Smart Energy: Las vías hacia la transición energética

Smart Energy Storage driving the energy transition

Gijon | July 24th 2018 | Reinhold Achatz | CTO thyssenkrupp AG

engineering.tomorrow.together.

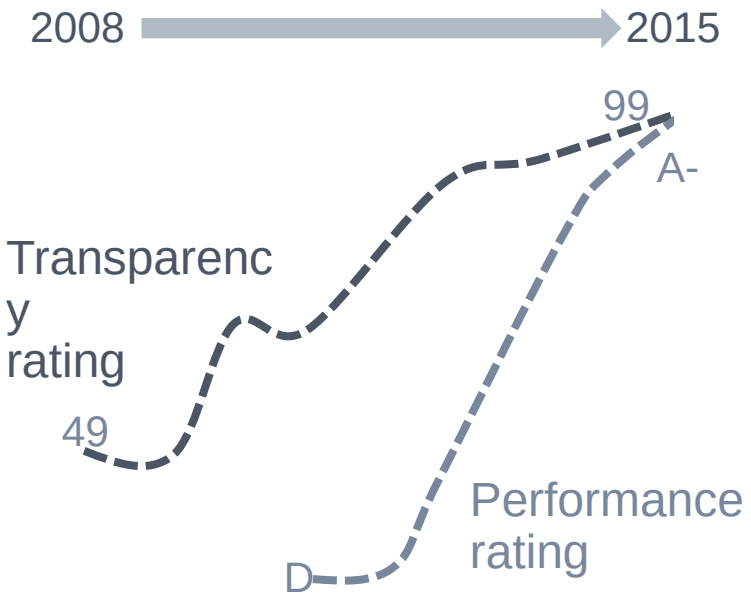
thyssenkrupp

thyssenkrupp's view on sustainability

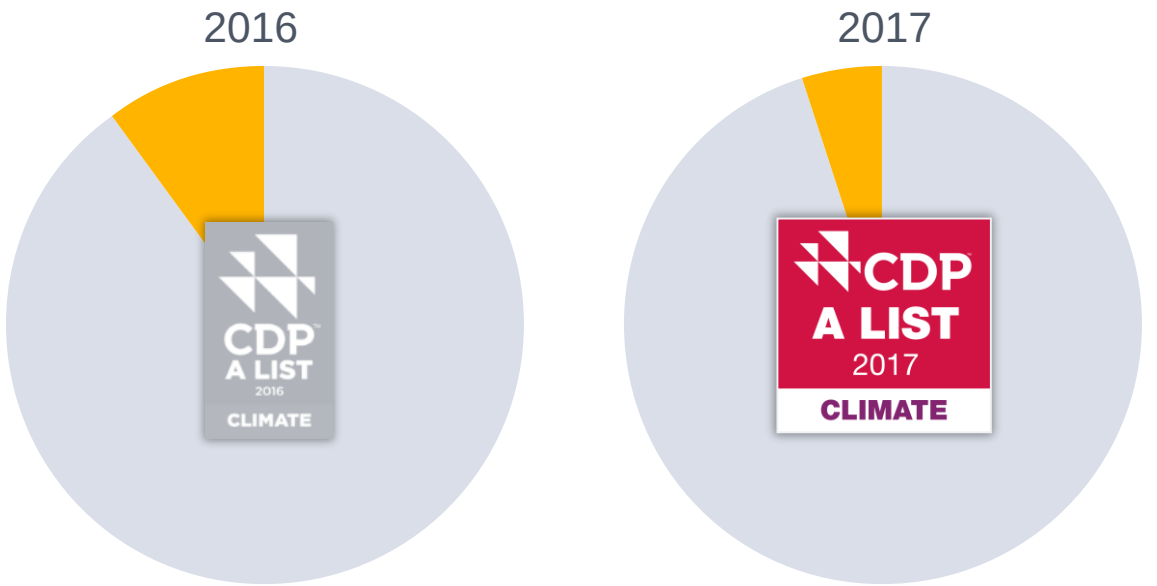
We take a broad set of subjects and perspectives into consideration

CDP – thyssenkrupp is recognized as a world leader in climate protection for the 2nd time in a row

Catching up with leadership



Leadership confirmed

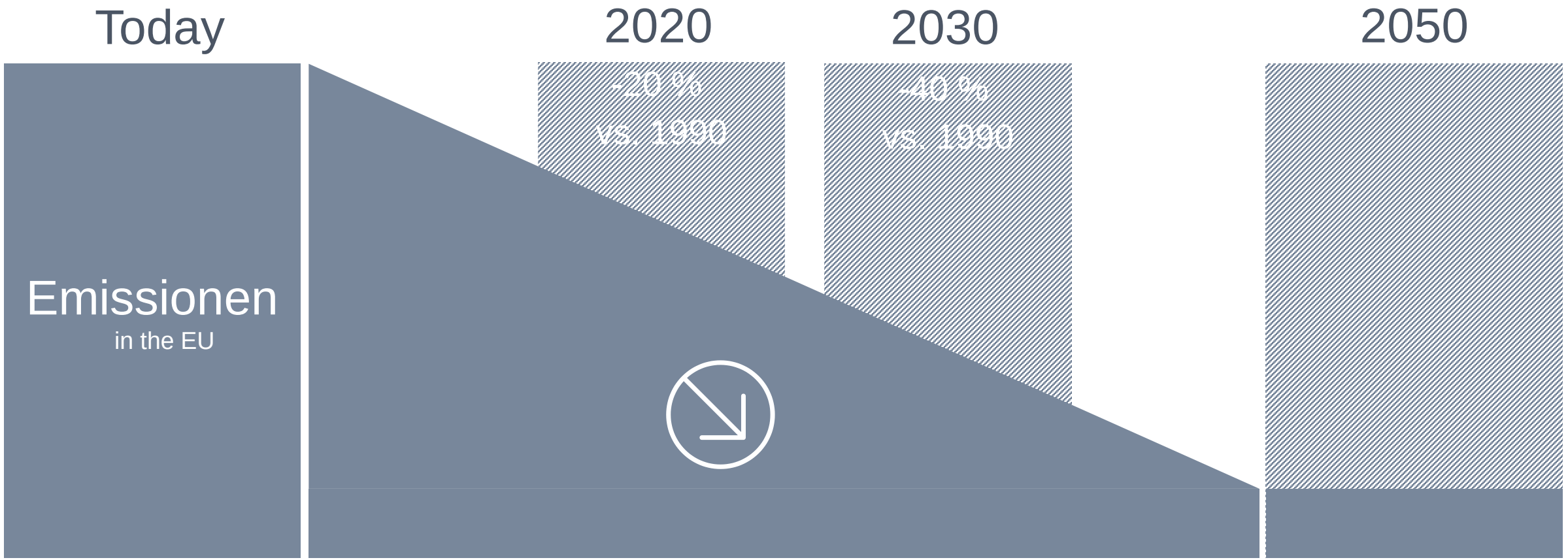


tk in **TOP 10 %** as one of 9 German companies

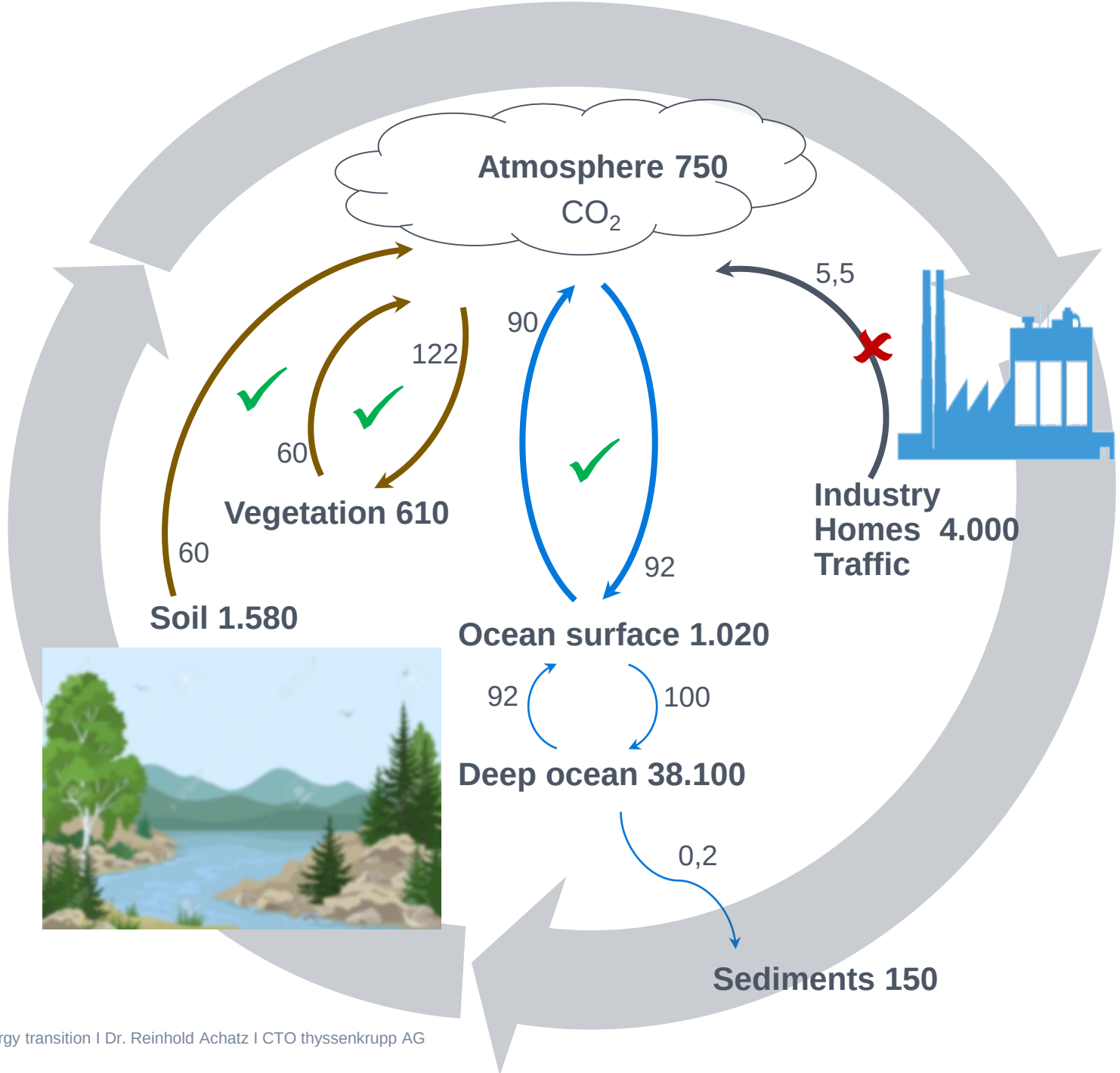
tk in **TOP 5 %** as one of 7 German companies

The CDP rates more than 2,400 companies on behalf of >800 institutional

The Paris Climate Agreement sets ambitious targets



Global carbon cycle



content in Gt C
flows in Gt/a C

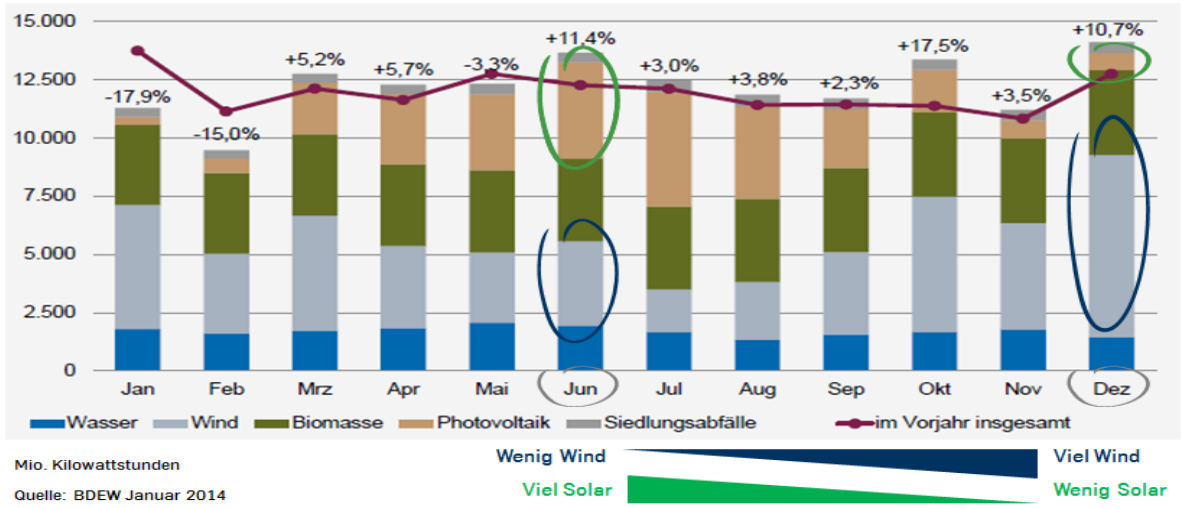
Impact of power generated from renewable resources

Fluctuation in power availability seasonal vs. daily/hourly

Example Germany

Monthly fluctuation is marginal

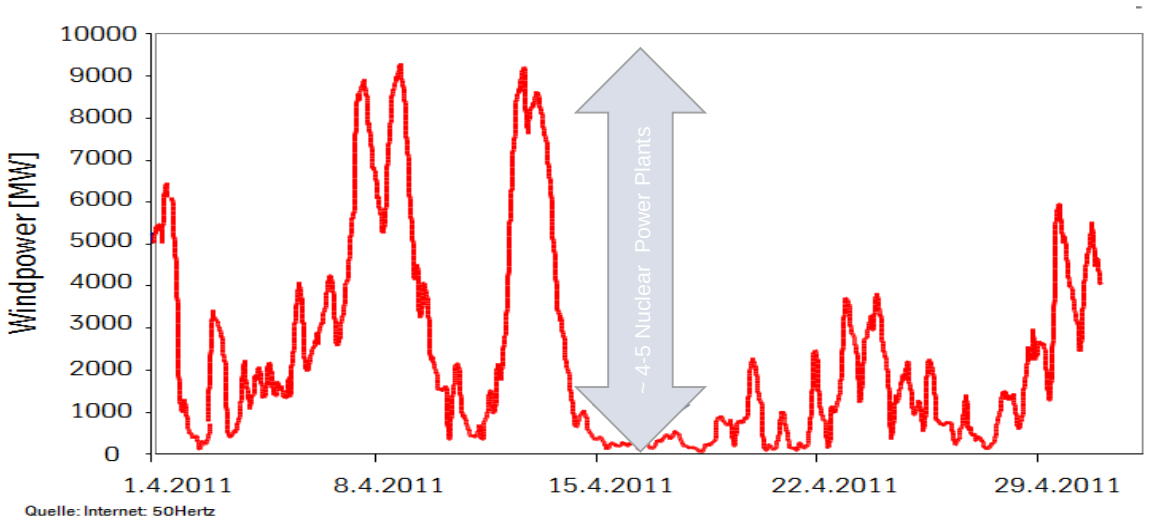
Time scale: Month



Probably low need for long term storage because of marginal seasonal fluctuation.

Daily/hourly input is extremely volatile

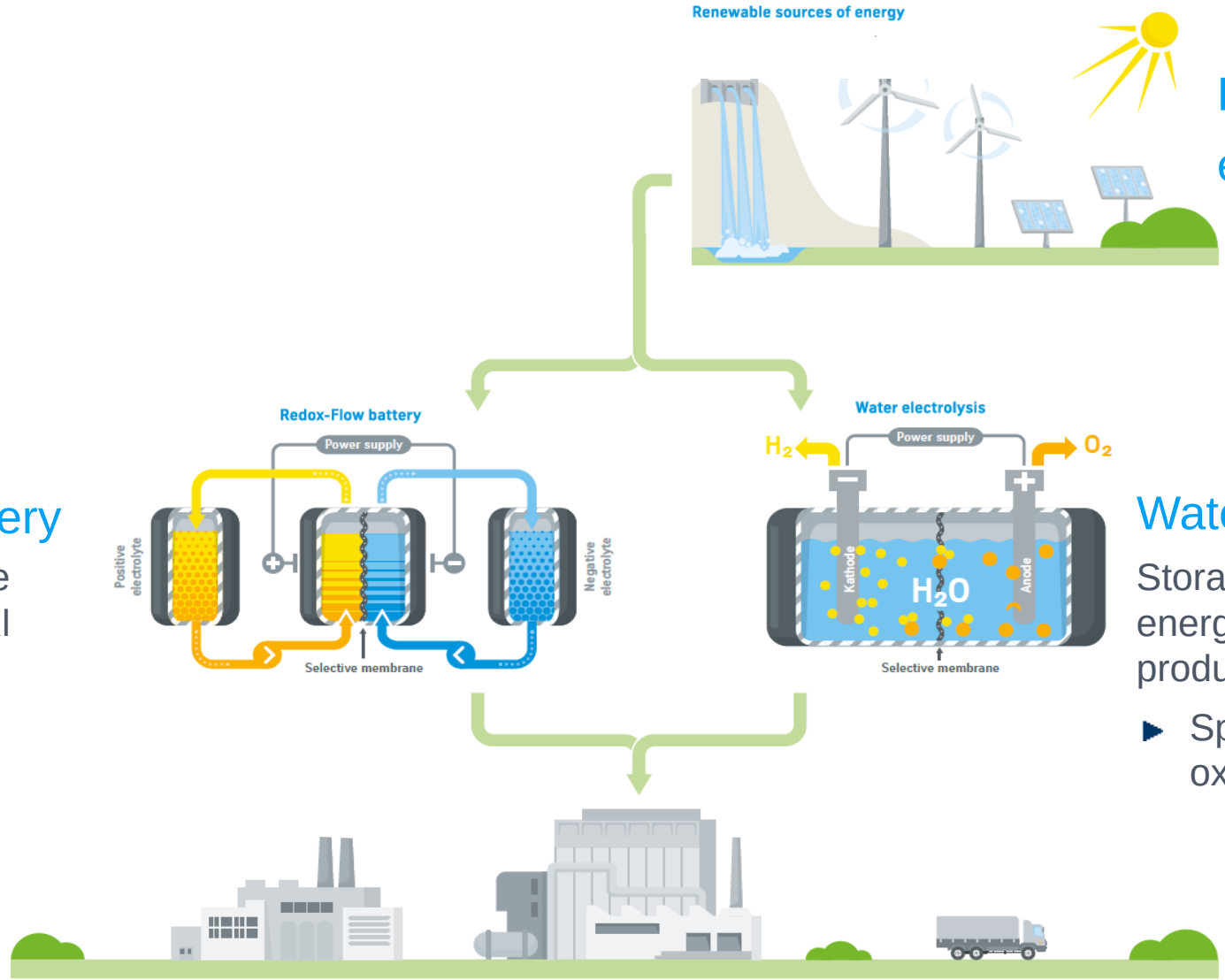
Time scale: Hours / Days



High daily and hourly fluctuation of wind power create need for flexible consumer and short and medium term storage.

Development of technologies supporting Greenhouse Gas neutrality

Storage is precondition for the extensive use of power from renewable sources and grid stability



Renewable energy sources

Redox-Flow battery

Storage of renewable energy in a „chemical battery“

Water electrolysis

Storage of renewable energy in a chemical product

- Splitting water into oxygen and hydrogen

Green hydrogen will become key in the future value chains

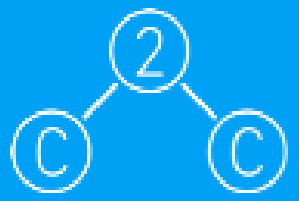
renewable energy

Water electrolysis

H_2

$H_2 + X$

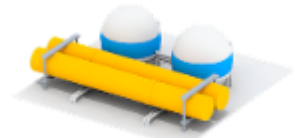
Power-to-X



Carbon2Chem®

Ammonia, Methanol, Urea, …

Power Generation



Power Distribution (Gas)

Industry

Mobility

Power grid
- central
- distributed

Our contribution: H_2 at scale - large water electrolysis plants

Advanced Water Electrolysis

- Alkaline atmospheric
- EPC turnkey installations at large scale
- Establi[illegible]ains

Experience cannot be copied.

#1 49% market share
supplier for electrolytic hydrogen production

600
electrochemical plants realized worldwide

over **10 GW**
of power installed

Hydrochloric acid diaphragm electrolysis

Hydrochloric acid ODC[1] membrane electrolysis

Chlor-alkali membrane electrolysis

[1] ODC: Oxygen Depolarized Cathodes

Green H_2 through water electrolysis - New dimensions for renewable energy integration

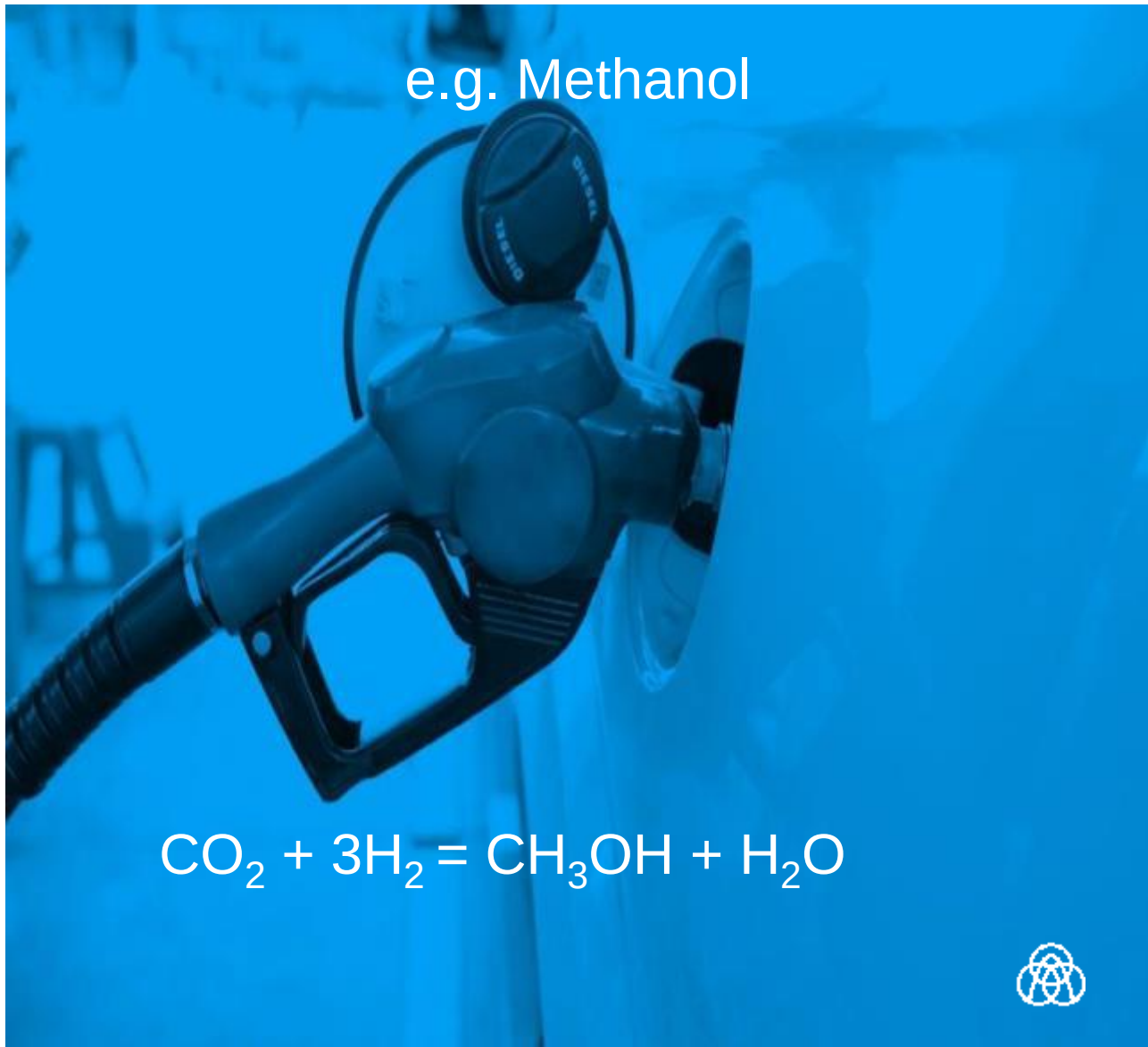
Example: Industrial Solutions

Water Electrolysis by thyssenkrupp

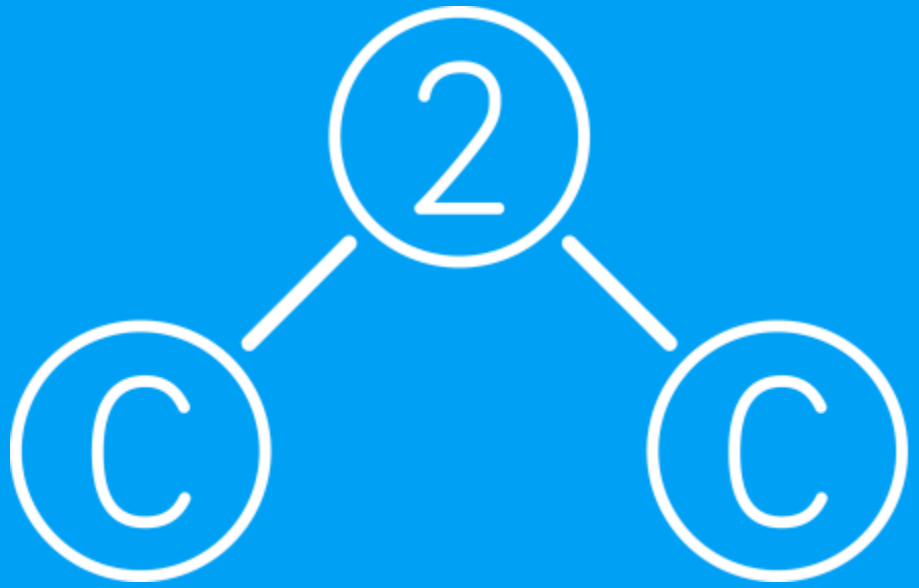
- Market potential 2017-23 for water electrolysis systems >€1.0 bn
  (Source: own assessment)
- Proven technology, scale economies
- Design for plants larger than 100 MW
- Target applications
  - Power-to-Gas (H2/ energy storage),
  - Power-to-X (e.g. methanol/ fuel, ammonia)

Carbon Capture & Utilization (CCU) - Use of CO_2 as a valuable recycling resource

- ~4450 Mio. tons of greenhouse gas emissions annually in Europe
- Potential Use for production of Base-Chemicals

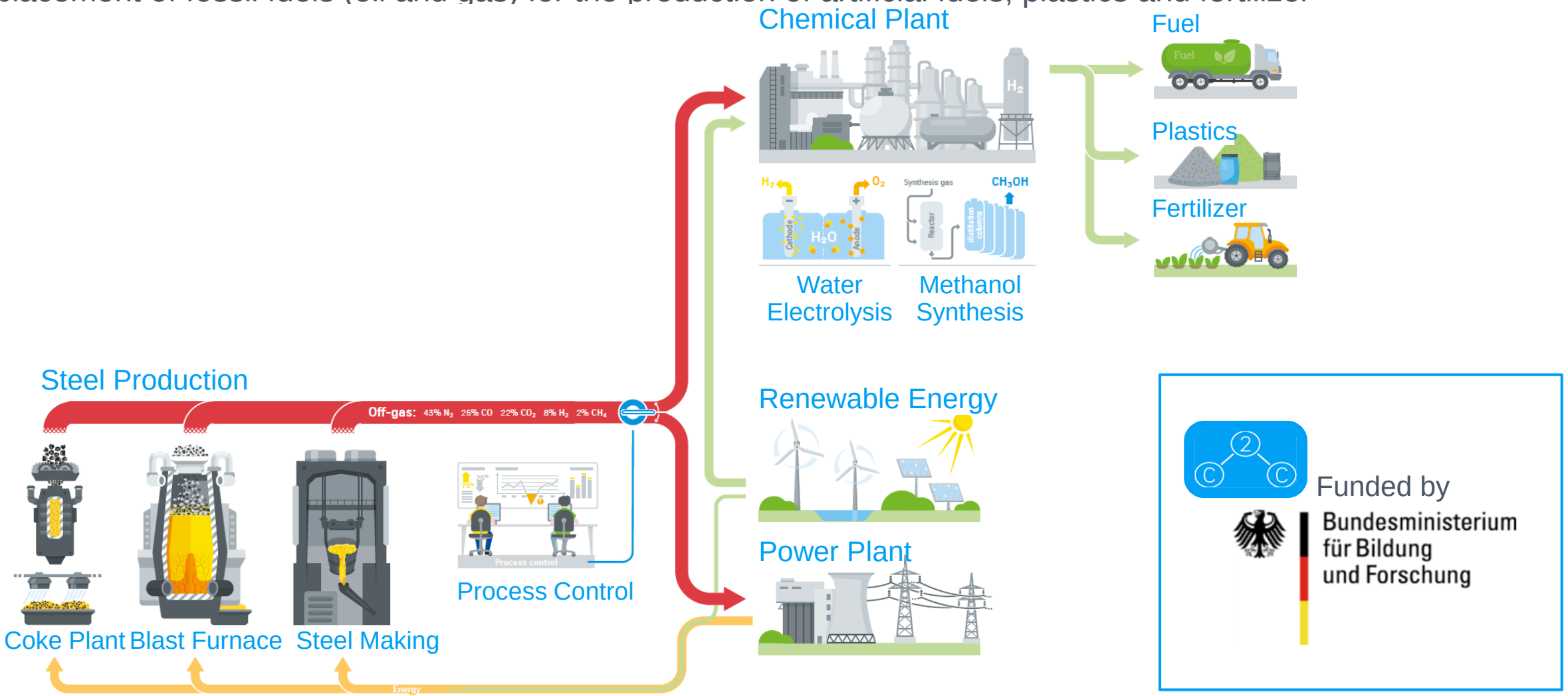


Carbon2Chem®



Carbon2Chem® – Recycling of top gases from steel production through cross-industry collaboration

Replacement of fossil fuels (oil and gas) for the production of artificial fuels, plastics and fertilizer



Funded by
Bundesministerium für Bildung und Forschung

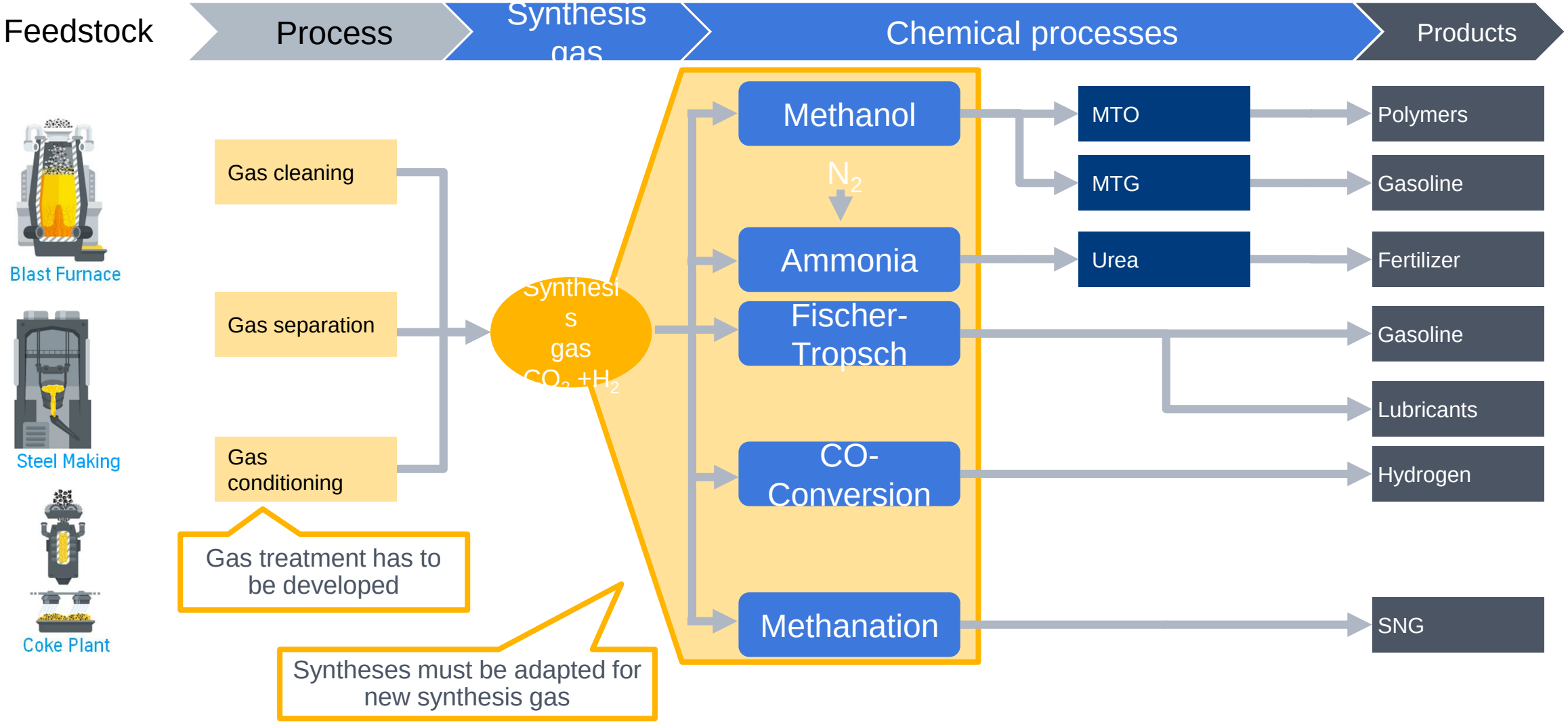
The chemical principals are known since 100 years,

… but they are not implemented in an economical way yet!

Kaiser-Wilhelm-Institut für Kohleforschung 1918

Carbon2Chem®: Transform top gases into chemical products

Replacement of fossil fuels (oil and gas) for the production of artificial fuels, plastics and fertilizer



GEFÖRDERT VOM
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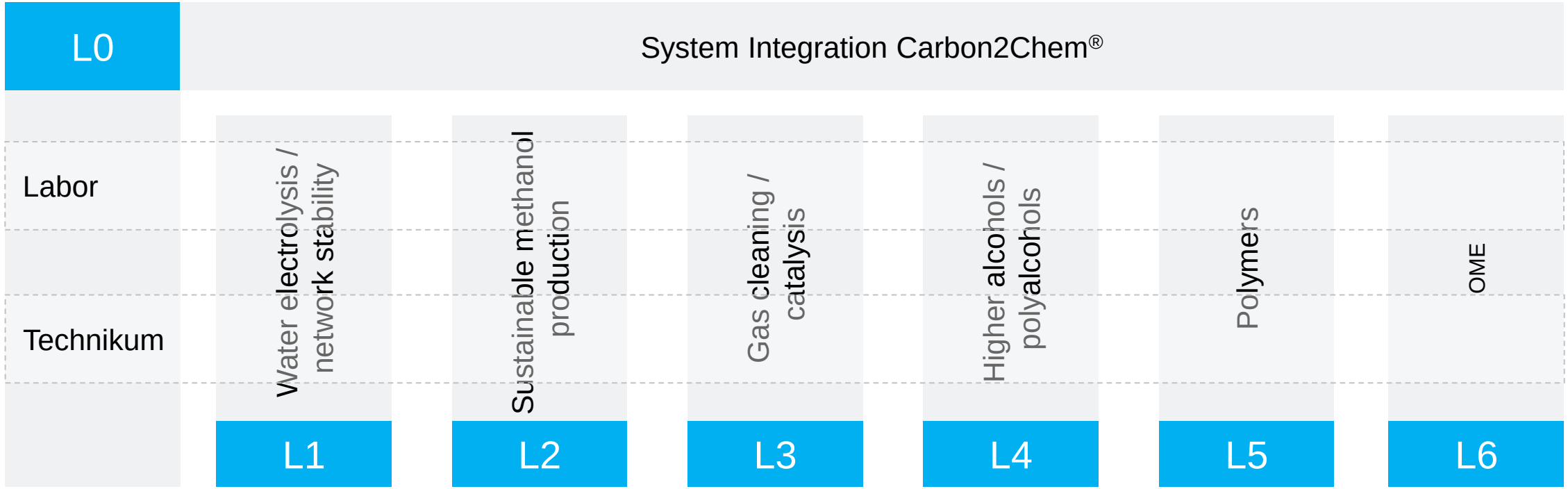
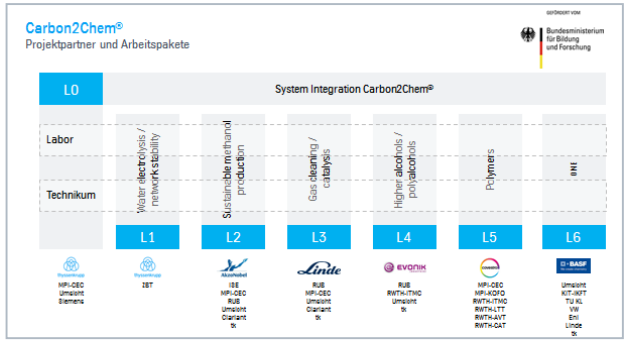
Carbon2Chem®
The project and the partners



Implementation of Carbon2Chem®

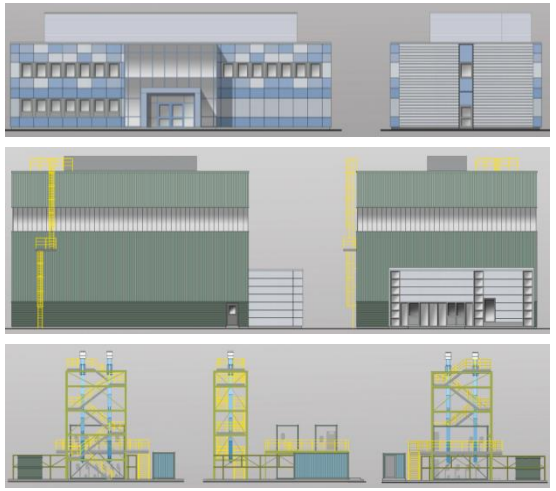
From idea to economical implementation

Research in Carbon2Chem®



Research and feasibility

Carbon2Chem® pilot plant



„Proof of Concept“

Commercial implementation

Supporting greenhouse gas neutrality

Carbon2Chem® Pilot Plant (Technikum)

Carbon2Chem® – major elements of the pilot plant are already in place an running

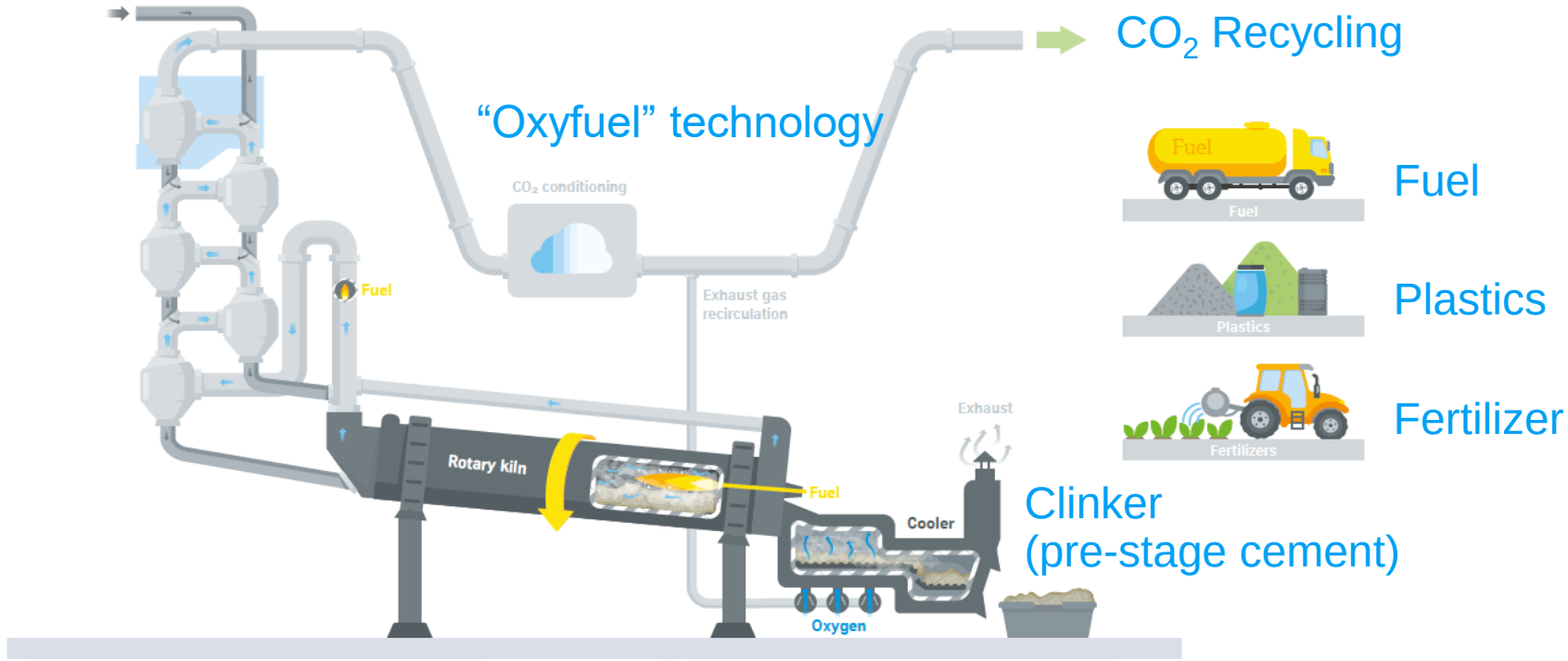
Gas Separation

Electrolysis

Carbon2Chem® - Technology modules can be offered for other CO_2 intense industries as well

Example: Industrial Solutions

Carbon capture and utilization (CCU) for cement production



- Oxyfuel technology can be combined with any kind of modern cement production technology
- thyssenkrupp’s outstanding position in cement production technology is a key lever for Oxyfuel technology roll-out

Leverage today’s leadership in chemical processes and engineering for tomorrow’s CO_2 recycling

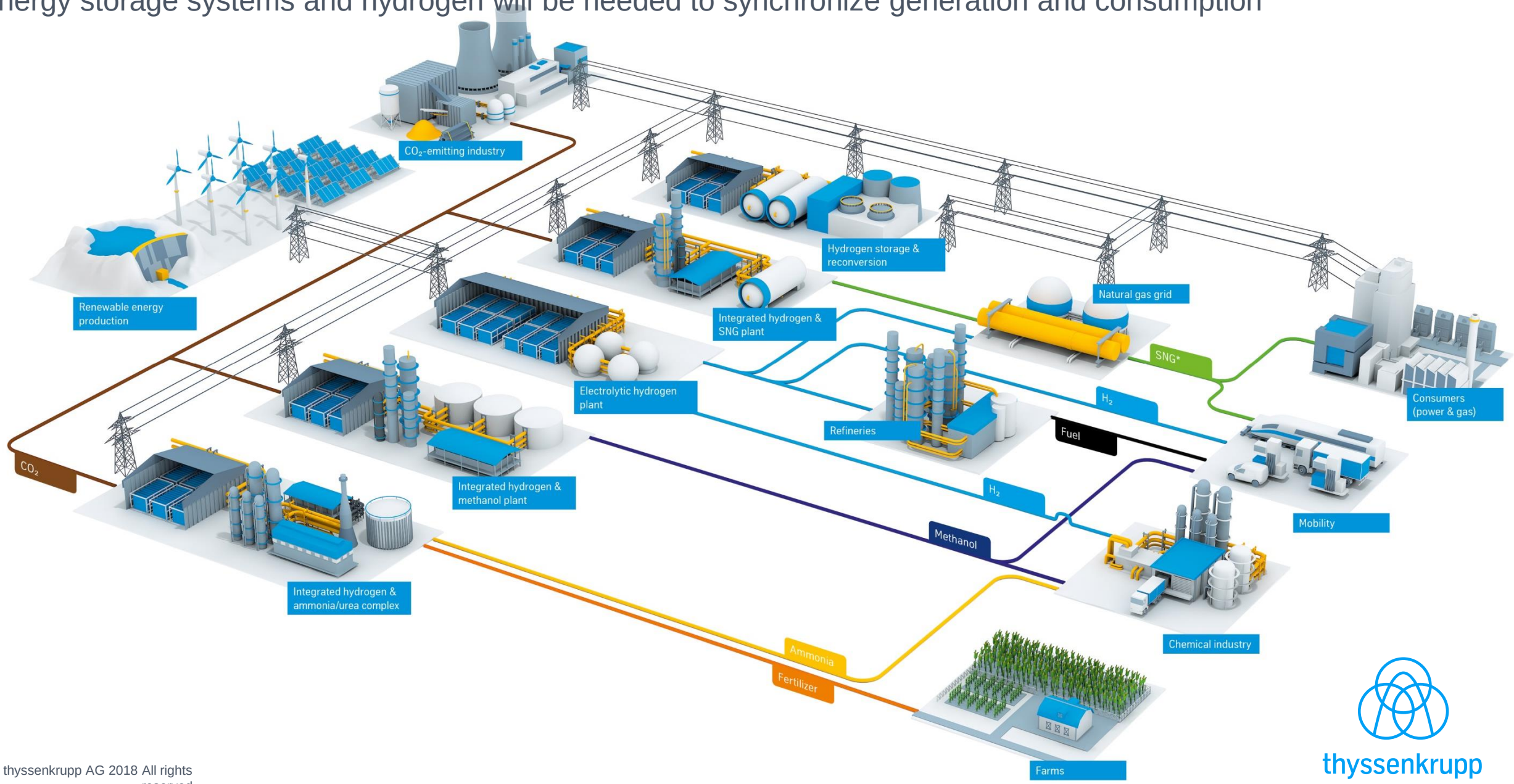
Example: Industrial Solutions

Chemical plants by thyssenkrupp

- Most efficient Ammonia and Urea plants with largest capacities
- World-leading process and plant design know-how
- We have built more than 2,500 chemical plants worldwide

Future energy system

Energy storage systems and hydrogen will be needed to synchronize generation and consumption



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Thank you for your attention!

Carbon2Chem® pilot plant
Duisburg / Germany

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