

Digital Briefing: Green Metals & Manufacturing

FRIDAY, 16 APRIL 2021 09:00 (CEST)

Decarbonization and Sector Coupling



HY-5 

The HY-5 logo graphic consists of three vertical bars in blue, green, and yellow.

Agenda

Opening Speech:

Thorsten Herdan (Federal Ministry of Economic Affairs and Energy)

Inspirational Speaker:

Annika Fischer (WT.SH Schleswig-Holstein | Hydrogen Expert)

Power Briefs:

Reiner Blaschek (ArcelorMittal | CEO)

Roland Harings (Aurubis | CEO)

Arne Stecher (Holcim | Head of Decarbonization)

Alexander Redenius (Salzgitter Mannesmann Forschung | Head of Department Efficiency of Ressources)

Robert Schwabe (Weber Maschinenbau | Supply Chain Manager)

Q+A w/ GTAI & HY-5 Investment experts



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What's next: **Inspirational Speaker**

Annika Fischer

WTSH Schleswig-Holstein | Hydrogen Expert



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HY-5



GREEN HYDROGEN
INITIATIVE OF
NORTHERN
GERMANY

A European perspective



Global Problems need global solutions

“To deal with global problems,
you need global solutions,
and no one – company, industry or government –
will reach the Paris Agreement vision
acting on it’s own“

Source: Hydrogen Council

6 Gt
Annual CO₂ abatement

18 %
of final energy
demand

30 mio
jobs created

\$2.5 tr
Annual sales
(hydrogen and equipment)

Source: Hydrogen Council; IEA ETP Hydrogen and Fuel Cells CBS; National Energy Outlook 2016

Hydrogen technologies maintain a strong momentum in 2020

Low-carbon production capacity remained relatively constant

The hydrogen produced from fossil fuel is responsible for CO₂ emissions of around **830 million tonnes of CO₂ per year**

Worldwide there are by now a number of regions that are interested in establishing a hydrogen economy.

Around 50 targets, mandates and political incentives in place to directly support hydrogen.

Over the past few years, global spending on hydrogen energy research, development and demonstration by national governments has risen.

An aerial photograph of Europe with a cyan color overlay. A white circular graphic element is partially visible on the left side of the image.

Hydrogen economy from an international perspective

Global hydrogen activities



May 2019

A new Hydrogen initiative was launched in Vancouver (10th Clean Energy Ministerial) to spotlight the role hydrogen and fuel cells can play in the global energy transition.

Japan, the European Commission and the United States signed a partnership for future co operation on hydrogen and fuel cell technologies

June 2019

Hydrogen was focal point of the **G20 discussion** in Osaka (Japan)

The Netherlands published a Climate Agreement containing a package of measures having broad societal support, including targets for hydrogen production and mobility.

Nov 2019

The five northern states Bremen, Hamburg, Mecklenburg-Vorpommern, Niedersachsen, and Schleswig-Holstein adopted a North German hydrogen strategy.

Jan 2020

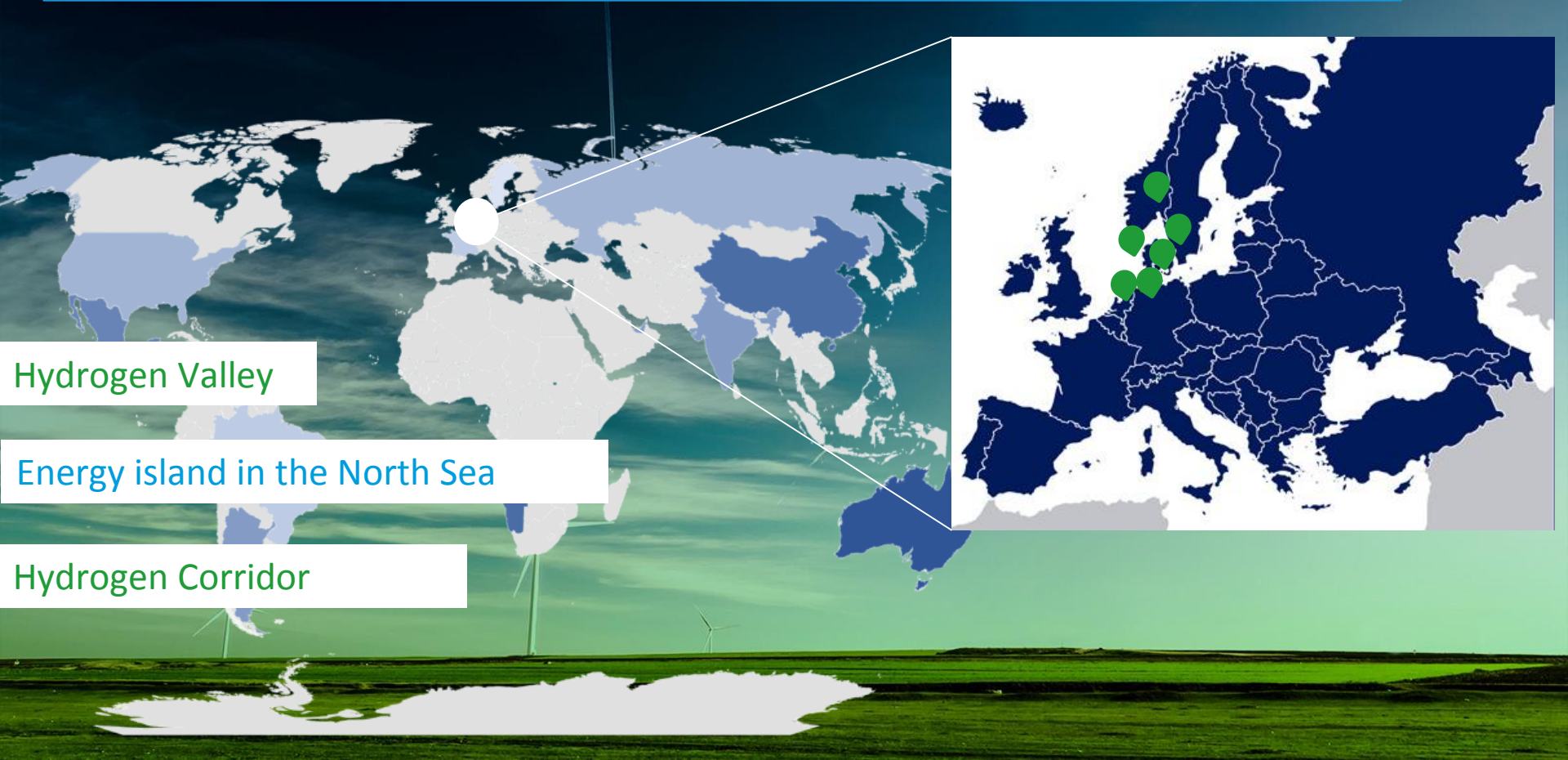
Broad majority of the Danish Parliament has adopted a climate agreement on green transformation of industry and the energy sector.

Australia's government published Australia's National Hydrogen Strategy defining 57 actions in areas such as regulation, infrastructure, mobility and R&D with the aim of positioning Australia as a world leader in hydrogen production and exports.

Nov 2020

The Green hydrogen alliance **HY-5 was launched**, representing 5 regions: Bremen, Hamburg, Mecklenburg-Vorpommern, Niedersachsen, Schleswig-Holstein

European Examples on high ambitions



Hydrogen Valley

Energy island in the North Sea

Hydrogen Corridor

The power of the North

Reliable offshore wind power

A hydrogen pipeline and well-developed natural gas grid infrastructure

Underground storage formation

Seaports as logistics and business hubs

+40 years of industry experience

Political willingness to support these technologies

Numerous of research facilities addressing hydrogen from different angles

Motivating each other

There is a lot of competency out there – Let's bring it together

Working together will motivate additional stakeholder to follow suit

Developing, using and sharing the the best examples

International cooperation is of vital importance for the establishment of a hydrogen economy

Industrial participation, media attention, governmental support and the will-of-the-people have never been higher.

Global problems need global solutions

In Northern Germany.

For the world.

Thank you for your
attention

HY-5

- Blue
- Green
- Black
- Red
- Yellow

Power Briefs: Industrial Demand of the Future

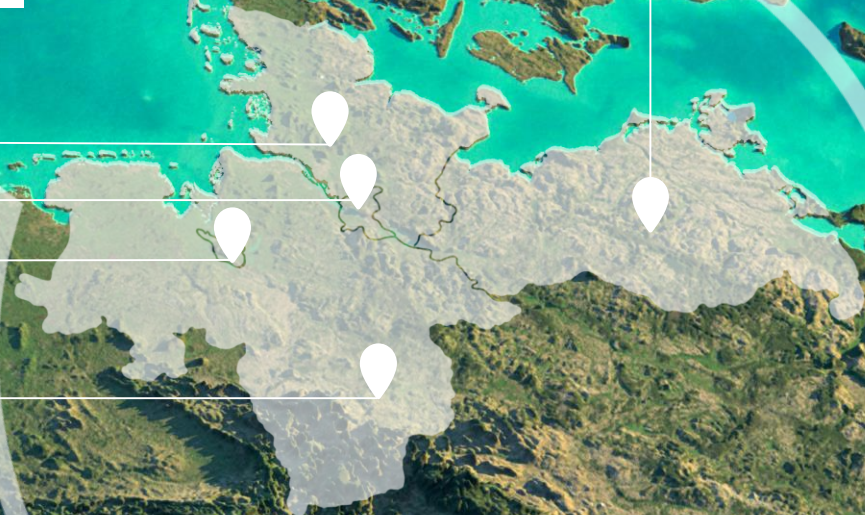
Weber Maschinenbau

LafargeHolcim

ArcelorMittal

Aurubis AG

Salzgitter AG



What's next: **Power Briefing**

Reiner Blaschek

ArcelorMittal Bremen | CEO



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ArcelorMittal

The Journey to Green Steel

HY-5 Webinar – Decarbonization and Sector Coupling

Reiner Blaschek
CEO ArcelorMittal Flachstahl Deutschland
2021, April 16th

ArcelorMittal in Germany



Bremen



Duisburg



Eisenhüttenstadt



Hamburg

- 4 production sites
- Flat products: Bremen and Eisenhüttenstadt
- Long products: Hamburg and Duisburg
- 13 Distribution and Steel Service Centre

* LTIFR = Lost Time Injury Frequency Rate)

	2020
Health and Safety (LTIFR*)	1,2
Crude steel production	6,5 Mt
Turnover	€ 5,2 Bn
Employees	8.500
Trainees	>500

Target: A climate neutral Steel production

Green Steel – a vision of an Industry that is responsible for 7 to 9% of CO₂ Emissions.

ArcelorMittal will take the task and is testing new technologies.

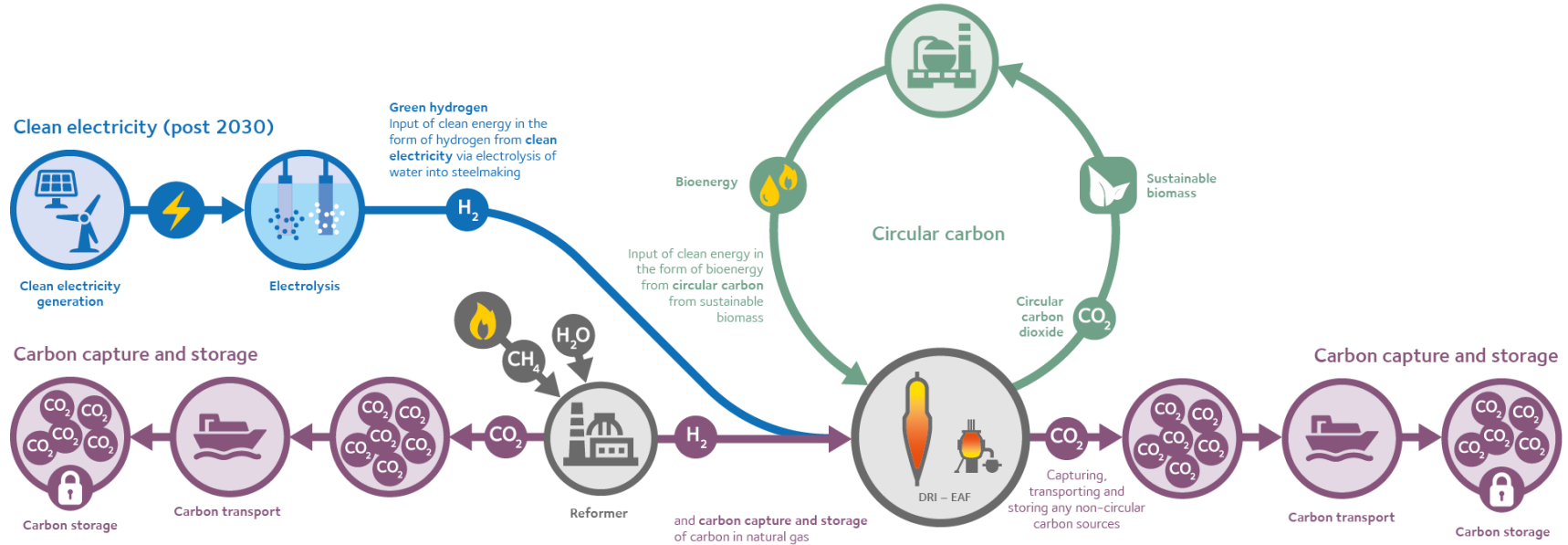
Targets for ArcelorMittal to achieve:

- 30% lower CO₂-Emissions until 2030
- Climate neutral Production until 2050



Is that technically possible? Is that economically feasible?
Can this be implemented in terms of time?

Route 2: Making carbon-neutral steel - the DRI-based route



- Substitution of HM by DRI, melting in the EAF.
- Reduction of ores with **green** or blue **Hydrogen** (in a 1st step with NG)
- Storage of the produced CO_2 (CCS, but a problem in Germany)
- Use of biomass for carburization (technically and metallurgical necessary)

Steel4Future – our Strategy in Germany

- In Germany, ArcelorMittal is pushing it's initiative **Steel4Future** in it's **4** production sites Bremen, Eisenhüttenstadt, Hamburg and Duisburg for innovative projects to produce steel in the future climate neutral.

4 Plants

1 Target

Climate neutral
Steel production

- Optimization of the current process route
- Investments in DRI and EAF equipment
- Creation of a Hydrogen infrastructure is necessary
- Use of Natural Gas in the meantime

Example of Bremen and Eisenhüttenstadt: Modification with NG and H₂ later on

- **First step in 2021:** Modification of the BF's in Bremen and Eisenhüttenstadt for **NG injection**, to switch later on to **Hydrogen**.
- **Until 2026** erection of DRI plants and EAF's to substitute 1 Blastfurnace in each site.
- Use of Natural gas in the transition period
- Use of **Hydrogen** when volumes available and economically reasonable
- **Cooperation** with Technology Partner
- Setup and expansion of a national **Hydrogen infrastructure**



Sector coupling

Energy Sector

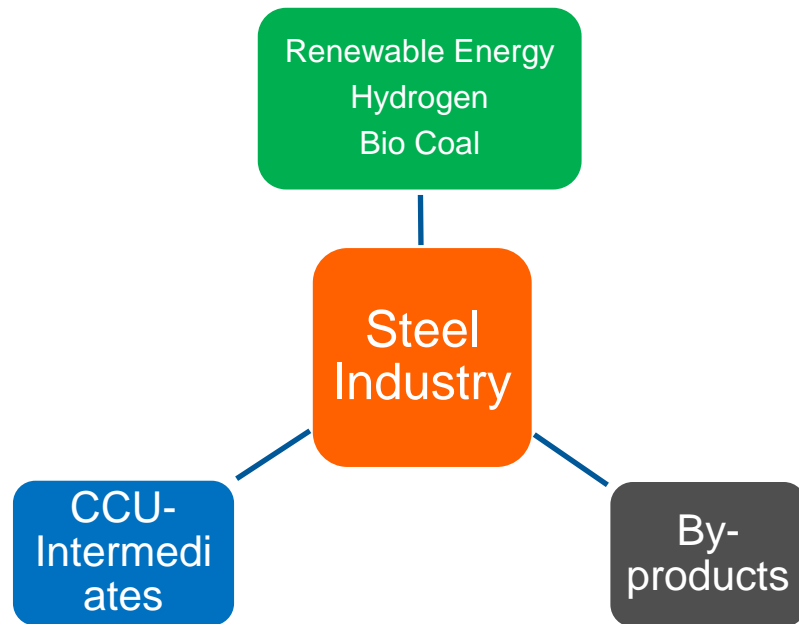
- Enormous amounts of green energy needed
- Around >60 kg of H₂ needed for 1 tonne of direct reduced iron
- ArcelorMittal Europe is producing around 40 Mt/a

Chemical Sector

- Captured CO and CO₂ could be transformed into chemical intermediates (Ethanol, Methanol, etc.)

Construction Sector

- CO₂ neutral slag could help to decarbonise the cement industry



Green Steel will enable **all our customers** to reduce their scope three CO₂-footprint!

Conclusion – The Journey to green steel...

A realistic approach ?

- Technically feasible
- Timeline is possible
- Requires funding during transition

Necessary pre-conditions !

- Level playing field (fair trade)
- CAPEX- and OPEX- funding
- Renewable Energy and Hydrogen

Above all, however, there needs to be social acceptance that sustainability has a higher market value



What's next: **Power Briefing**

Roland Harings

Aurubis | CEO



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Energy intensive and highly efficient – Climate protection at Aurubis

April 2021

>150

years

experience in the
production of non-ferrous
metals



One of the
**worldwide
leading
companies** in
copper recycling

Around
7.400
employees
worldwide



Important
**supplier for
gold, silver,
platinum and 16
other metals** and
compounds



over **1 Mio. t**
Copper products

Aurubis

Metals for Progress

Aurubis is a global leader in decarbonization – with nearly half the global average CO₂ footprint

Life Cycle Assessment of the copper cathode



Global average:
4,027 kg CO₂
per t of copper

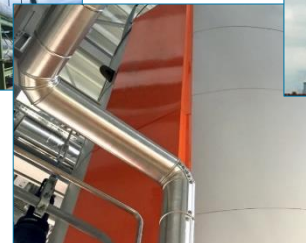


300 kg of further CO₂ savings potential per t of copper remains

Aurubis:
2,300 kg CO₂
per t of copper

Decarbonization enabled through innovation at Aurubis:

- » District heating part 1 in Hamburg (20,000 t CO₂)
- » Power2Steam in Hamburg (up to 4,000 t CO₂)
- » Wind turbine in Olen (~5,800 t CO₂) / back-pressure turbine in Pirdop (~5,600 t CO₂)



Strategic perspective: “Most efficient and sustainable smelter network worldwide”



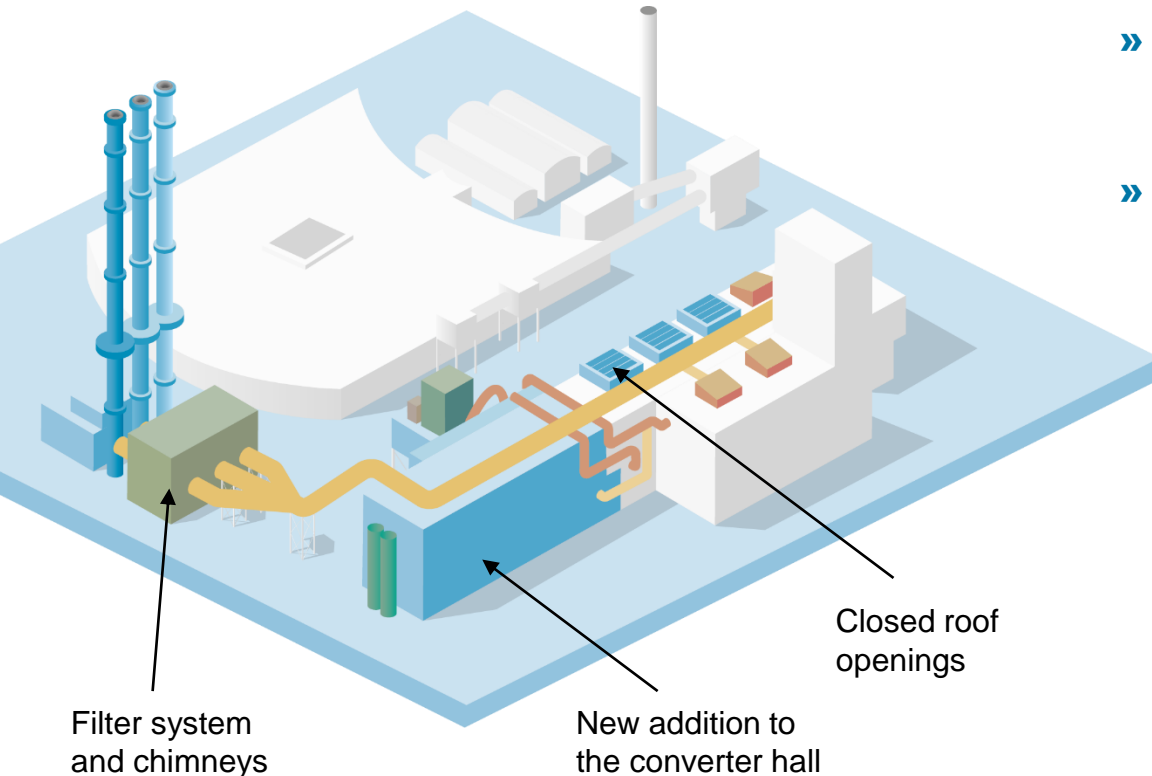
Aurubis aims to be the **most efficient and sustainable** integrated smelter network worldwide

Our levers:

- » Efficiency projects
- » Greater flexibility when purchasing electricity
- » Process optimization

Our goals 2022/23:
to reduce CO₂ through projects by more than 100.000 t CO₂

Diffuse emissions suctioning system



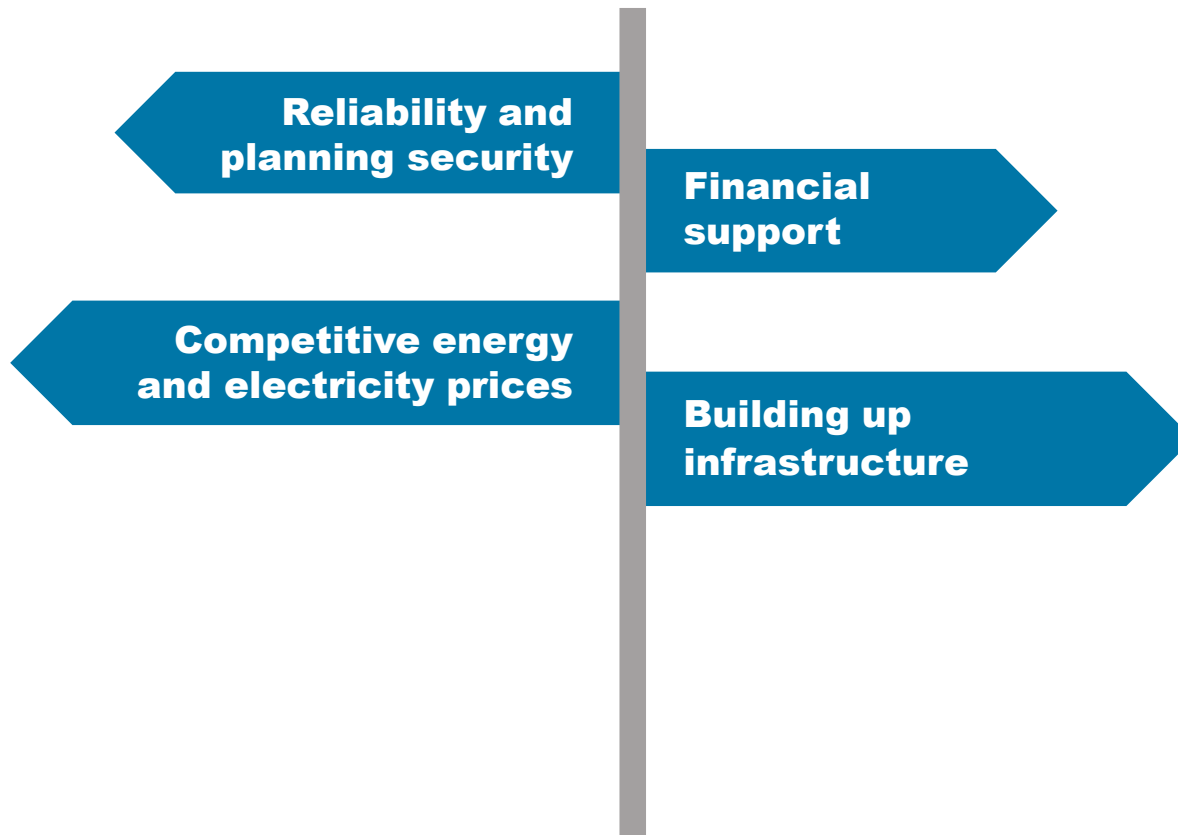
- » Major investment in Hamburg of about € 100 million in suctioning devices and filter facilities
- » Expected reduction of more than 70 % in diffuse emissions



Example for further CO₂ reductions: Substitution of natural gas – use of hydrogen in anode furnace



- » Use of hydrogen as a reducing agent in the anode furnace
- » Trial on an industrial scale is planned to take place in June 2021
- » Goal of exploring the increased efficiency of hydrogen in the reduction process
- » CO₂ reduction potential estimated at 6,000 t p.a. for anode furnace in Hamburg



What's next: **Power Briefing**

Arne Stecher

Holcim | Head of Decarbonization



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Decarbonization and Sector Coupling

HY5 Webinar; Arne Stecher, Head of Decarbonization, 16th April 2021



From today's
„cost factor“
towards a new
by-product

Holcim: Solutions for modern society

The demand for building materials and solutions from Holcim is being fueled by urbanization, rising standards of living, and sustainable and digital construction practices.

We support our customers and society every day in the quest to overcome major challenges.



Creating places to live and work
e.g. housing, schools, office buildings



Building infrastructure
e.g. bridges and locks, coastal defenses



Facilitating mobility
e.g. building highways, railroads, waterways, airports



Safeguarding energy supplies
e.g. constructing wind turbines, power stations, storage facilities



Delivering innovation
e.g. building research institutions, developing own products

LafargeHolcim Decarbonization Roadmap



Driving green construction with *net zero* pledge



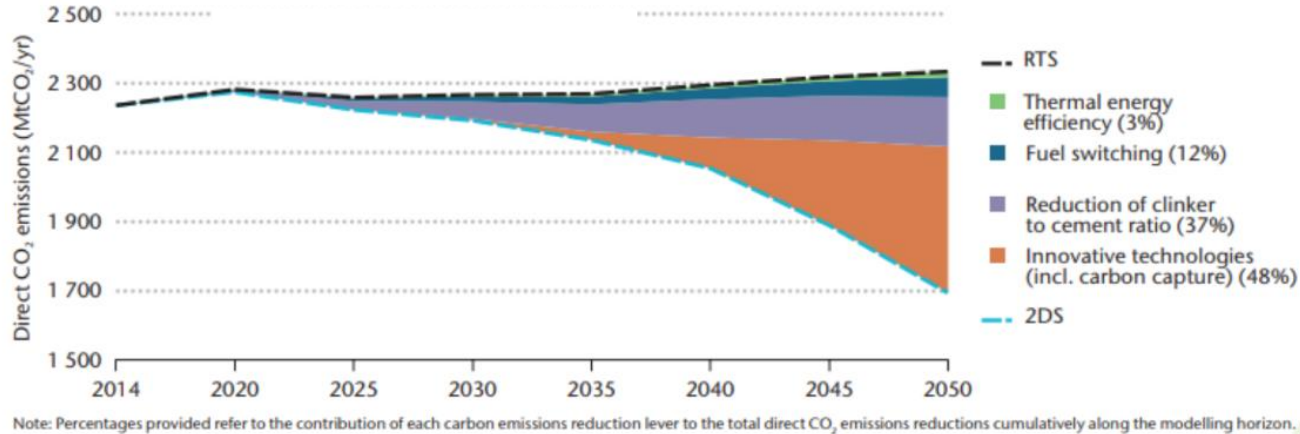
Example: cement plant „Lägerdorf“ , Northern Germany



CO₂ emission per year: 1.3 million ton



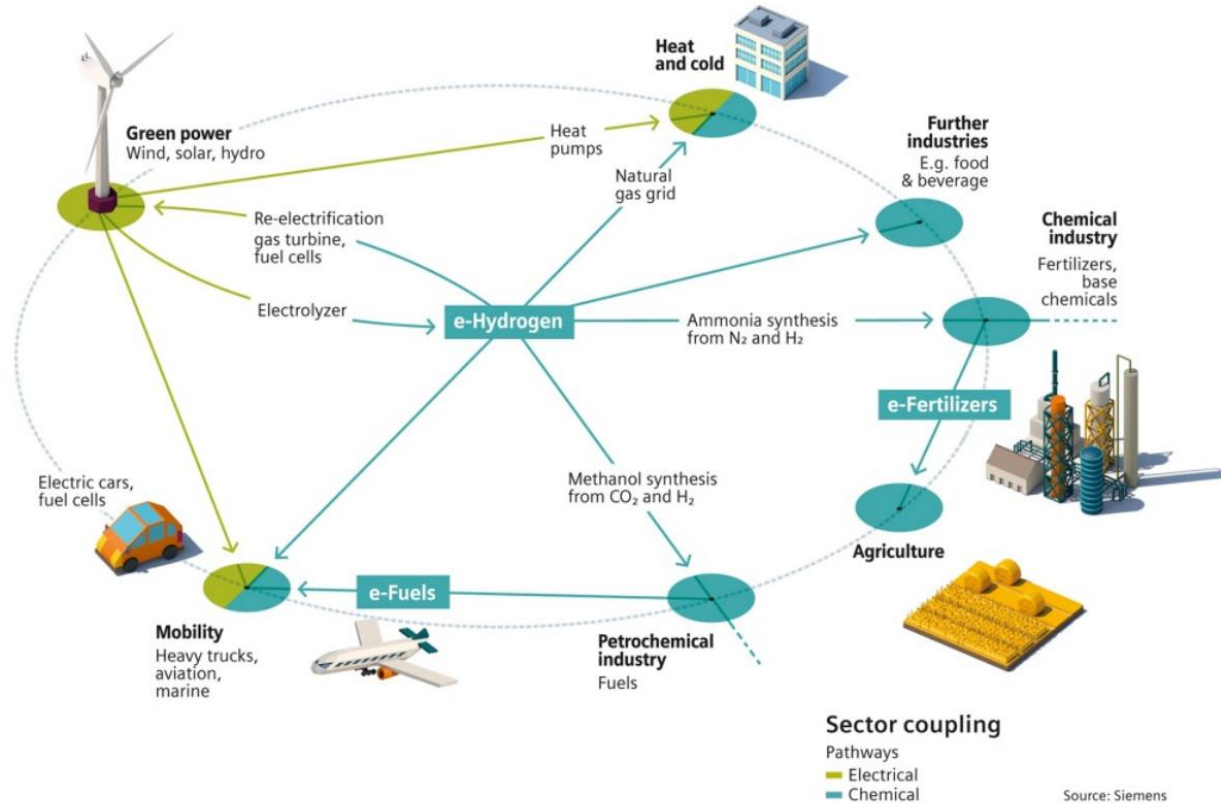
Carbon Capture is a must !



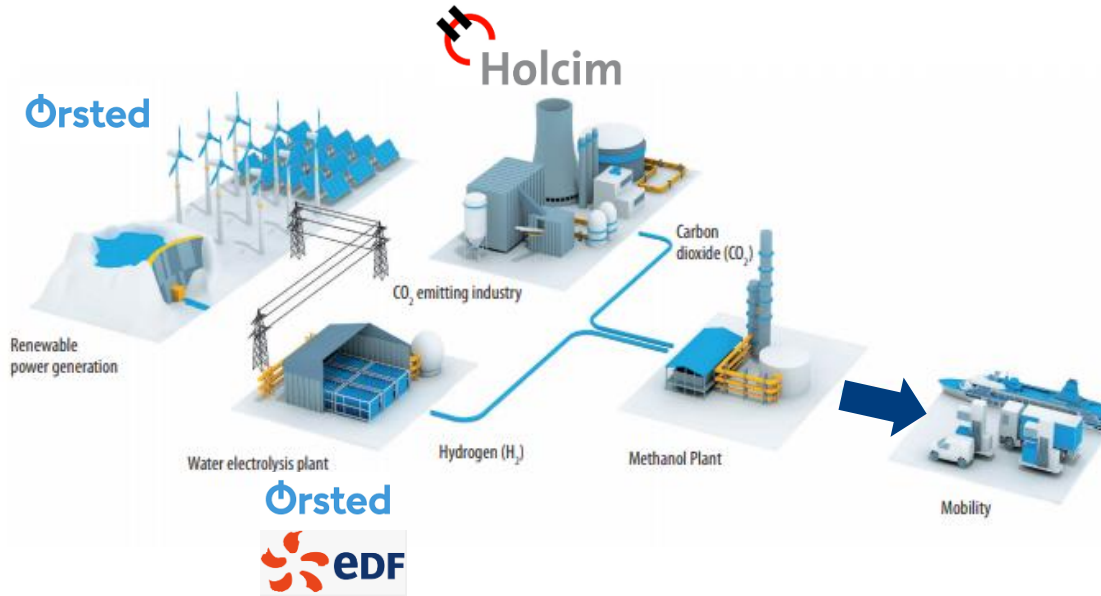
Graph 1 – IEA & CSI Technology Roadmap, Low-Carbon Transition in the Cement Industry (RTS: Reference Technology Scenario), April 2018

... but what can we do with million tons of CO₂ ?

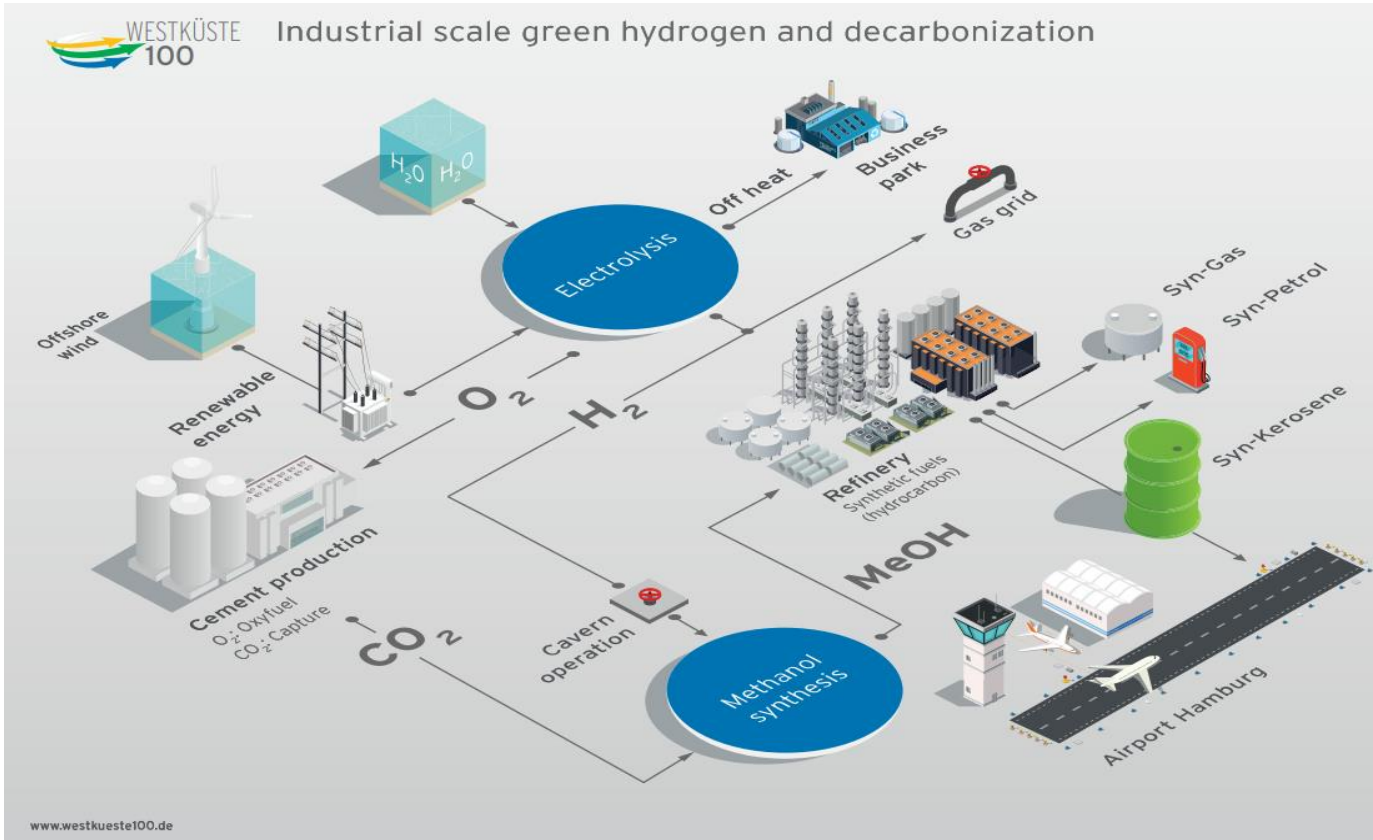
Sector coupling is the key for the needed transformation



New supply chain: simplified set-up



CO₂ transforms to raw material
Green Methanol is the crude oil of the future





 A member of
LafargeHolcim

What's next: **Power Briefing**

Alexander Redenius

Salzgitter Mannesmann Forschung

Head of Department Efficiency and Resources



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SALCOS
Steelmaking. Reinvented.

Salzgitter (Lower Saxony), 16.04.2021

Dr.-Ing. Alexander Redenius

Salzgitter Group: Key data FY 2019



Salzgitter AG Group

External Sales cons.: € 8.5 billion
EBT: € -253 million

Employees: 23,354

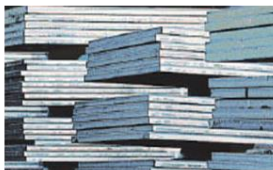
Strip Steel

- **External Sales:**
€ 2.2 billion
- **EBT:**
€ -42.8 million
- **Employees:**
6,090



Plate / Section Steel

- **External Sales:**
€ 0.8 billion
- **EBT:**
€ -124.0 million
- **Employees:**
2,352



Mannesmann

- **External Sales:**
€ 1.1 billion
- **EBT:**
€ -41.5 million
- **Employees:**
4,643



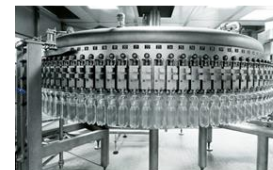
Trading

- **External Sales:**
€ 2.8 billion
- **EBT:**
€ 31.0 million
- **Employees:**
2,066



Technology

- **External Sales:**
€ 1.4 billion
- **EBT:**
€ 32.7 million
- **Employees:**
5,557



Our Basic Concept: Direct Avoidance of CO₂ Formation in Metallurgical Processes

Replacement of Carbon by (electrolytically produced) Hydrogen as Reducing Agent in Iron Ore Reduction

→ indirect use of electrical power



Electric Arc Furnace (EAF) for Primary Steel Production

→ direct use of electrical power

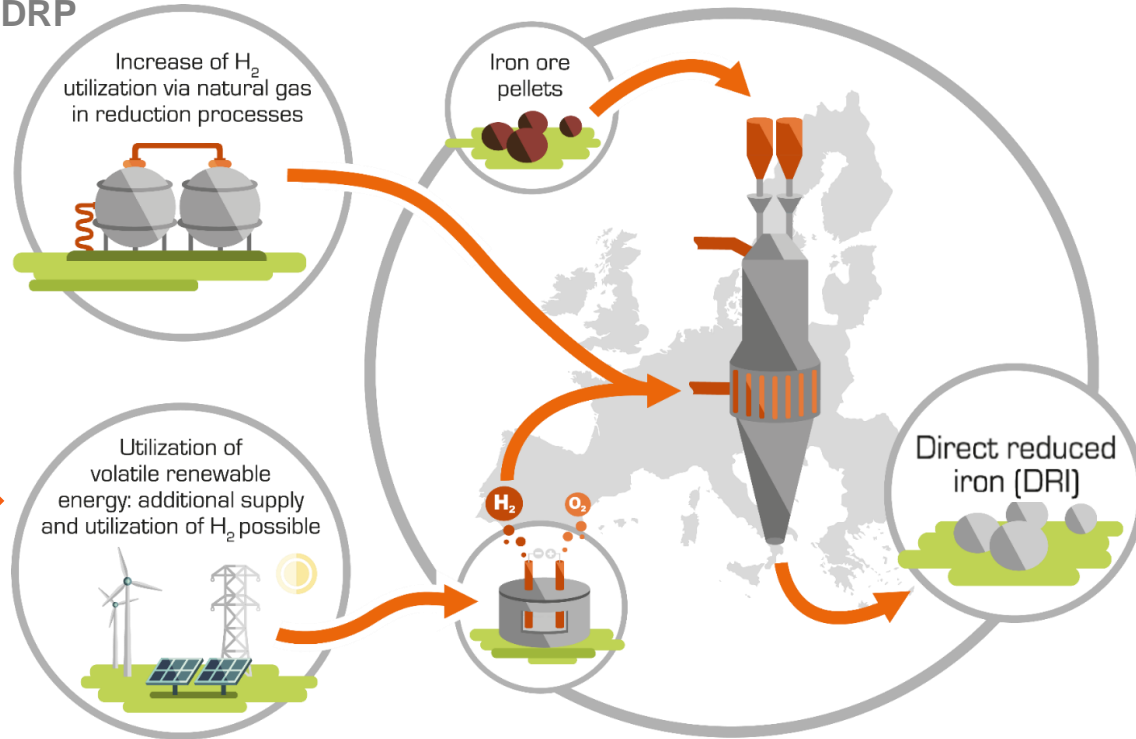
«Carbon Direct Avoidance»

=

Incremental Electrification of Primary Steelmaking

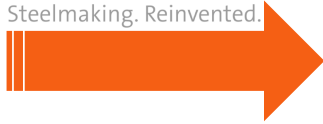
„DRP 2.0“ - Further Lowering the CO₂ Footprint via Additional, Flexible Electrolytical Hydrogen Input

Standard DRP

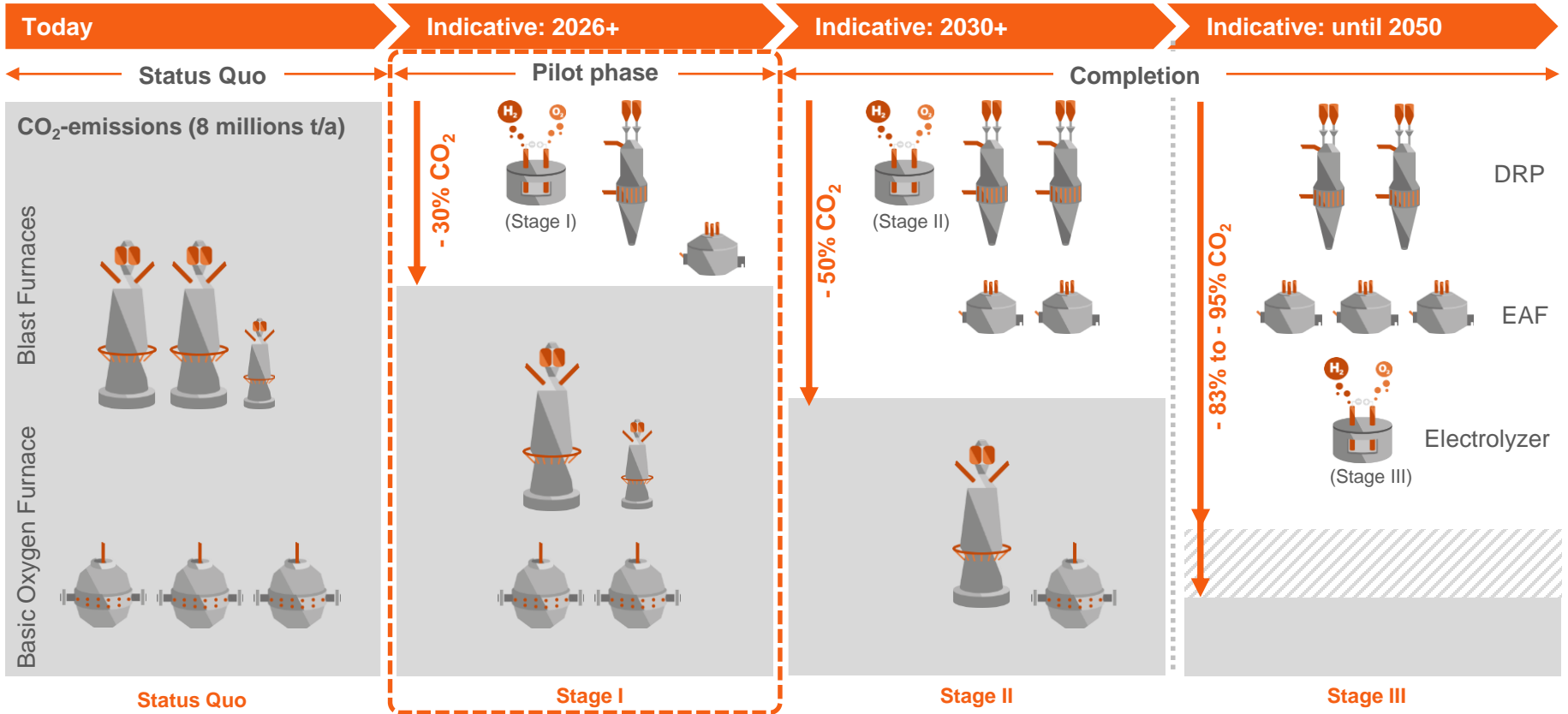


- Use of already established (direct reduction with natural gas) and novel (hydrogen production and use) technologies
- Integration into existing and optimized integrated iron-and-steel works
- Gradual reduction of CO₂ emissions up to 95%!
- Sustainable "Carbon Direct Avoidance" approach: Reducing instead of recycling!

SALCOS
Steelmaking. Reinvented.



Transformation of integrated steelmaking in Salzgitter to H₂ enhanced DRP/EAF-based steelmaking in three stages



Excursus - SALCOS – Building Blocks



First steam electrolysis in megawatt scale at Salzgitter Flachstahl beginning in 2020



Wind-H₂ – Sector coupling



Production of electric energy by means of windpower and electrolytic hydrogen on the premises

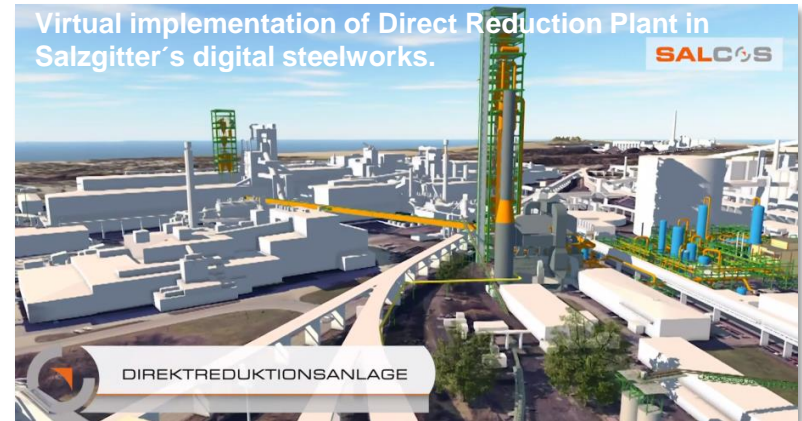
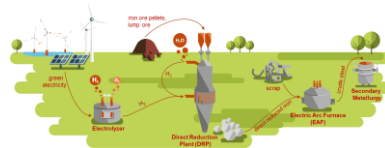


MACOR – SALCOS-Feasibility Study

BMBF-funded, May 2020 finalized

BeWiSe – SALCOS-Supporting Research

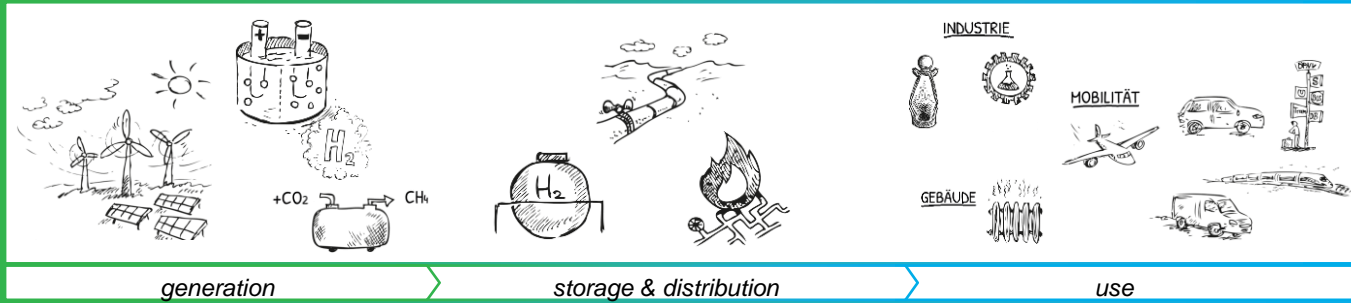
BMBF-funded, July 2020 - June 2023



Hydrogen Campus Salzgitter (Lower Saxony, Germany)

- + region with high future **hydrogen demand**
- + broad **industrial expertise** in hydrogen technologies
- + **open for joint projects**, e.g. in the fields **electrolysis, fuel cells, (railbound) mobility, industrial H₂ use, ...**

realisation of complete hydrogen value chain



boosting the hydrogen industry in Salzgitter region



Qualification
consulting, training

Startup Hub
business location

Demonstration & Scaling
operation of H₂ infrastructure

Bundling of regional expertise



Amt für regionale Landesentwicklung Braunschweig



MAN Energy Solutions
Future in the making



BOSCH



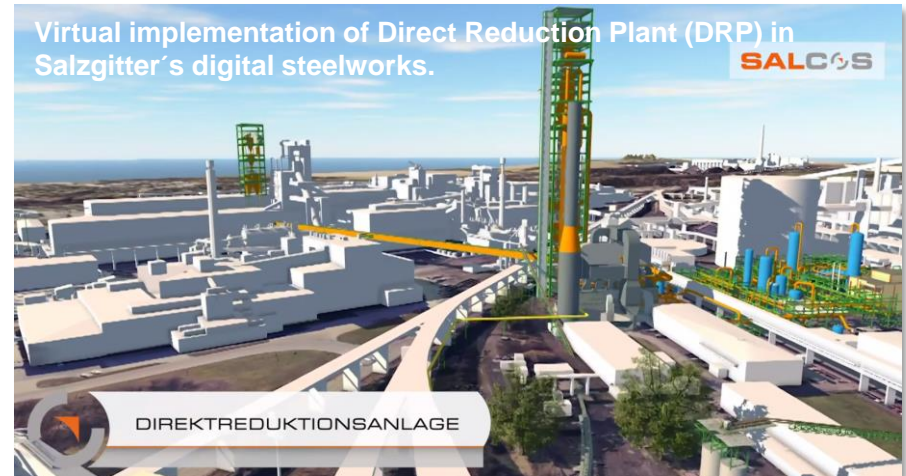
SALZGITTERAG
Stahl und Technologie



Fraunhofer
IST

What is **SALCOS** about?

- **SALCOS** is based on **commercially available technologies** – can be operated **flexibly with natural gas and hydrogen** in different compositions.
- Replacement of carbon with **hydrogen and renewable electrical energy**
- **Significant CO₂ reduction** already by using natural gas and even lower CO₂-footprint – when available – by higher amounts of **green hydrogen**
- Directly avoiding the production of CO₂ (means for Salzgitter **-2 Mio. t of CO₂**), which is **more sustainable** than CO₂ recycling or storage
- Very **energy efficient** approach – that can also be used at other steel production sites in Europe



What's next: **Power Briefing**

Robert Schwabe

Weber Maschinenbau | Supply Chain Manager



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Green Manufacturing Challenges

16.04.2021 |
Neubrandenburg

Robert Schwabe

Manufacturing activities have been one of the major polluters of the environment. Here is where green manufacturing trends come into play. Green manufacturing is primarily about changing our existing business and manufacturing practices, as well as the mindset of stakeholders, to mitigate the industrial contribution to climate change and other environmental concerns.

INFORMATION: ABOUT WEBER

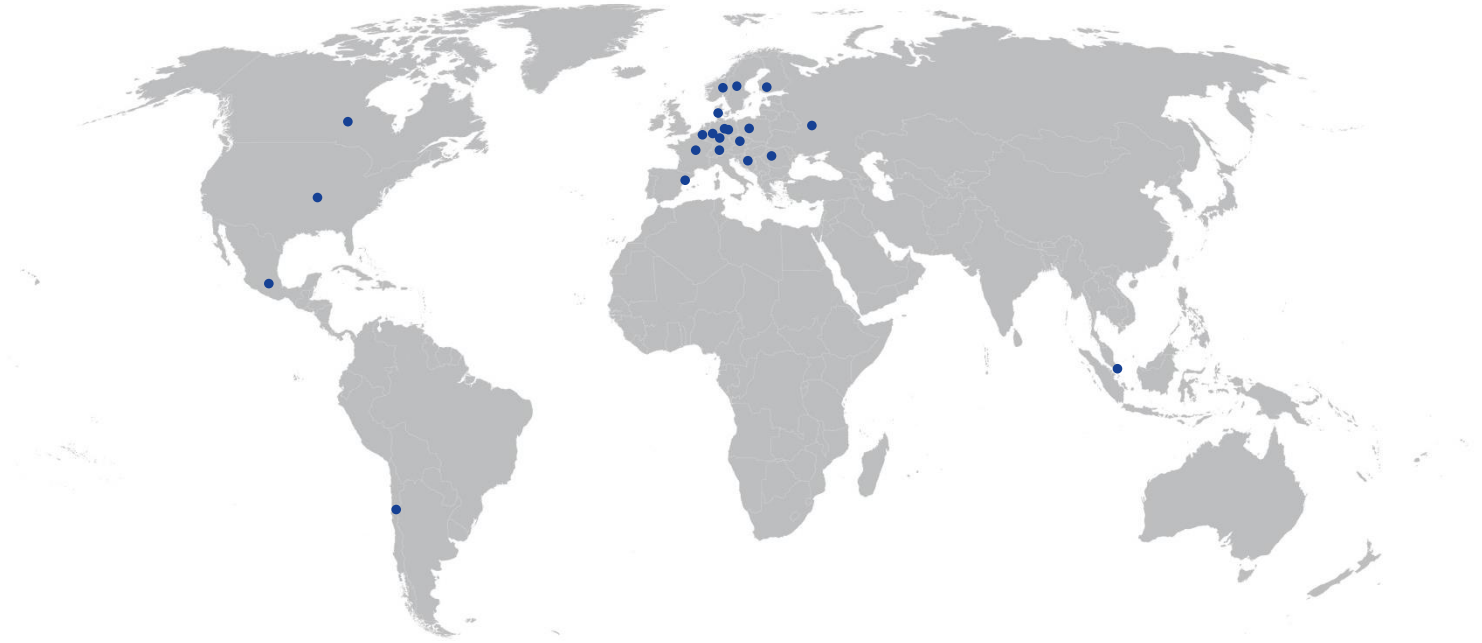
FACTS AND FIGURES

- Total solution provider – from slicing and automatization to packaging, all from one source
- Manufacturing at **5 sites** in Germany
- **TOP 100** in Germany: Weber ranks 45th in the national list of best companies (Handelsblatt)
- Founded **1981** and **100% family owned**, led by CEO Tobias Weber, the eldest son of the company's founder Günther Weber.
- About **1,450 employees** at **22 locations** worldwide
- In total **7,000** delivered and installed slicers worldwide
- Total revenue: approx. **€ 232 Mio**



LOCATIONS

WEBER WORLDWIDE



ENERGY INSIDES FACTORY NEUBRANDENBURG

- electrical energy consumption in 2020 nearly 3.700.000,00 kWh p.a.
- self- sufficiency through photovoltaics in 2020 nearly 700.000kWh p.a.
- 1.136.013 kWh/a natural gas p.a.



permanent reducing energy consumption is one of the major keys reducing our carbon footprint

MILESTONES REDUCING FACTORY ENERGY COSTS

- ✓ self- sufficiency through photovoltaics in 2020
nearly 700.000 kWh p.a.
- ✓ scheduling Shut-Downs and Start-Ups chipping and processing
- ✓ optimize Air Compressors (use energy termally)
for example: 30kW compressor = 123.472 kWh/h
p.a.
72% can be used termally for heat utilization
that leads to 90% of the hot water demand can
be met by heat recovery
- ✓ LED in every factory building saved up to
200.000 kWh p.a.
- ✓ Reduction of the scrap rate

CHIPPING PROCESS WITH FULL AUTOMATED TECHNOLOGY



- constant replacement and renewal of machinery
- consumption optimized components, such as LED lighting, efficient drives the recovery of braking energy and intelligent control of all aggregates
- up to 30% energy savings implemented



VISION OF GREEN MANUFACTURING – LIGHTHOUSE PROJECTS

Implementing the first full integrated sheet metal building line, for 1 piece production, in Europe – from laser to robot bending with our partner Trumpf in Q3/ 2021.



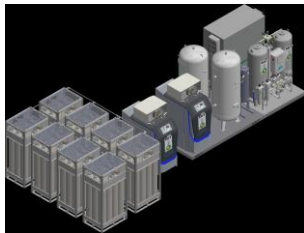
- Efficient components, demand control, energy recovery and efficient design
- use energy drawn from the power grid several times within the machine network

VISION OF GREEN MANUFACTURING

- generate our own nitrogen for the laser with a nitrogen generator use self made energy



Storage
and
buffer



detailed planning starts in
Q2/2021
implementation in Q4/2021

FOR A MOVING FUTURE



What's next: **Q&A**

GTAI
&
HY-5 Investment Experts



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Transport & Digitalisation

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Coast and Sea

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March 12th

**The Production
of
Green Hydrogen**

The Energy
of the Future

April 16th

**Green Metals
&
Manufacturing**

Decarbonization and
Sector Coupling

May 7th

**Green Mobility
&
Transportation**

The Fuels
of the Future

June 15th

**Green Distribution
&
Storage**

Maritime Industry and
Infrastructure:
The Supply Chain of the
Future

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