Innovation Fund Workshop

Cefic

05-06-2019

Examples from companies (illustrative)

Thematic areas

- Electrification: Power-to-Heat & Power-to-Chemicals
- Plastic recycling & chemical recycling of waste
- Chemical valorisation of CO_2 and CO
- Biobased products

Electrification

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BASF Carbon Management

Shradha Abt,

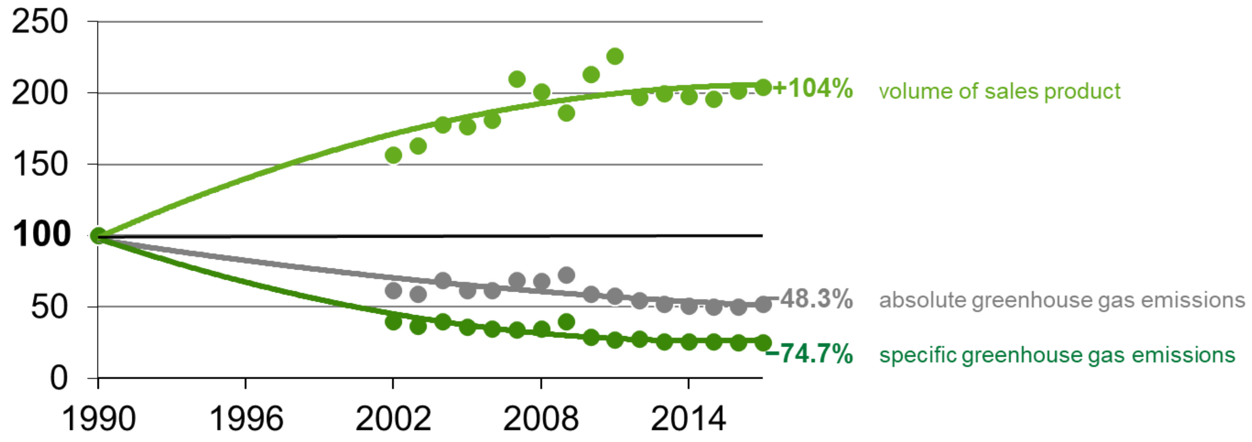
Senior Manager Energy and Climate Policy

05 June Brussels

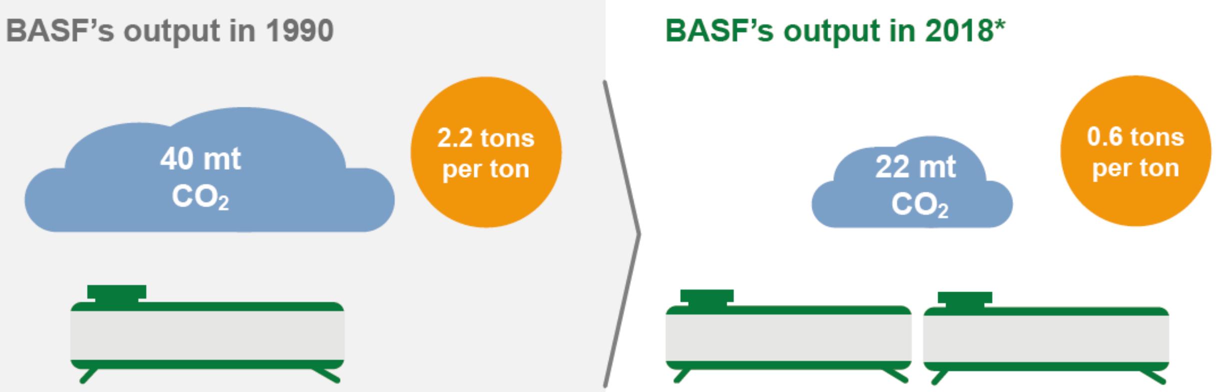
Reduction of Greenhouse Gas emissions with increased production

Development since 1990

Index 1990 = 100%, BASF Group excl. oil and gas business



BASF's successful greenhouse gas reduction



Since 1990, BASF has halved its emissions and doubled its sales volume

BASF
We create chemistry

BASF's strategy: CO_2 emission target

+50%

sales products

Baseline 2018

-33%

specific emissions

Our target 2030:

CO_2-neutral growth

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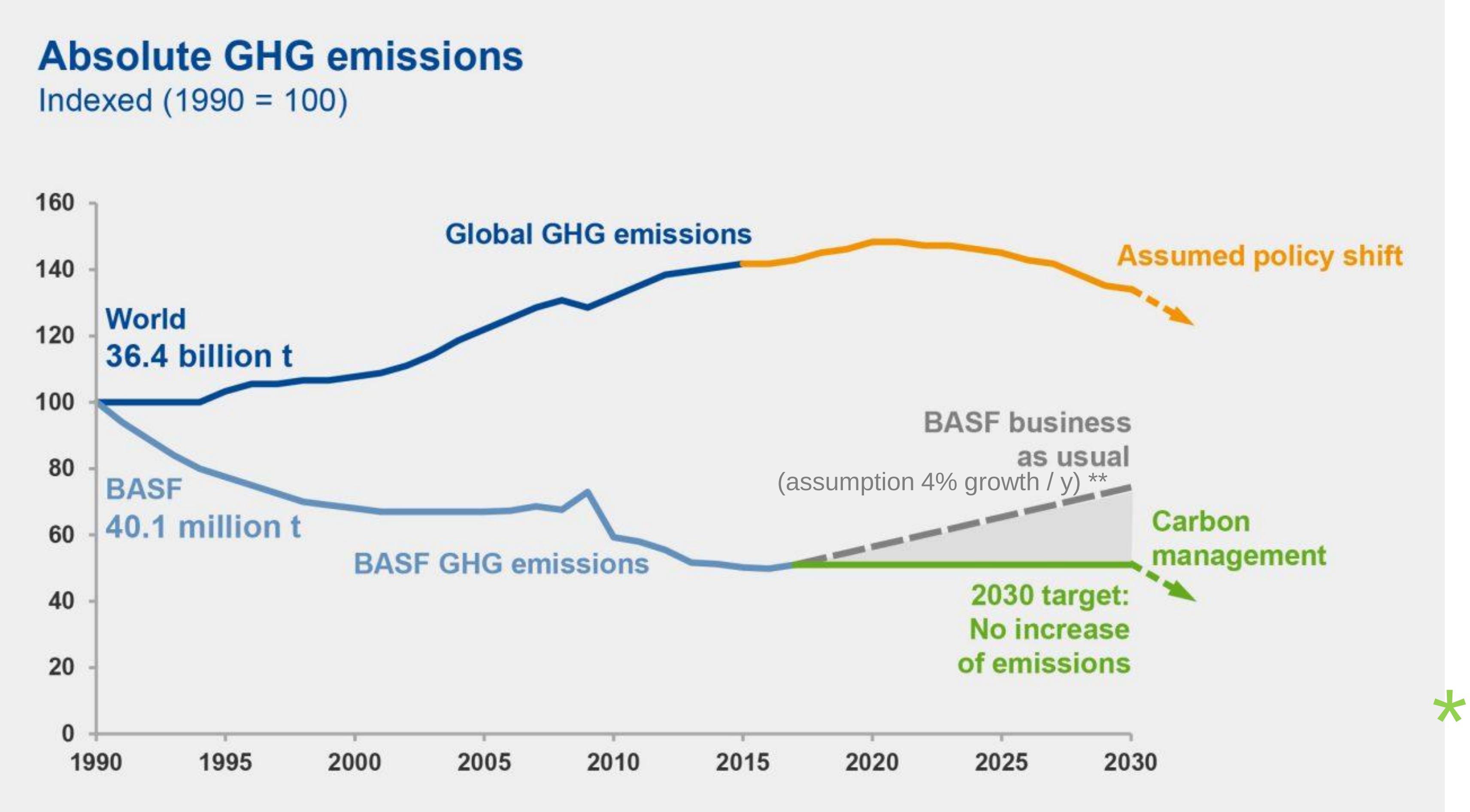
Development of emissions

Dilemma: Growth generates higher CO_2 emissions, since emission reduction per ton of product reaches limits



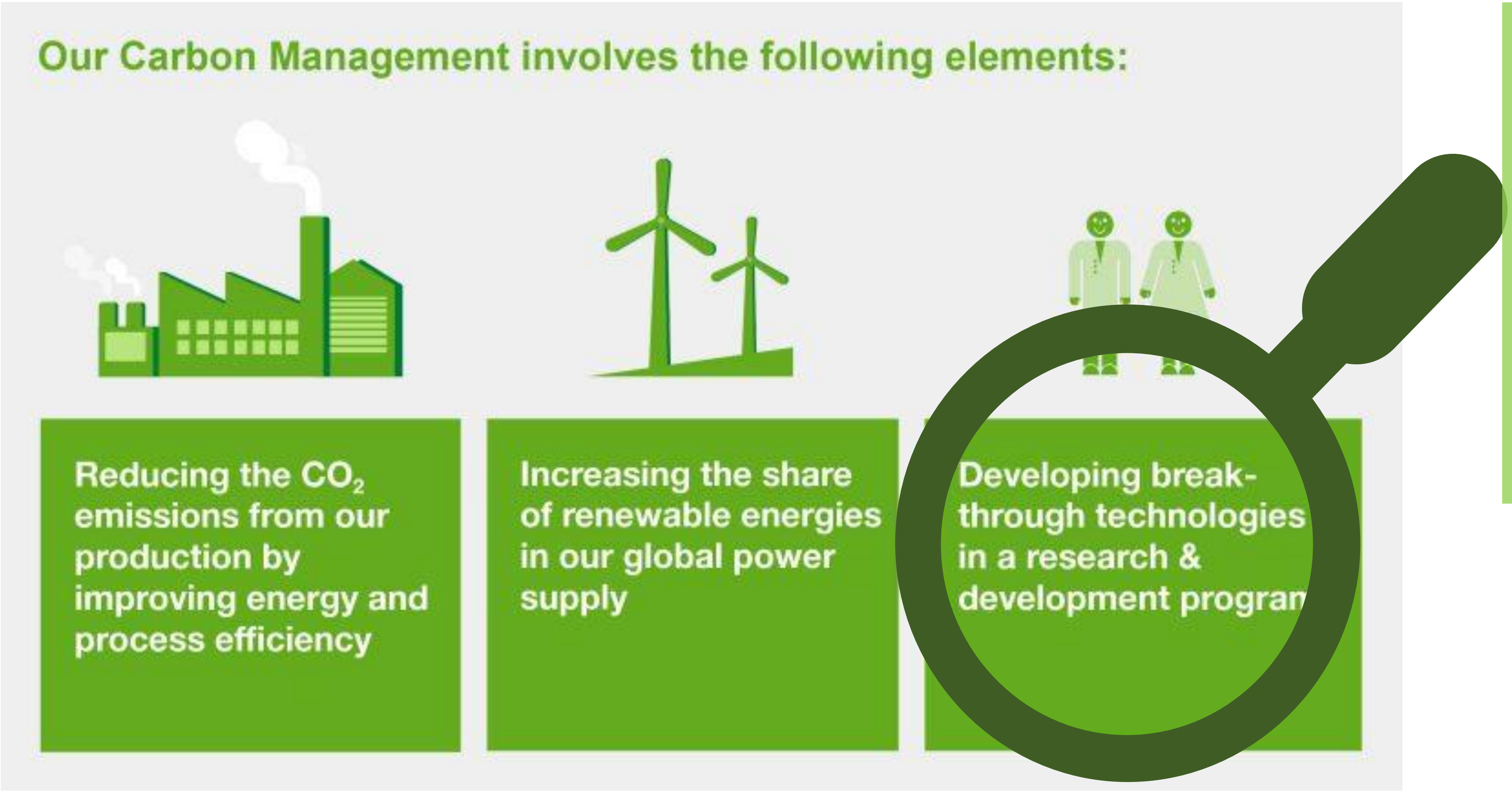
*

Successful implementation depends on

- Technical feasibility
- Renewable energy supply
- Globally comparable CO_2 pricing

** Continuous reduction of BASF's product specific CO_2 emissions included

What is Carbon Management?



New low greenhouse gas processes

- **High use of renewable electricity – *e-cracker***
- **Hydrogen production with solid carbon - *methane pyrolysis***
- **Change from CH2 (naphtha) to CH4 (gas). Inclusion of process CO_2 in products – *Emissions free Methanol***
- **New catalytic systems**

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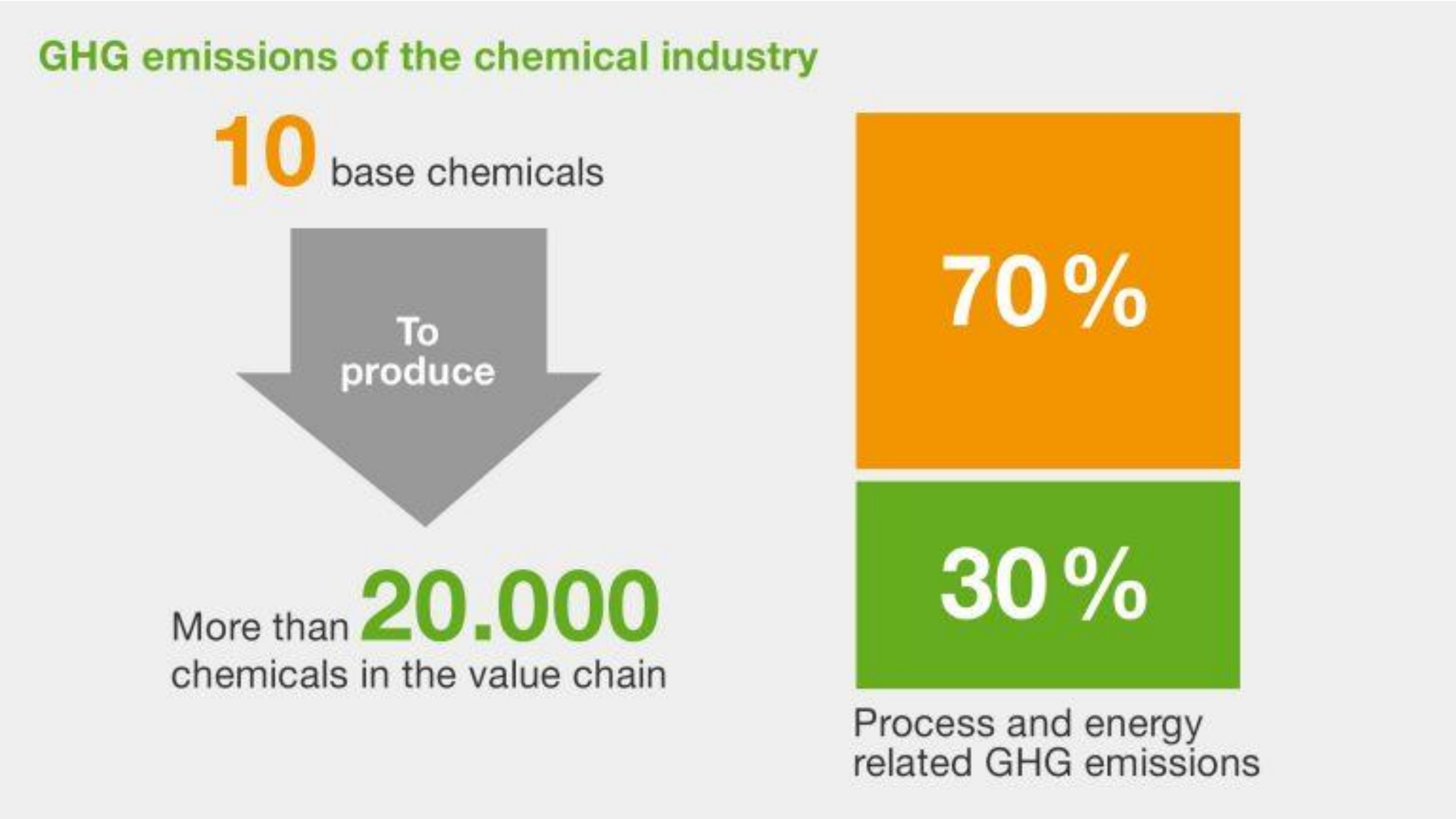
Substantial further reductions require completely new technologies What are the big emitters?



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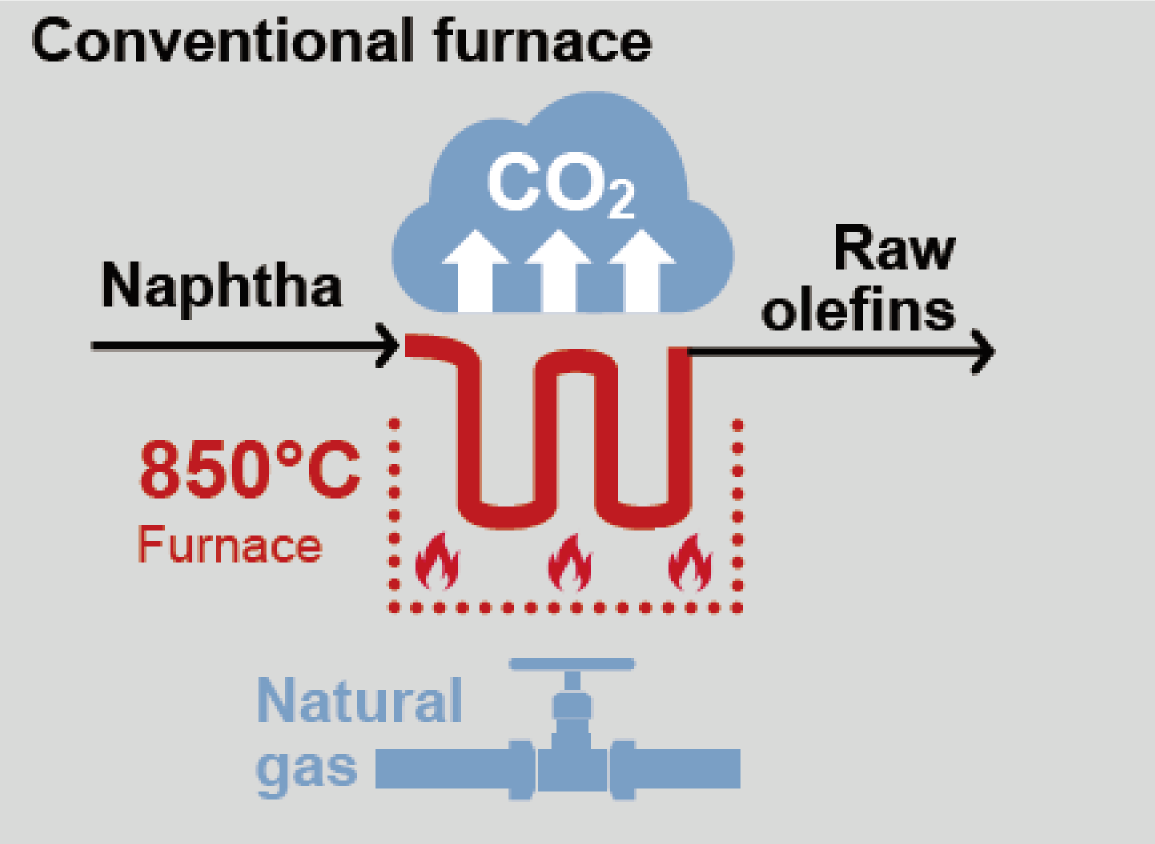
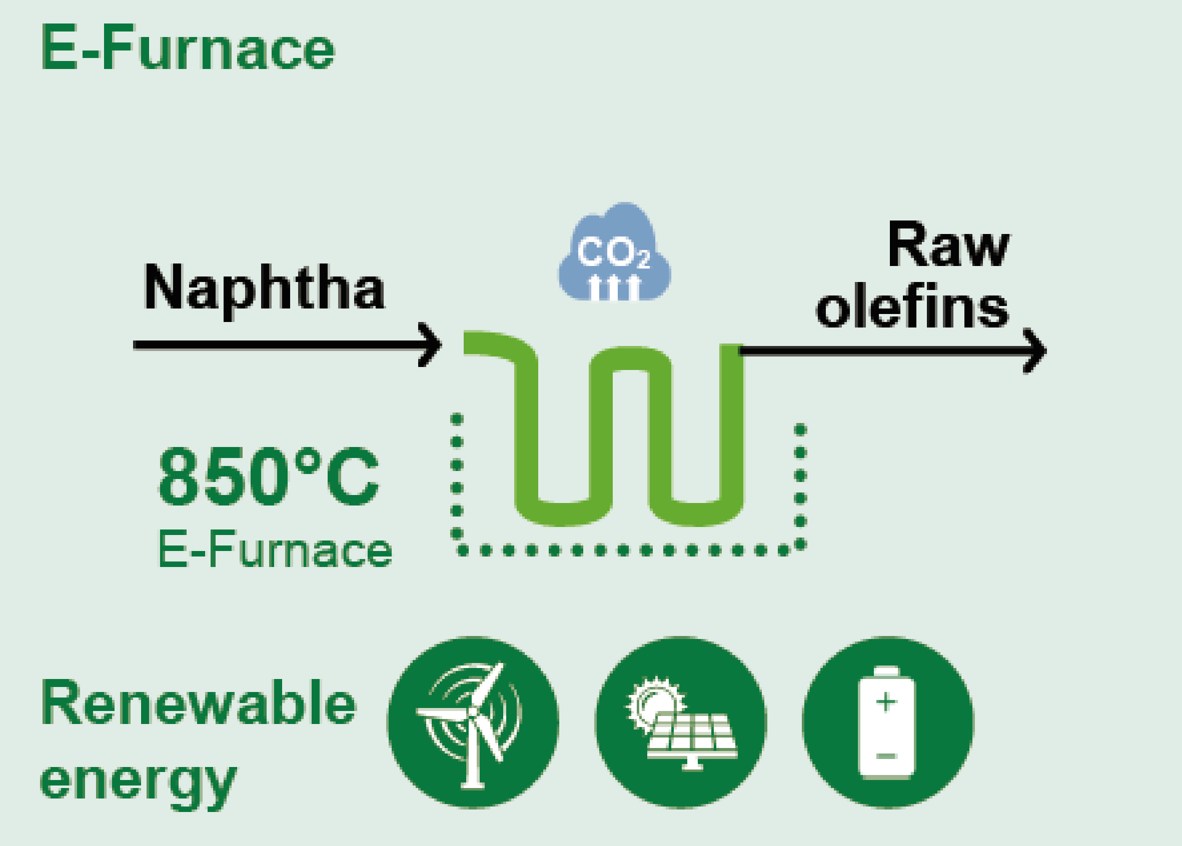
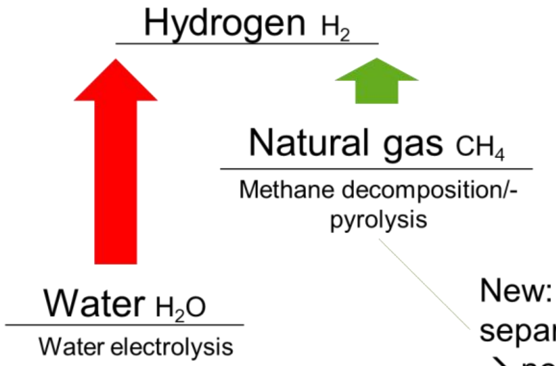
Technology 1: from conventional furnace to E-Furnace



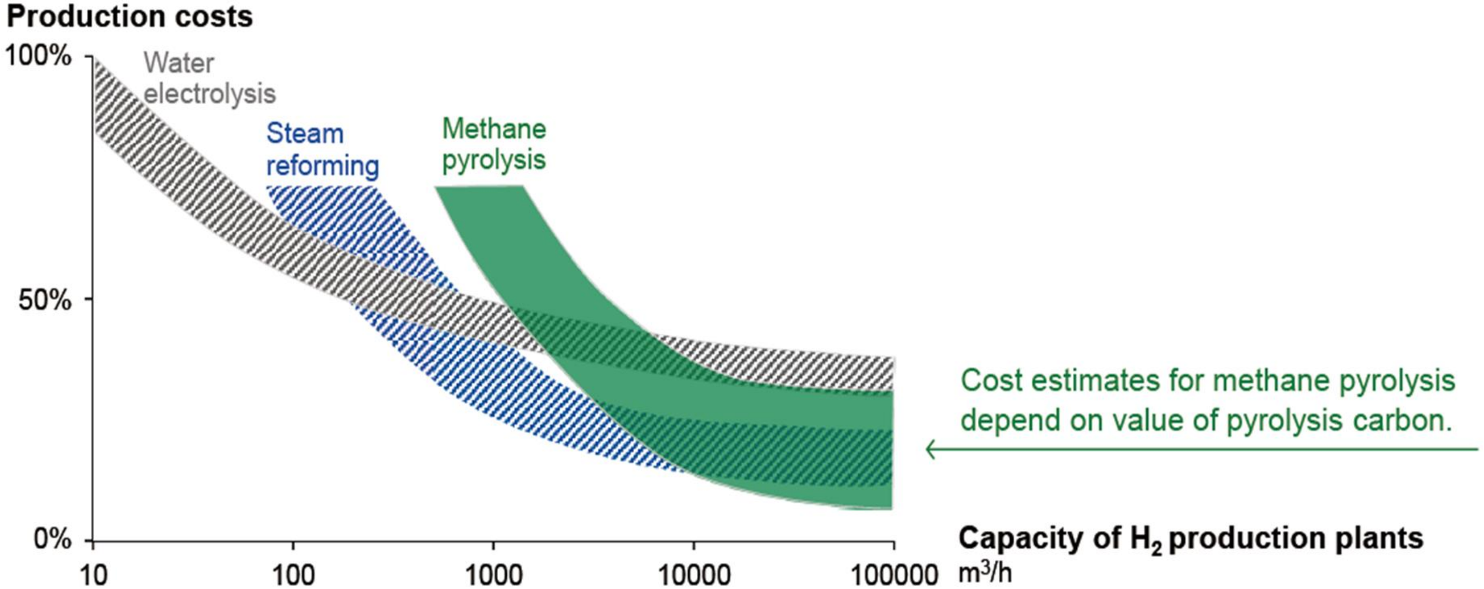


Technology 2: Hydrogen production without direct CO_2 emission at low energy demand – a development project (methane pyrolysis)

Energy demand for new processes for hydrogen production



New: Carbon is separated as solid
→ no CO_2 emission!



Priorities:

1. **Avoidance of GHG emissions** while minimizing transitional losses
   - New low GHG production processes
   - Energy efficiency of the whole value chain (ongoing), while allowing for higher consumption of new processes

2. **Circularity**
   - Biomass use (e.g. Biomass Balance)
   - Circularity of carbon (-containing products): ChemCyling, CCU etc.

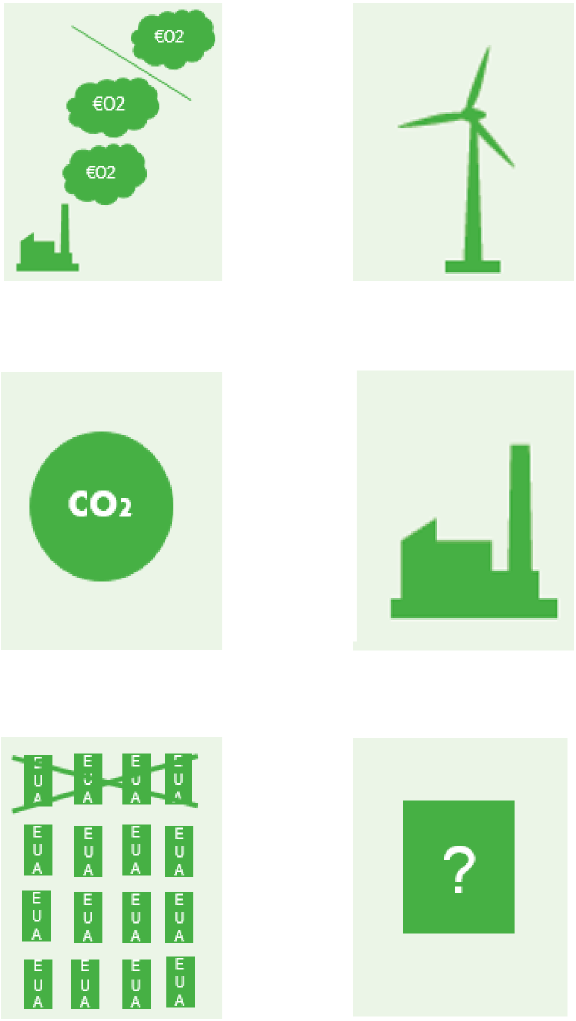
The way forward: significant effects of new technologies after 2030 only

- Large-scale CO2-reductions can only be achieved through a significant **electrification** of industrial processes, leading to a huge increase of low-carbon electricity demand.

- **R&D funding programs** necessary for de-risking and scaling.

- Radically **lowering the price of renewable** electricity, including Government driven surcharges and levies, presents an indispensable prerequisite for a successful industrial transformation.

- **Without a global (at least G20) CO2 price, a moderate ETS** can support the transition, but economic constraints around industrial zero-carbon transformation need to be better acknowledged.



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Plastic recycling & chemical recycling of waste

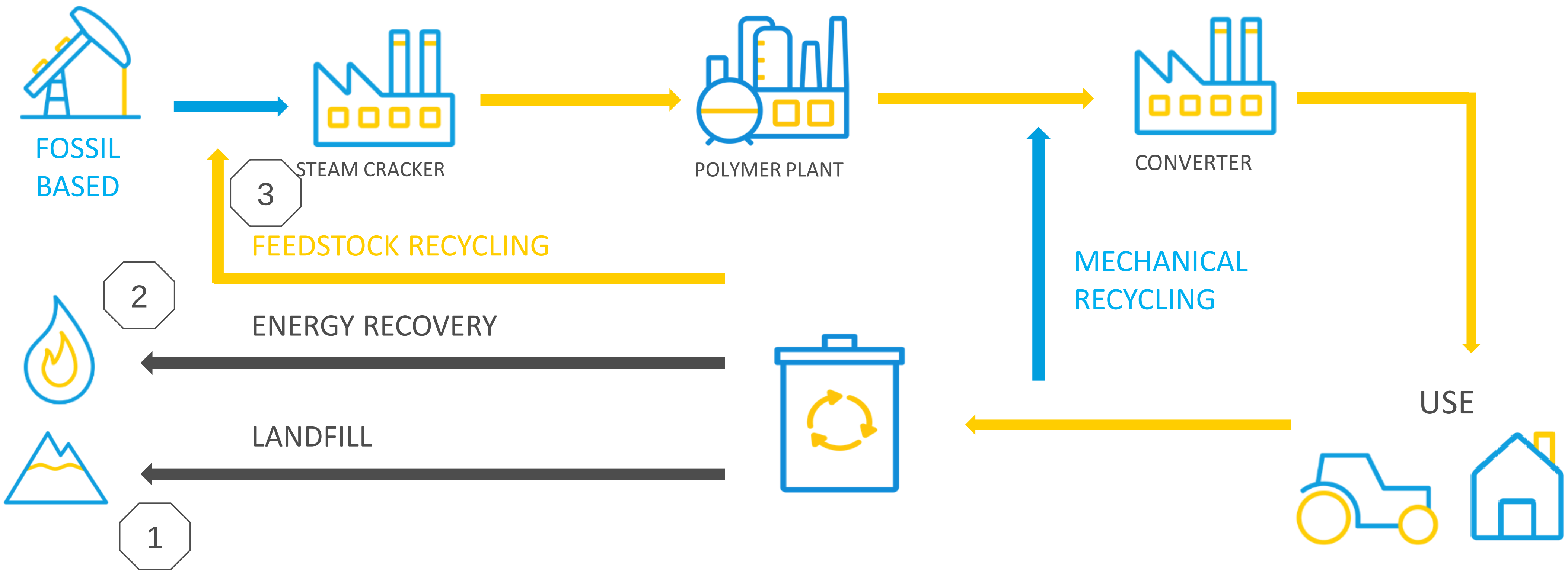
CHEMISTRY THAT MATTERS™

CHEMICAL RECYCLING

CIRCULAR TECHNOLOGY WITH COMPLEX GHG CONSEQUENCES

Dr. Steven de Boer
SABIC
DG Clima – EIB - CEFIC meeting – Brussels- Jun 05 2019

PLASTIC WASTE TO FEEDSTOCK FOR PETROCHEMICALS



Realizing the circularity goals gives rise to GHG emission considerations

GHG IMPACT OF VARIOUS WASTE MANAGEMENT ROUTES

1. Landfill: will be phased out because of waste regulation

2. Incineration will give CO2 emissions

3. Chemical processing of plastic waste will give rise to some process emissions but will avoid all the emissions associated with incineration

Avoidance of more than 2 kg of GHG eq per kg of waste is possible, allocation is the key question


THANK YOU

Innovation Fund

PLASMA GASIFICATION

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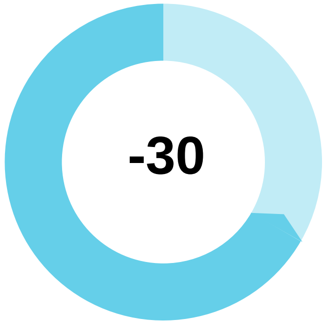
O. Wachsen
Group Process Technology
Group Technology & Innovation
05.06.2019

what is precious to you?

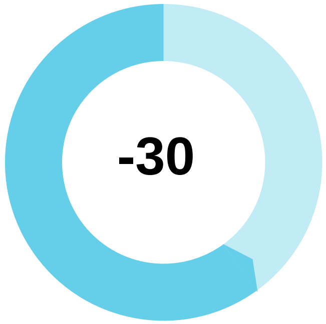
Planet – Environment Protection as a Driver for Growth

ENVIRONMENTAL TARGETS[1] BY 2025 IN % WELL ON TRACK compared to 2013 basis

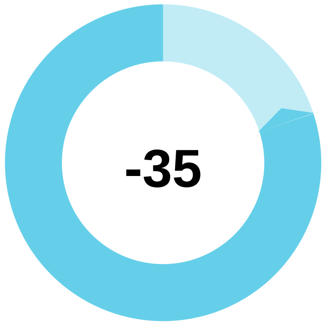
Reduction of Energy Consumption



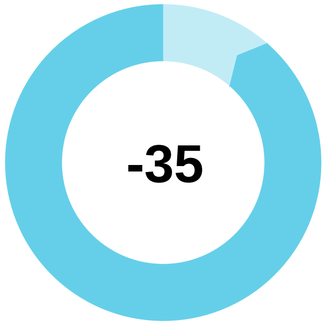
Reduction of Direct CO_2 Emissions



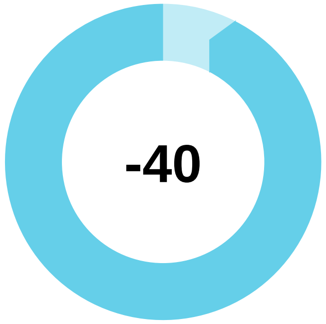
Reduction of Emissions from Greenhouse Gases



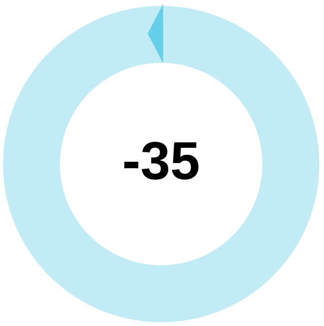
Reduction of Water Consumption



Reduction of Volume of Waste Water



Reduction of Volume of Waste[2]



[1] Per ton of products produced, [2] Waste performance mainly affected by non-hazardous waste increase e.g. from gypsum waste

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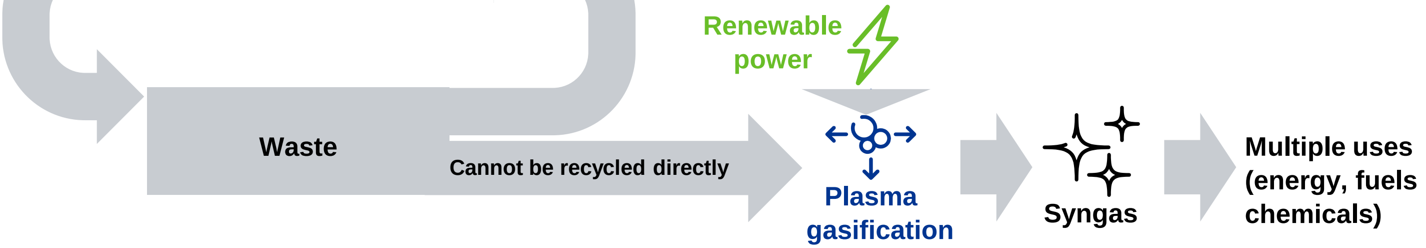
Plasma gasification as sustainable process platform for Circular Economy

PROJECT IDEA

- Huge amounts of unsorted waste (e.g. municipal, industrial, agricultural) **cannot be recycled directly**
- Plasma gasification directly produces **syngas, which can enter a variety of applications**
- Plasma can utilize **renewable energy**



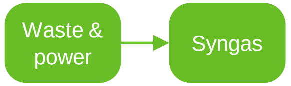
TECHNOLOGY STATUS

- High selectivity to synthesis gas and low emissions make plasma gasification attractive as recycling technology in addition to waste to energy applications:
  - Carbon conversion efficiency is higher compared to conventional gasification
  - Green house gas (GHG) impact compared to incineration is much better in terms of global warming potential
- Single unit operations (pre-treatment, gasification, catalytic downstream) are mature (TRL 7-8)

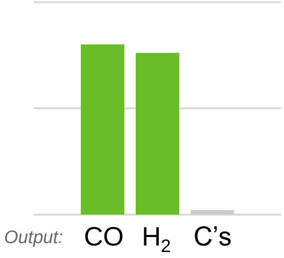
ADVANTAGES

Tolerant against varying input streams

One-step-route from waste to syngas



Highly **selective** and minimal solid waste



Minimal emissions into atmosphere

DEVELOPMENT NEEDS

- End-to-end demonstration is required to improve TRL of system including all unit operations (TRL 8-9)
- Cross-sectorial collaboration to demonstrate industrial symbiosis within a sustainable Circular Economy
- CAPEX and OPEX still sensitive to legal framework
- **CAPEX estimate for demonstration plant: approx. 20 Mio. €**

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- from its vendors on acceptable terms, or at all, and to continue to obtain sufficient financing to meet its liquidity needs; and changes in the political, social and regulatory framework in which the Company operates or in economic or technological trends or conditions, including currency fluctuations, inflation and consumer confidence, on a global, regional or national basis.
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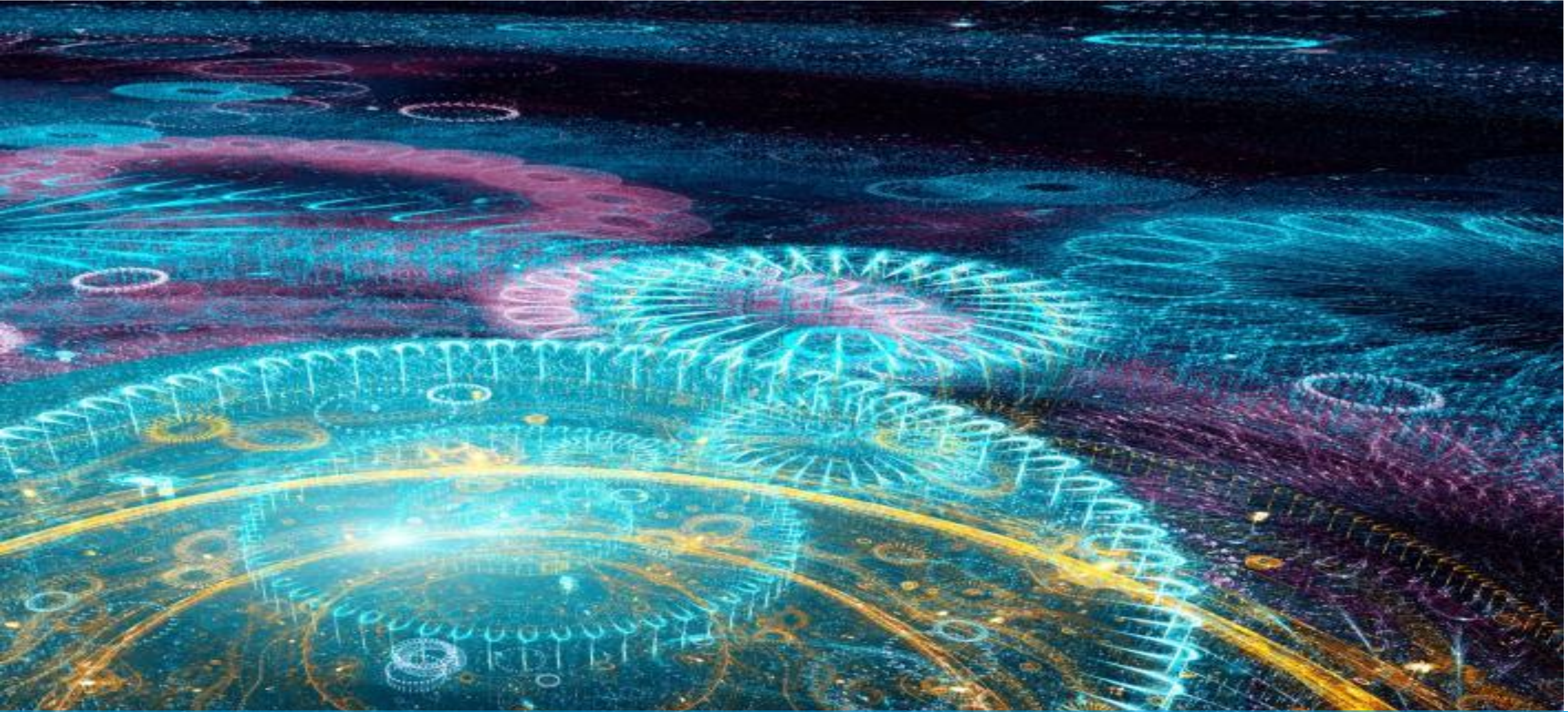
Chemical valorisation of CO_2 and CO



SOLVAY

asking more from chemistry®

ETS INNOVATION FUND

CO_2 Capture and Utilization @ Solvay

D. SAVARY, June 2019

OUR FIVE SUSTAINABLE COMMITMENTS BY 2025

SOLVAY

Contribute to *Society*

SOCIETAL ACTIONS

x2
employees involved in societal actions

Innovate *Sustainable* solutions

SUSTAINABLE PORTFOLIO MANAGEMENT

50%
share of sustainable solutions in the Group portfolio

Act *Responsibly*

SAFETY

- 50%
of occupational accidents

GREENHOUSE GAS INTENSITY

NEW TARGET
Reduce our Greenhouse gas absolute emission by 1 million tons by 2025

ENGAGEMENT INDEX

80%
employee engagement index

Baseline 2014

Since January, 1, 2016 Solvay apply an internal price for CO_2 emissions at 25 euros per ton in its investment decisions.

CO_2 CAPTURE AND UTILIZATION @ SOLVAY

Key Facts & Figures of the project	• **Objective:** direct CO_2 emissions reduction • **Short description:** CO_2 capture on a steam methane reformer of Solvay with a high-TRL technology; CO_2 will be valorized by mineral carbonation (Ca-/Mg-based) • **Country location:** Germany • **Brownfield** • **TRL:** 7 → 8 • **Capacity** < 100 kt CO_2 captured/yr

Advantages to capture CO_2 on SMR flue gas:

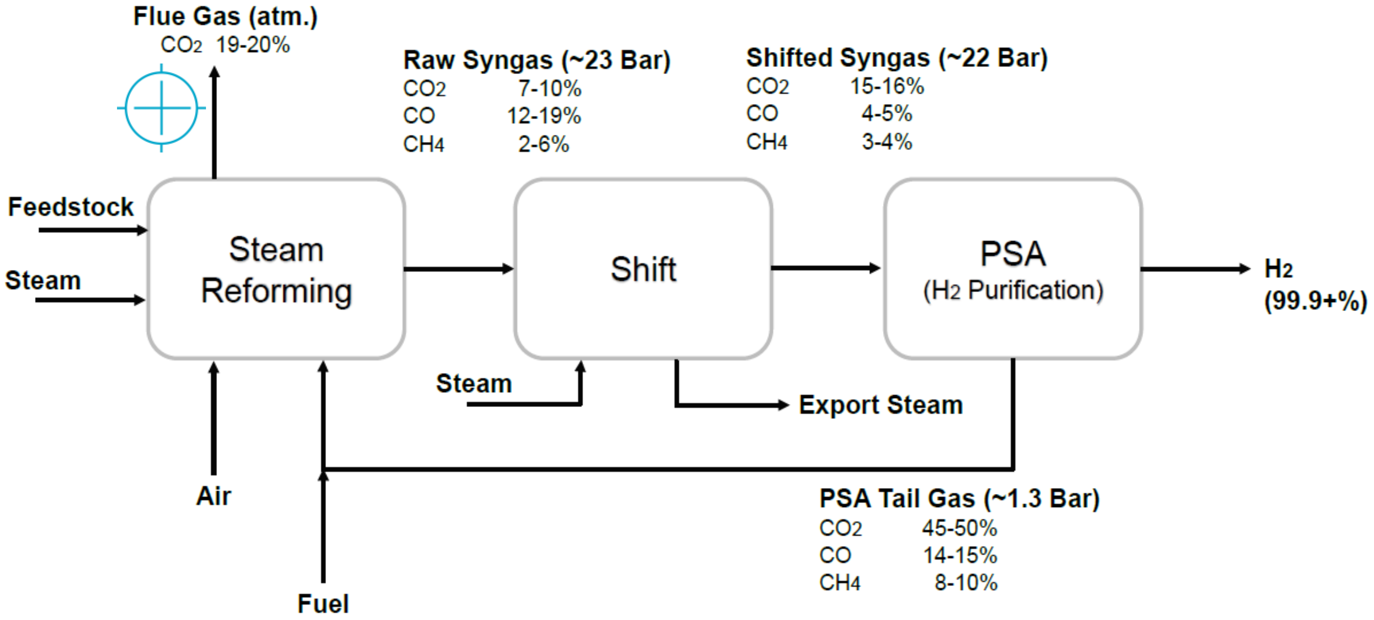
- Few impurities to manage
- No impact on SMR operation

Capture technology:

- Membrane-based
- Or cryogenics
- Or adsorption

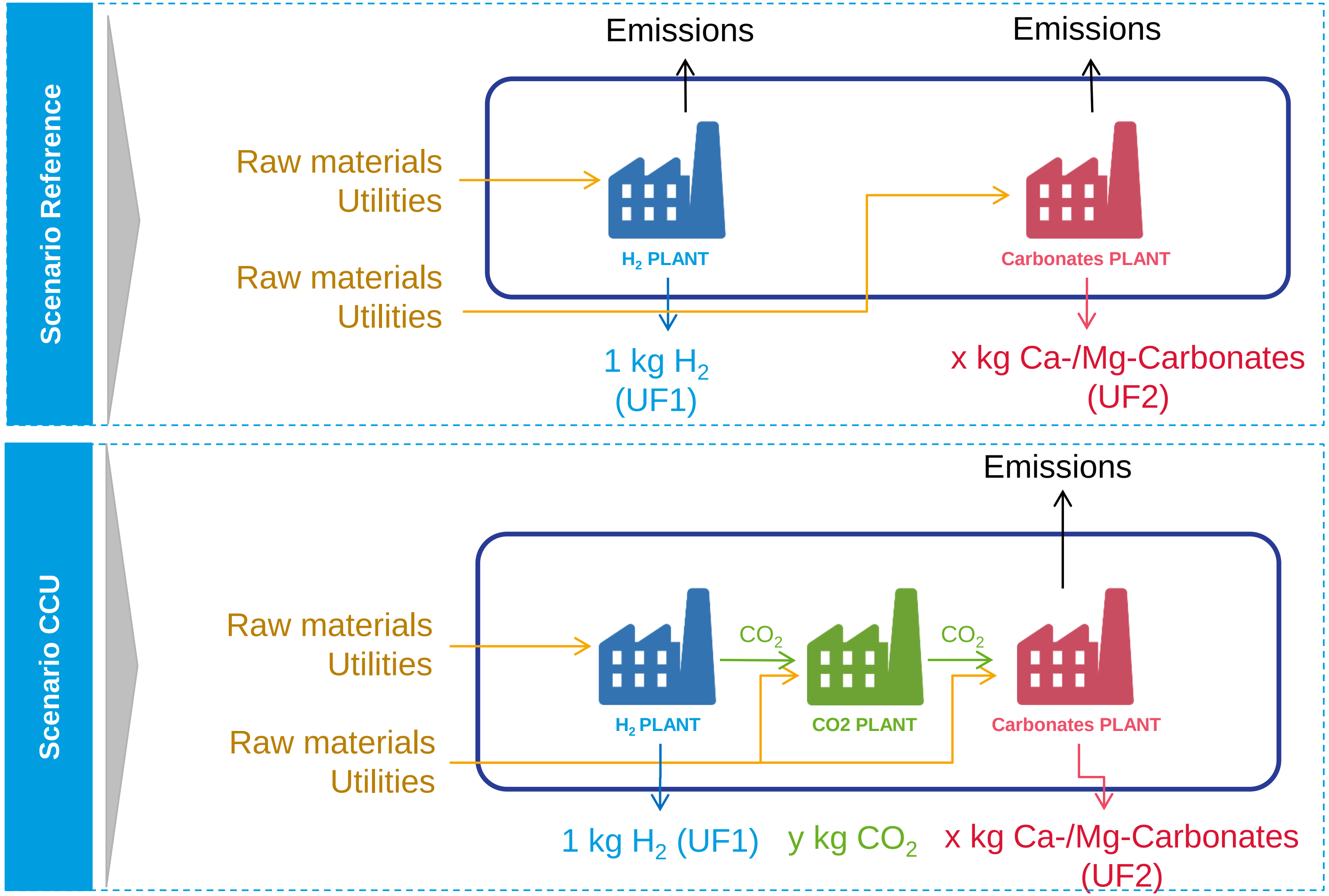
Engineering Feasibility study on-going

Open to Collaboration



Source: IEA-GHG

CO_2 CAPTURE AND UTILIZATION @ SOLVAY



CO_2 CAPTURE AND UTILIZATION @ SOLVAY

GHG emission allowances	• Attributional LCA • Impact assessment : CO_2 and other impacts (toxicity, water, photochemical oxidation, ozone depletion, land use, acidification,…) • Monetization of impacts to get an aggregated view of environmental assessment
Budget	Order of magnitude for capex < 20 M€ for the total investment Opex < 60 €/t CO_2 captured
Degree of innovation	Example: • About membrane technology : polymer with improved permeability and CO_2 selectivity • About adsorption : new adsorbent with high CO_2 capacity, optimized process
Project maturity	Planning: • Preliminary study on-going • Start-up of operations targeted for 2022
Technical and market potential	Solvay's SMR throughout the world Other SMR in the world (200+); other combustion units?
Critical points	• Methodology for evaluation of the GHG emission avoidance: how to share the reduction of CO_2 emissions between CO_2 capture and CO_2 utililzation? • Accuracy of budget proposal (Order of Magnitude, Preliminary) ? • Assessment of relevant costs : what if we use innovative technology + commercial technology (eg liquefaction step) ?

let's create
more future

SOLVAY
asking more from chemistry®

Evonik innovation projects for low carbon industry

CEFIC Workshop on ETS Innovation Fund

June 5, 2019 | H. Gebhardt, J. Lang

Evonik committed to Paris Agreement on Climate Change

SDG 13

One of the four most relevant SDGs for the Evonik Group

CO_2

-50%

absolute, Scope 1 & 2

2008 - 2025

2008 - 2018: -30% ✓

Internal Carbon Pricing

for important investments

75% of sales already covered by CO_2-regimes

Avoided emissions

108 million metric t CO_2eq[1]

avoided emissions by use of selected Evonik products[2] compared to conventional alternatives on the market

R&D for "green" energy

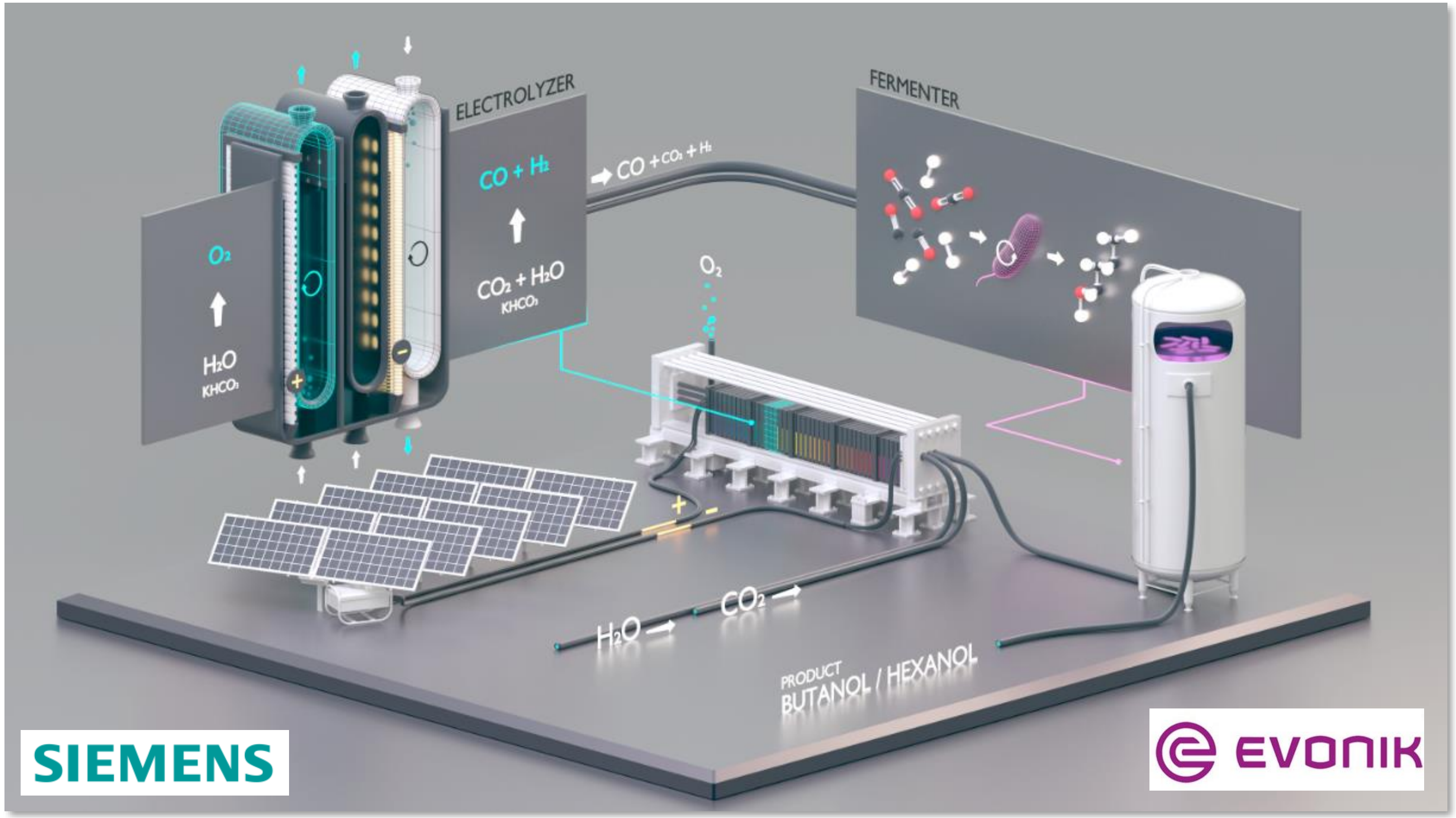
Joint R&D project by Siemens and Evonik on artificial photosynthesis

Generation of high-value specialty chemicals from carbon dioxide and eco-electricity

Test plant to go on stream by 2021 in Marl

FY 2018 | 1) Carbon dioxide equivalents 2) „green tire" technology, amino acids in animal feed, foam stabilizers for insulation materials, and oil additives in hydraulic oils

Artificial Photosynthesis



Status

Joint project of Siemens and Evonik funded by BMBF

Transfer into technical test plant ongoing

Benefit

Carbon Capture and Utilization (CCU)

Convert carbon dioxide (CO_2) into specialty chemicals (e.g. butanol, hexanol)

Electricity from renewable sources

Facts

Biotechnological production process

Target capacity for production plant: up to 20,000 tons per year

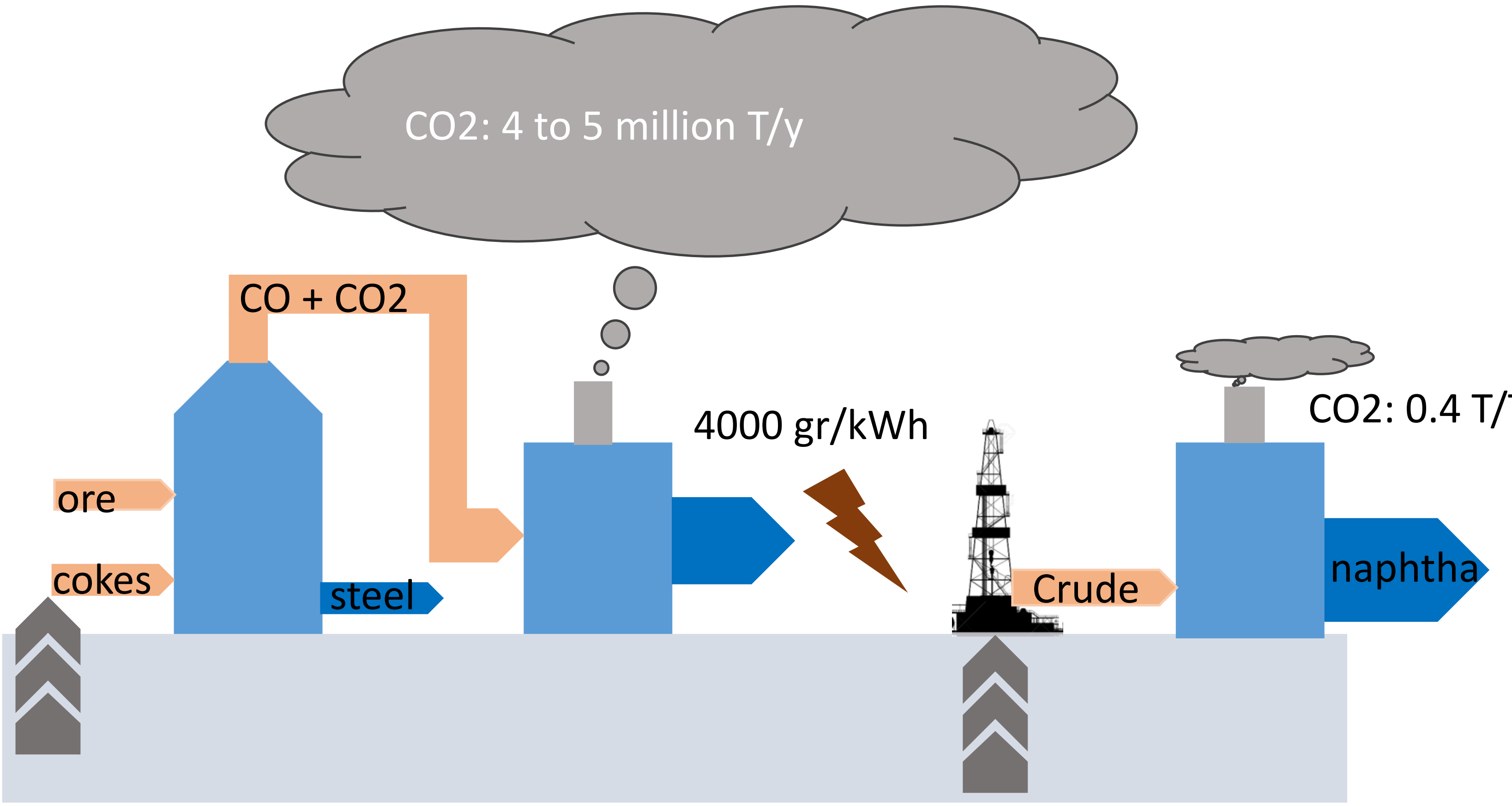
SPONSORED BY THE

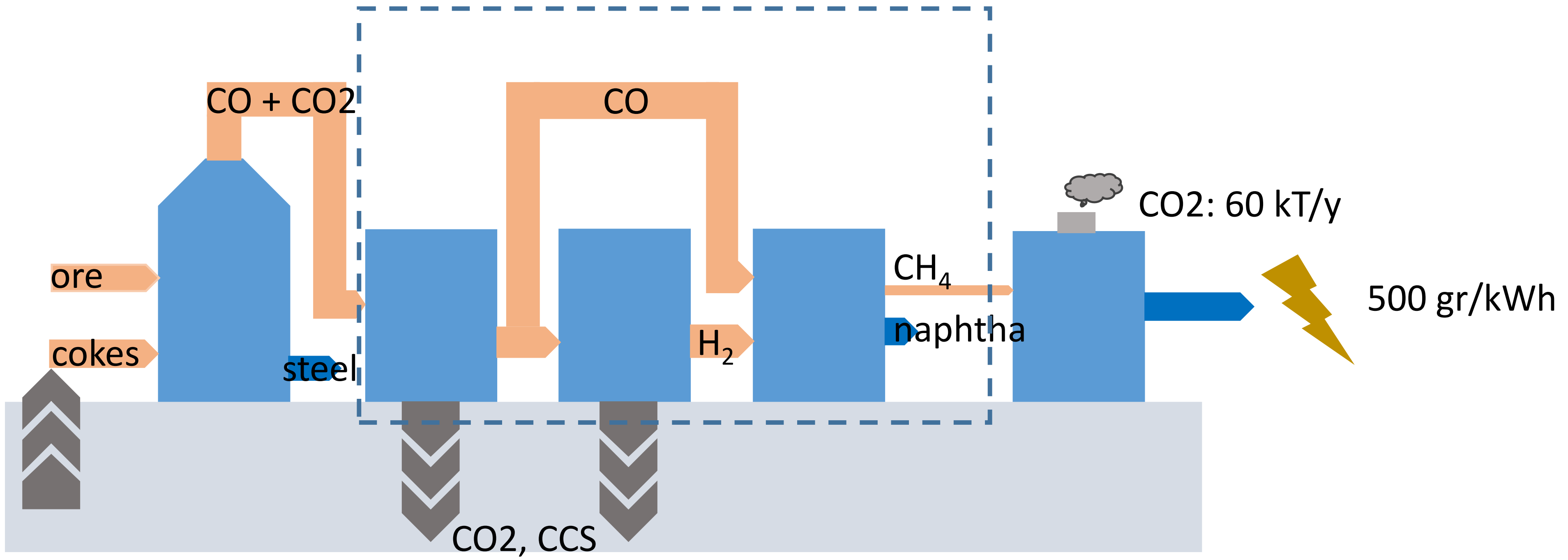
Federal Ministry of Education and Research

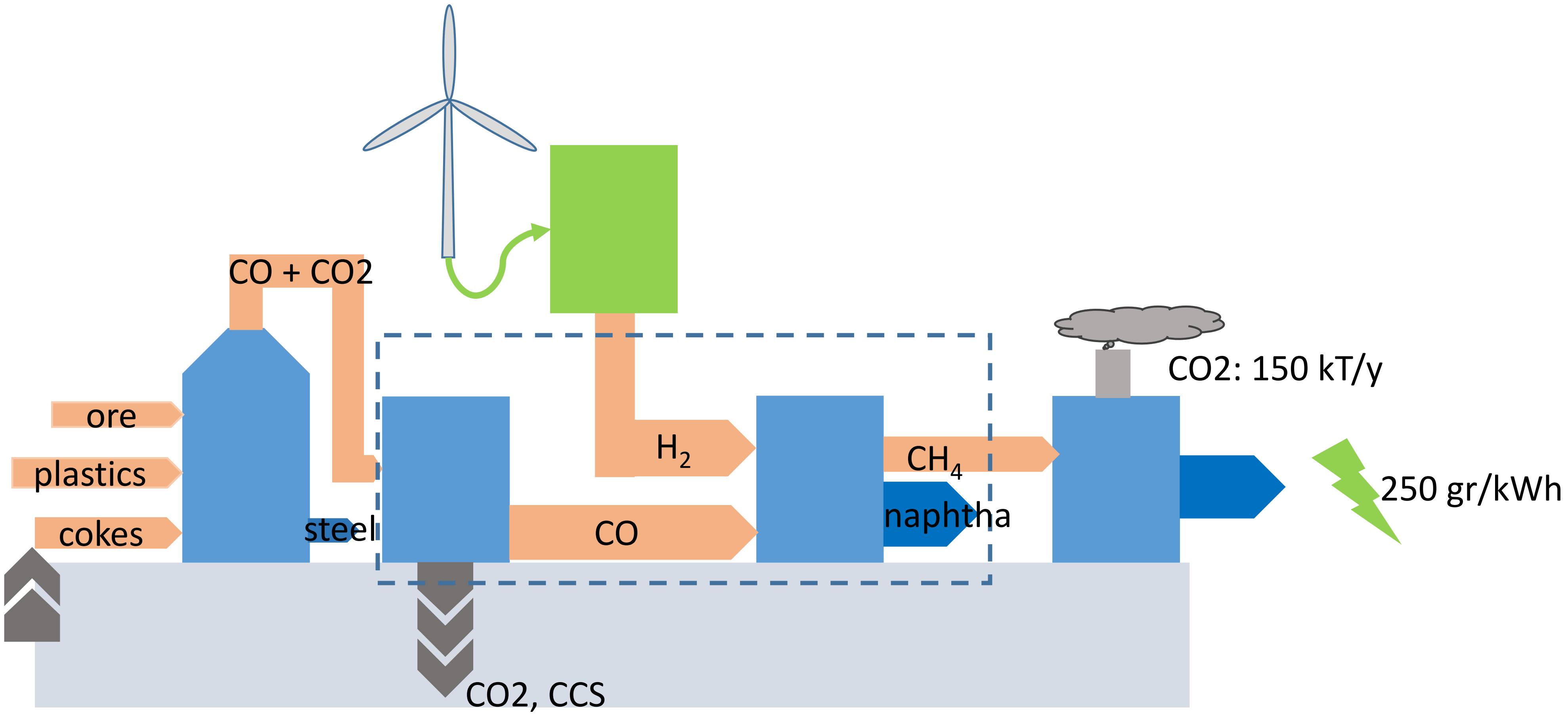
EVONIK POWER TO CREATE

EVONIK
POWER TO CREATE

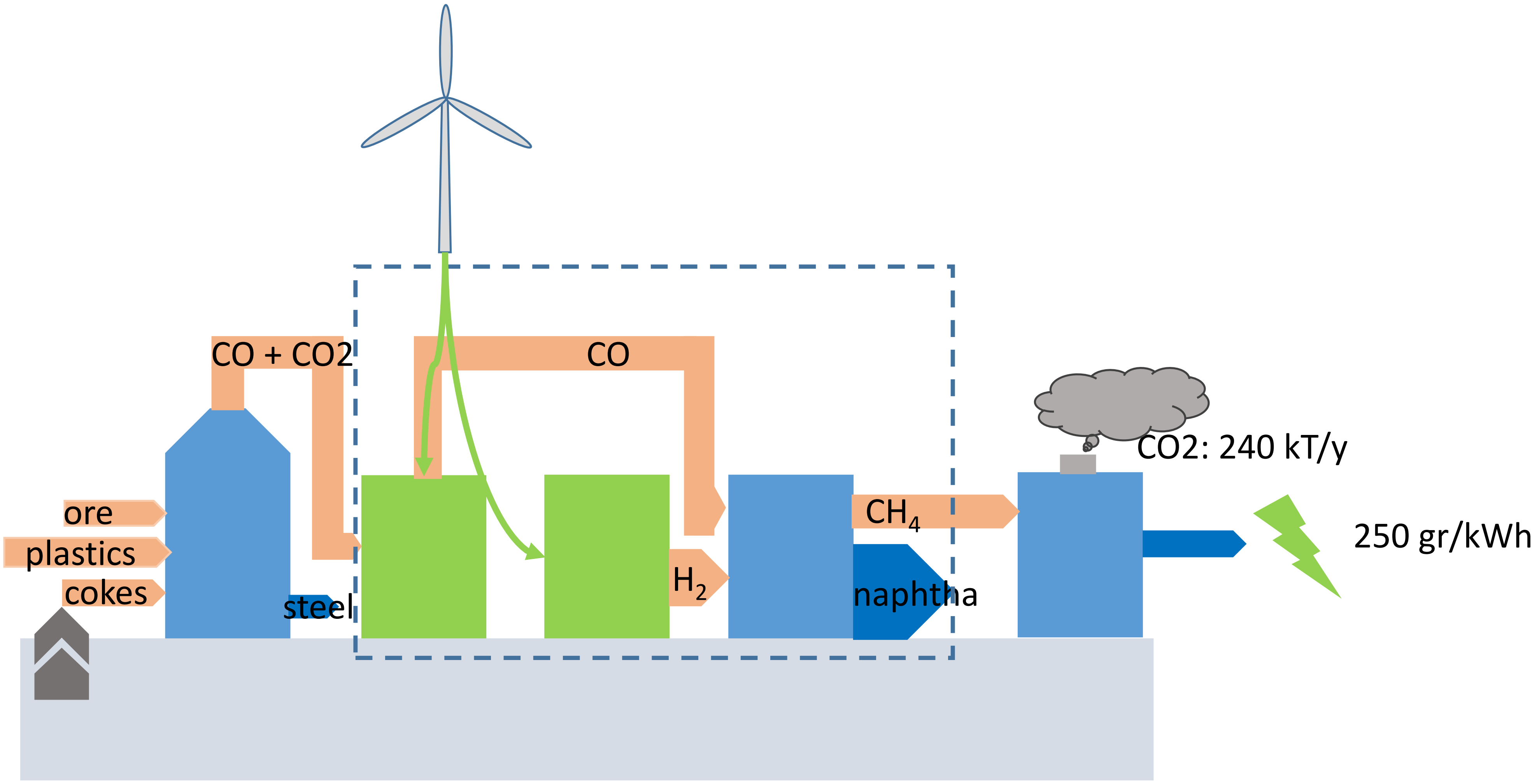
Steel2Chemicals


CO2: 4 to 5 million T/y
CO + CO2
4000 gr/kWh
CO2: 0.4 T/T
ore
cokes
steel
Crude
naphtha


CO + CO2
CO
CO2: 60 kT/y
ore
cokes
steel
CH_4
H_2
naphtha
500 gr/kWh
CO2, CCS

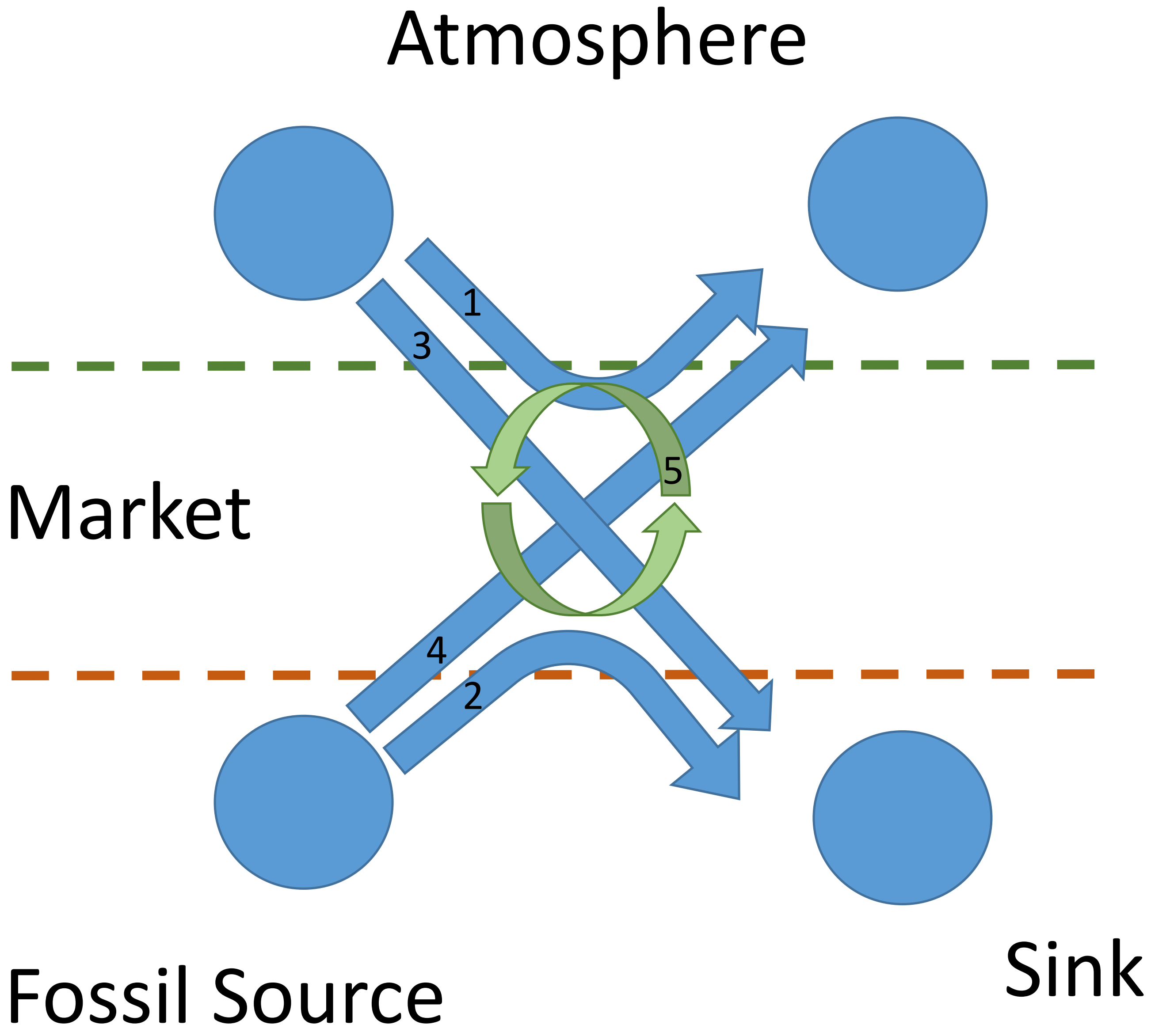


CO + CO2
ore
plastics
cokes
steel
H_2
CO
CH_4
naphtha
CO2: 150 kT/y
250 gr/kWh
CO2, CCS



CO + CO2
CO
CO2: 240 kT/y
ore
plastics
cokes
steel
H_2
CH_4
naphtha
250 gr/kWh

Carbon routing



	Source	CO2 effect
1	bio	Neutral
2	fossil	Neutral
3	bio	Sink
4	fossil	Source
5	bio/fossil	Neutral/Sink

Industrial Symbiosis Projects & the ETS Innovation Fund

- How does the definition of relevant costs (additional costs) apply to industrial symbiosis projects?
- What is the conventional production route a project involving more than one sector should be compared to?
- Would an integrated project consisting of CCS and CCU sub-projects require separate proposals?
- How should the GHG emissions avoidance be assessed for complex projects that involve multiple elements such as carbon capture, power generation, and carbon utilization?
- Should GHG emission avoidance of industrial symbiosis projects be compared to benchmarks and if so which benchmarks should be used?

Biobased products

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SUNLIQUID® TECHNOLOGY PLATFORM

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O. Wachsen
Group Process Technology
Group Technology & Innovation
05.06.2019

what is precious to you?

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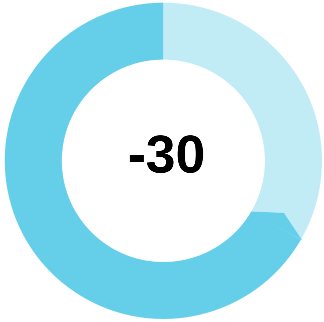
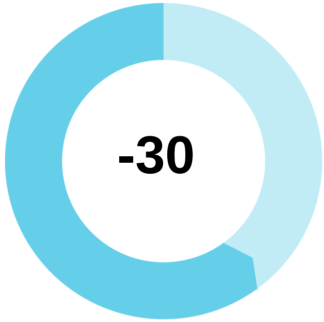
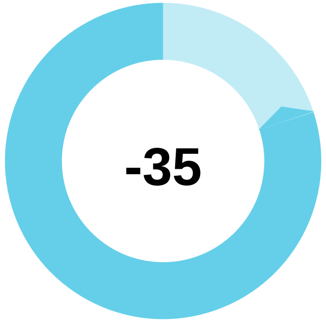


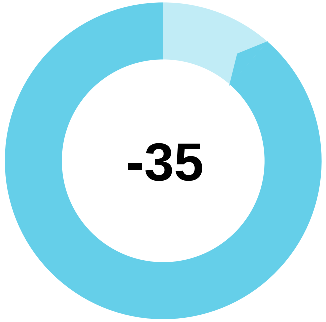
Reduction of Direct CO_2 Emissions



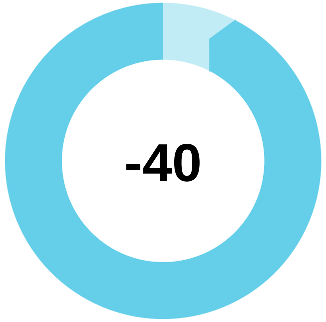
Reduction of Emissions from Greenhouse Gases



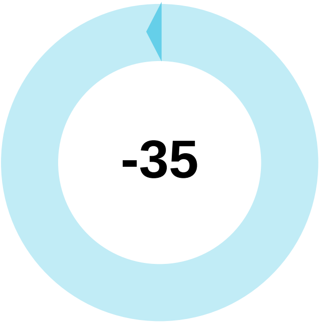
Reduction of Water Consumption



Reduction of Volume of Waste Water



Reduction of Volume of Waste[2]



[1] Per ton of products produced, [2] Waste performance mainly affected by non-hazardous waste increase e.g. from gypsum waste

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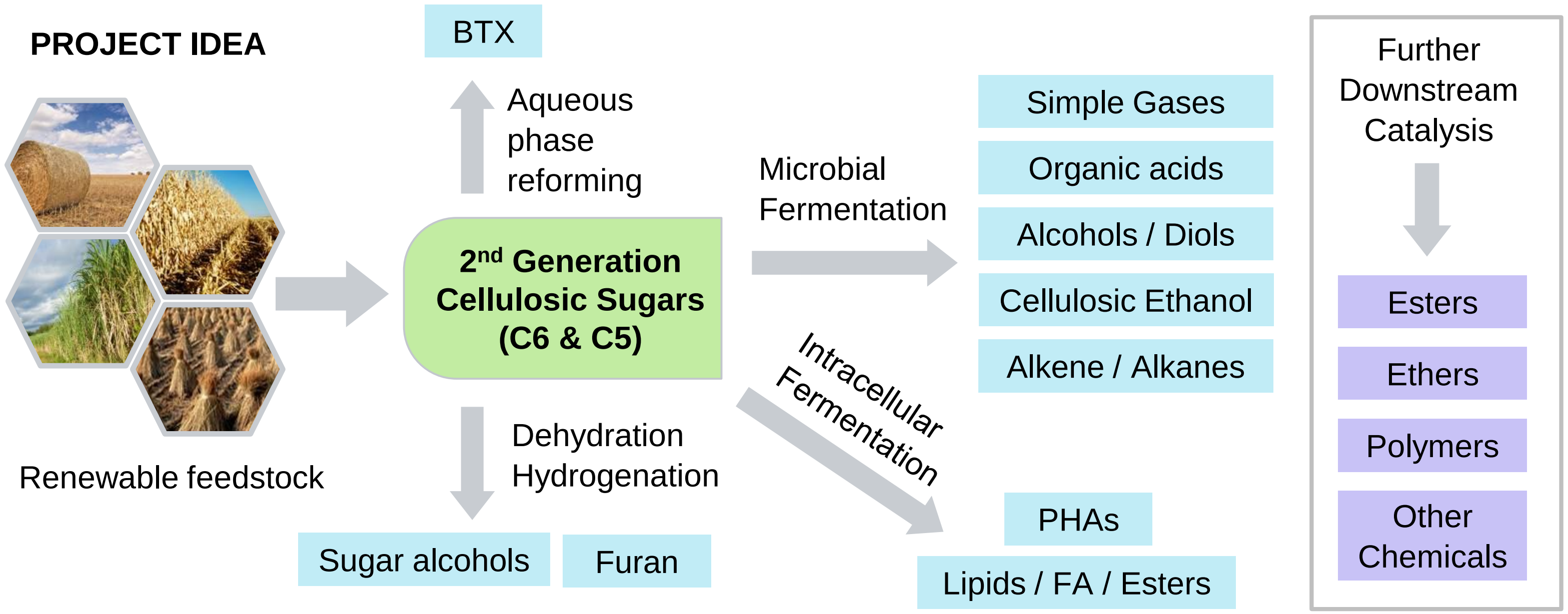
sunliquid® Technology Platform for Highly Sustainable Bio-based Products

PROJECT IDEA



TECHNOLOGY STATUS

- High reduction of GHG emissions due to the usage of renewable non-food biomass *(e.g. >95 % GHG savings for the process to cellulosic ethanol compared to fossil route)*
- Integration of new technologies based on cellulosic sugars into existing production processes enables higher GHG savings *(e.g. integration of 2G ethanol into existing 1G ethanol technology, currently at TRL 7)*
- Potential for additional GHG emission savings due to capturing of CO_2
- Downstream processes via 2G cellulosic sugars in demonstration scale (TRL 6–7)
- Various downstream pathways and sustainable products possible (also new ones with lower TRL)
- Huge development opportunities for a vast variety of different bio-based products

ADVANTAGES

Usage of currently **underutilized renewable feedstock**

High reduction of GHG emissions compared to fossil routes

Creation of green jobs in rural areas and agricultural sector

Boost of local economies and creation of business opportunities

DEVELOPMENT NEEDS

- Downstream processes needs support through the ETS fund to increase TRL level
- Reasonable translation of the ETS regulation into Calls needed to be attractive for industries to apply

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Generation of high-value specialty chemicals from carbon dioxide and eco-electricity

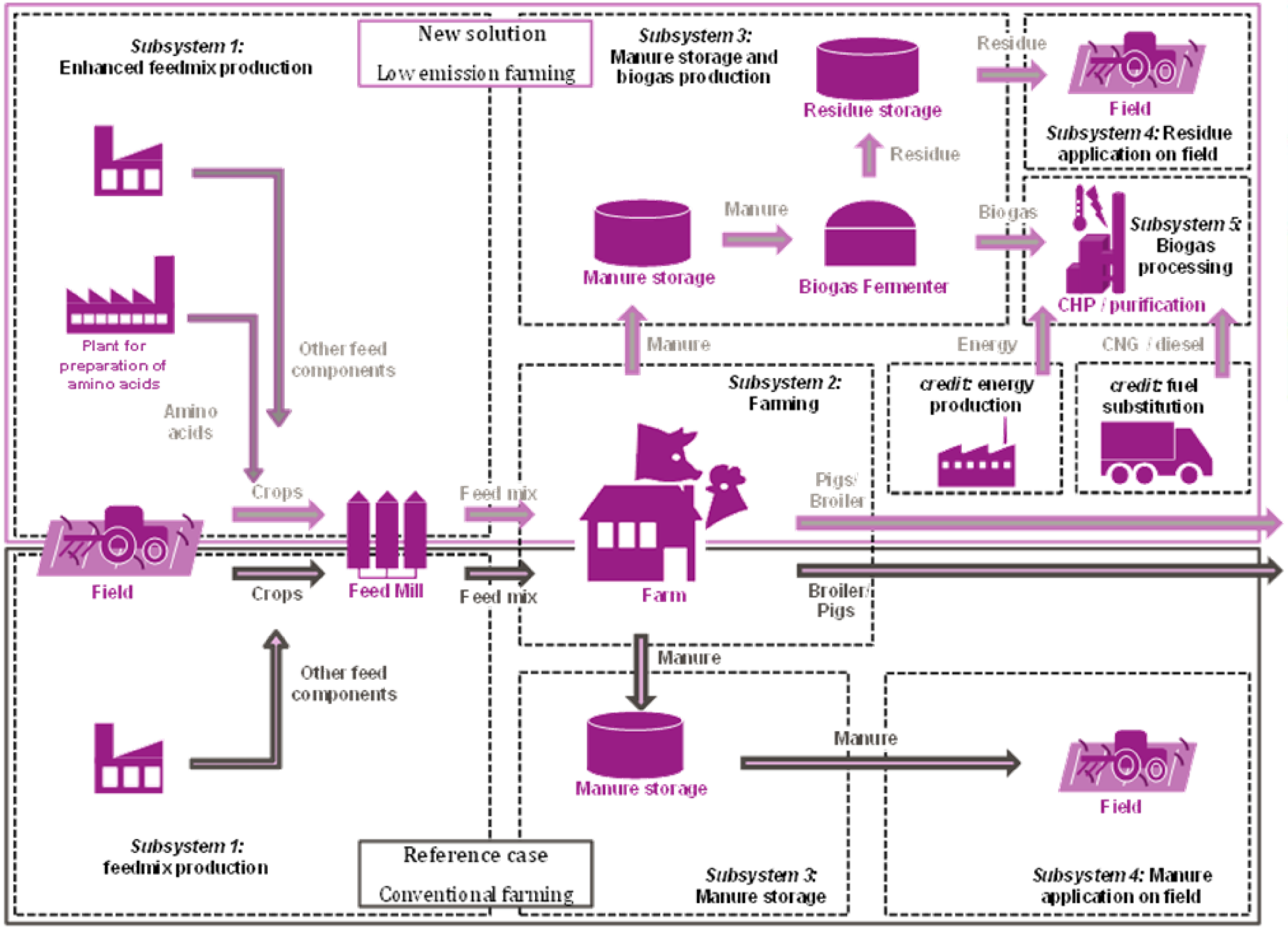
Test plant to go on stream by 2021 in Marl

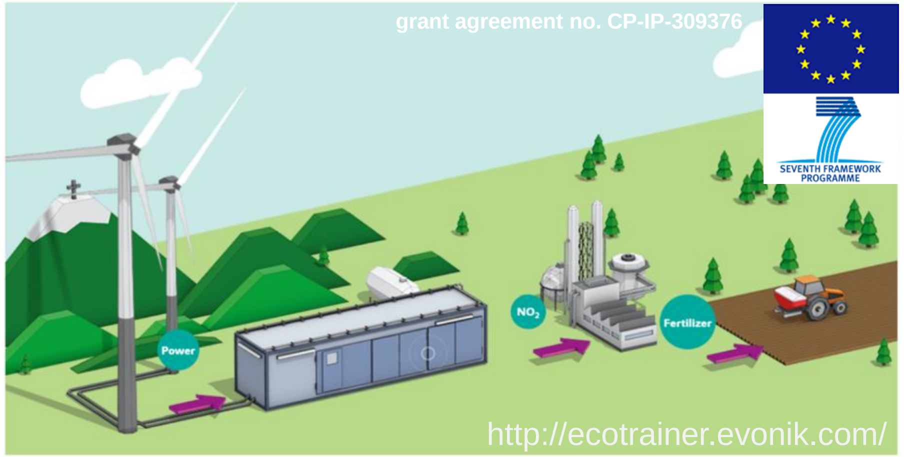
FY 2018 | 1) Carbon dioxide equivalents 2) „green tire” technology, amino acids in animal feed, foam stabilizers for insulation materials, and oil additives in hydraulic oils

EVONIK POWER TO CREATE

Evonik Low Emission Farming (LEF)

One Field of GHG reduction by Chemistry





Optimized Nitrogen Management

Status

Demonstration of economical fertilizer production

Chemicals from N_2 source by innovative process

Benefit

Fertilizer with negative CO_2 footprint

prevent NH_3-Emission from soil

Facts

Green power reduces GHG footprint

New plant with 400 t/a capacity

Fertilizer type for small soil areas

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