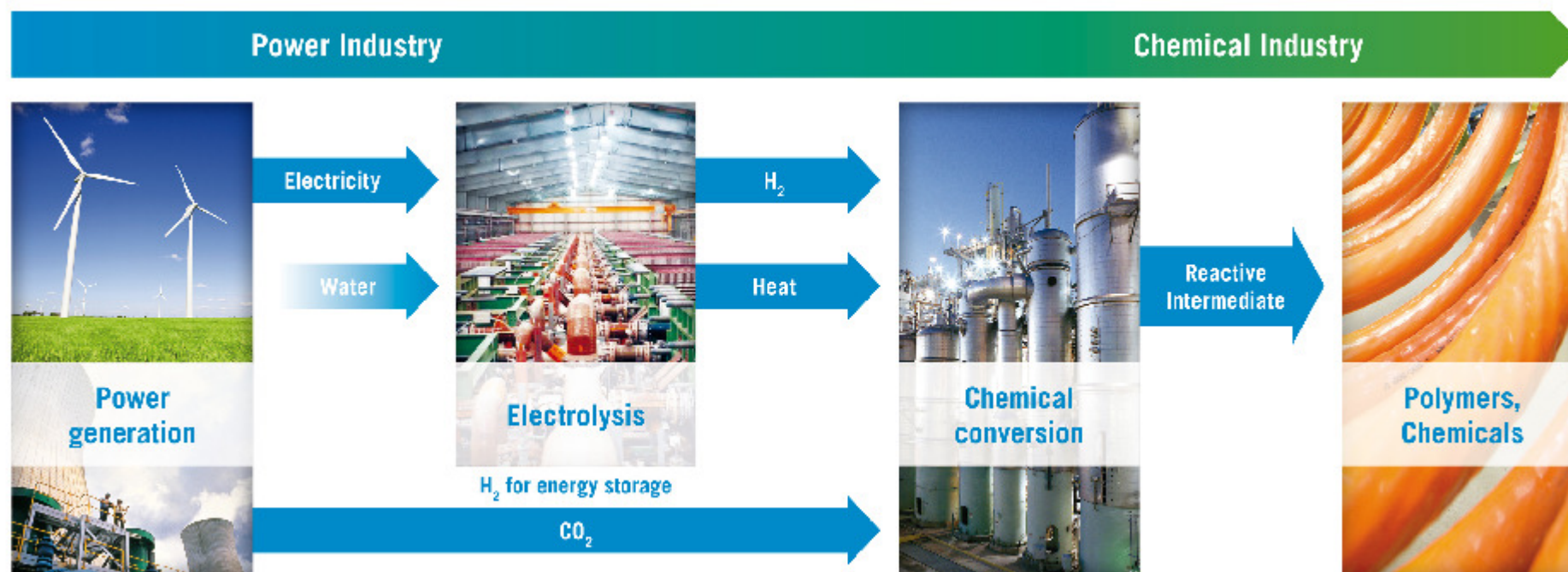
Making CO₂ available for both materials and fuels



CO₂rrect: From wind power to polymers

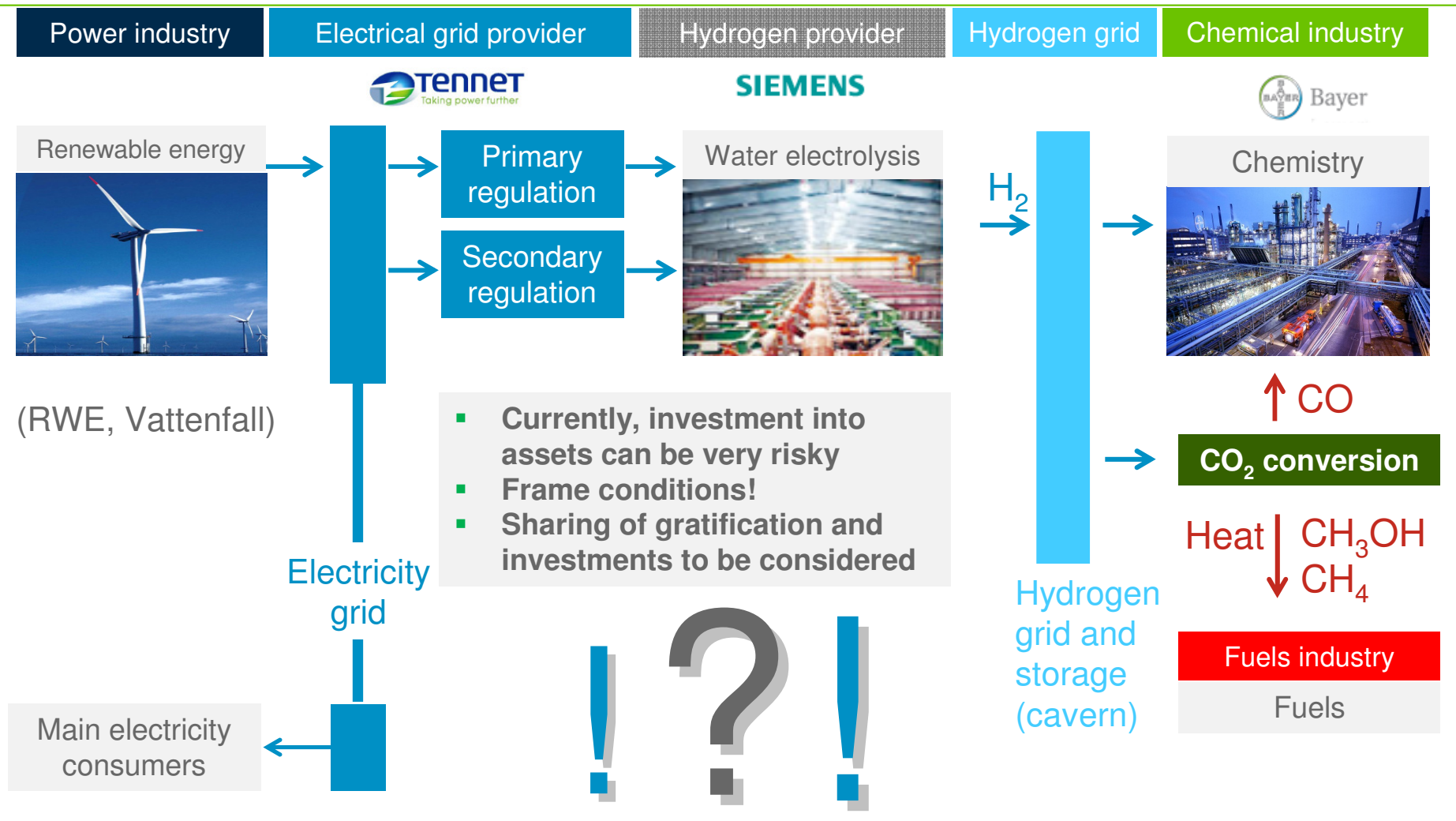


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Research project CO₂RRECT (CO₂-Reaction using Regenerative Energies and Catalytic Technologies) with RWE, Siemens, Bayer and 11 universities

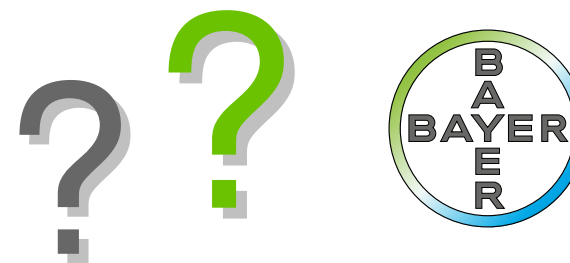
Collaboration of industries is essential to use CO₂ as a feedstock – and highly complex





What's next?

Questions



Part 2: R&D needs for innovation and Policy and regulation for commercialisation

- How does CO₂-based chemicals research look like worldwide and in Europe? (Good!)
- Who are the main players, especially in Europe? (Bayer, BASF, Norner)
- How is the European research positioned compared to other parts of the world?
European research is working on fast track - Good at the front end, more engagement encouraged over the value chain to keep speed
- What kind of CO₂-based chemicals research is supported by EU framework programs or national programs, what is the philosophy behind it and what the longer-term aims?
See BMBF presentation and DG RTD programs –use less fossil materials, sustainability
- What kind of research support is required for the short (HORIZON 2020) term and longer term?
Support for fast process research, piloting and industry integration would be desirable
- What could be the role for the European Commission (DG RTD, DG EAC, DG CLI)?
Give emerging technologies a stable frame and risk assessment and sharing
- What could CO₂-based chemicals contribute to main policy targets (climate, supply, innovation)? It would certainly contribute – directly or by using its properties (rigid foam)
- What policies cause main barriers or provide good opportunities to commercialize CO₂-based chemicals to the market (So far little obstacles – think of a positive compensation for CO₂ utilization when being used as a raw material)

Some ideas from the industrial point of view (1)



- CO₂: A valuable raw material, no matter whether fossil or biogenic!
- CO₂ certificates – value of CO₂ - will they be applicable to the use of CO₂ for materials? Applies to Scope 3 emissions and their compensation – affects frame conditions
- DG RTD and BMBF (100 Mio € funding) have been well engaged in research funding – now we have many topics about to enter the next stage of piloting
- With these upfront investments, BMBF and DG RTD are trying to establish a lead market in Germany and Europe – the basis for the spreading of the technology from Europe to the World.
- However market introduction of eco-friendly technologies requires Pilot plant implementation

Some ideas from the industrial point of view (2)



- **Acceleration:** Investment in the next phase of development is needed.
 - Be at least 2 years faster than based on usual business
 - Coherent policies and reliable supportive conditions are still needed to push the Technology readiness level further and to allow investments
- Refinancing of Assets has a focus on short term risk assessment – (“Value of Death”) is still unclear yet with good perspective – directly affects Implementation of CO₂ research
- Collaboration across Europe: joint forces and joint strategy is needed (DG Research & Innovation – DG Climate – DG Energy & Culture)
- Education + Entrepreneurship will lead to broader mindset
- EIT: Climate KIC is focusing on CCU!



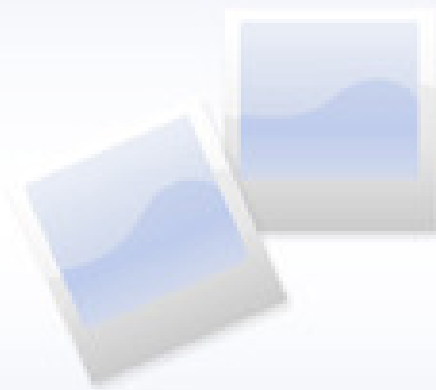
CO₂ Utilization – a real contribution!





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Thank you!



Bayer MaterialScience



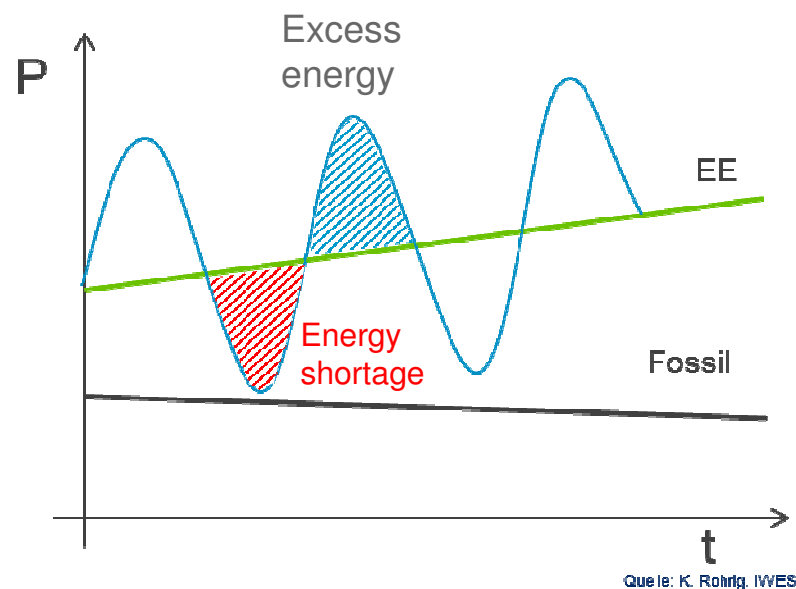
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The next step – using unsteady wind energy



Renewable energy

- ❖ Electricity has low emissions – but generation is fluctuating
- ❖ Intelligent concepts for energy storage needed
- ❖ Chemical industry plans to make use of current peaks to make CO₂-based products (e.g. Bayer, Solvay)