



Potential for a hydrogen based economy in South Africa

African Hydrogen Partnership – Annual conference 2020

February, 18th 2020 | Philipp Nellessen
CEO Sub-Sahara Africa thyssenkrupp Industrial Solutions



engineering. tomorrow. together.





We are a global corporation with
presence in 79 countries with ~2,000 sites

thyssenkrupp AG Sales: 44,571 [€ mn] | EBIT adj.: 1,812 [€ mn] | Employees: 157,066

Sources: Key indicators as of year 2019/2020



Serving Sub-Saharan Africa since 1959 with regional offices in key locations

thyssenkrupp Industrial Solutions (Africa) (Pty) Ltd

thyssenkrupp Industrial Solutions
South Africa (Pty) Ltd

Established in SA since 1959
ISO 9001 certification
ISO 18001 certification and NOSA¹ 5 Star rating

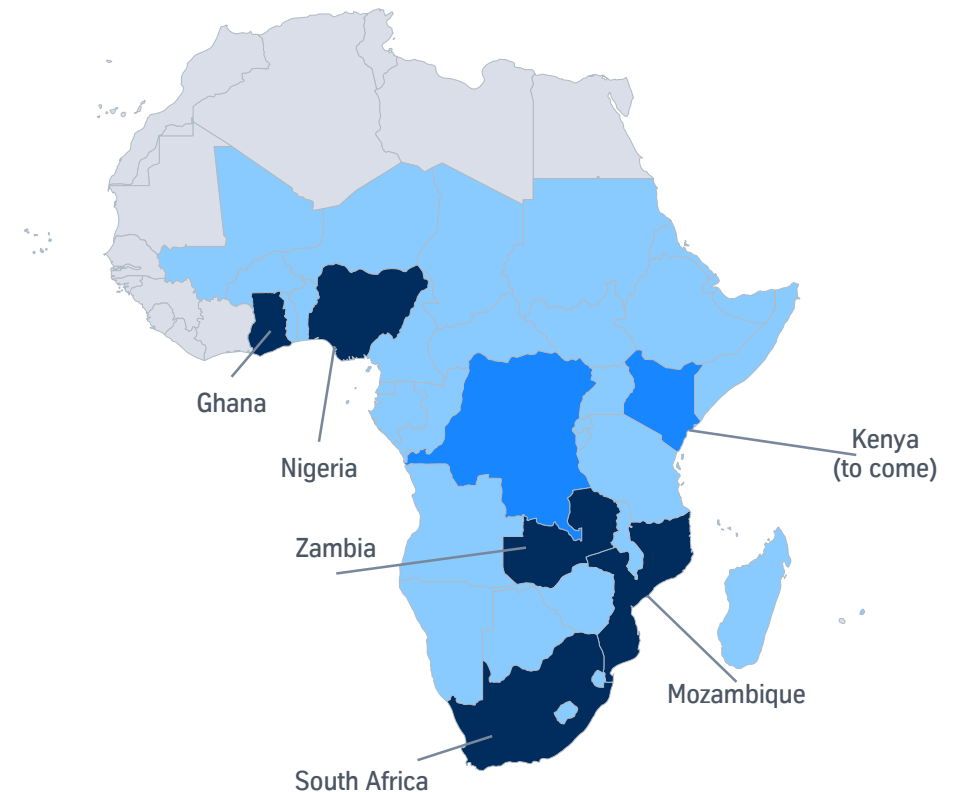
Industries Served:

Chemicals, Petrochemicals, Refining, O&G, Fertilizer,
Cement, Mining, Mineral Processing, Materials Handling

Dedicated Service Centre – Revamps, Spare Parts, Asset
Management, Training, Workshop

More than 150 projects executed
BEE Level 3: 30% Black women owned

Sub-Sahara Africa regional offices



Existing presence or legal entities¹



Emission reduction is reality...

Leaders of European Union and the G8 announced an objective to reduce GHG emissions by 80% below 1990 levels by 2050

Source: www.roadmap2050.eu

Dutch parliament to set target of 95 percent CO₂ reduction by 2050

Source: www.reuters.com

Under the interim target for 2030, Germany's total greenhouse gas emissions need to be reduced by at least 55 percent compared to 1990 by 2030

Source: Climate Action Plan by Federal Government

World Bank's Carbon Pricing Leadership...not to be at least in the range of \$40-80/tCO₂e by 2020 and \$50-100/tCO₂e by 2030 to deliver on the Paris Agreement targets,..."

Source: Nitrogen+Syngas 362



Ursula von der Leyen has warned China and other large fossil fuel producers to find a way to price carbon at home or risk being hit by the EU with a planned CO₂ tax on imports.

Source: Financial Times; <https://www.ft.com/content/c93694c8-3d15-11ea-a01a-bae547046735>

Challenging targets require drastic actions resulting in opportunities for neighboring countries with best renewable energy sources



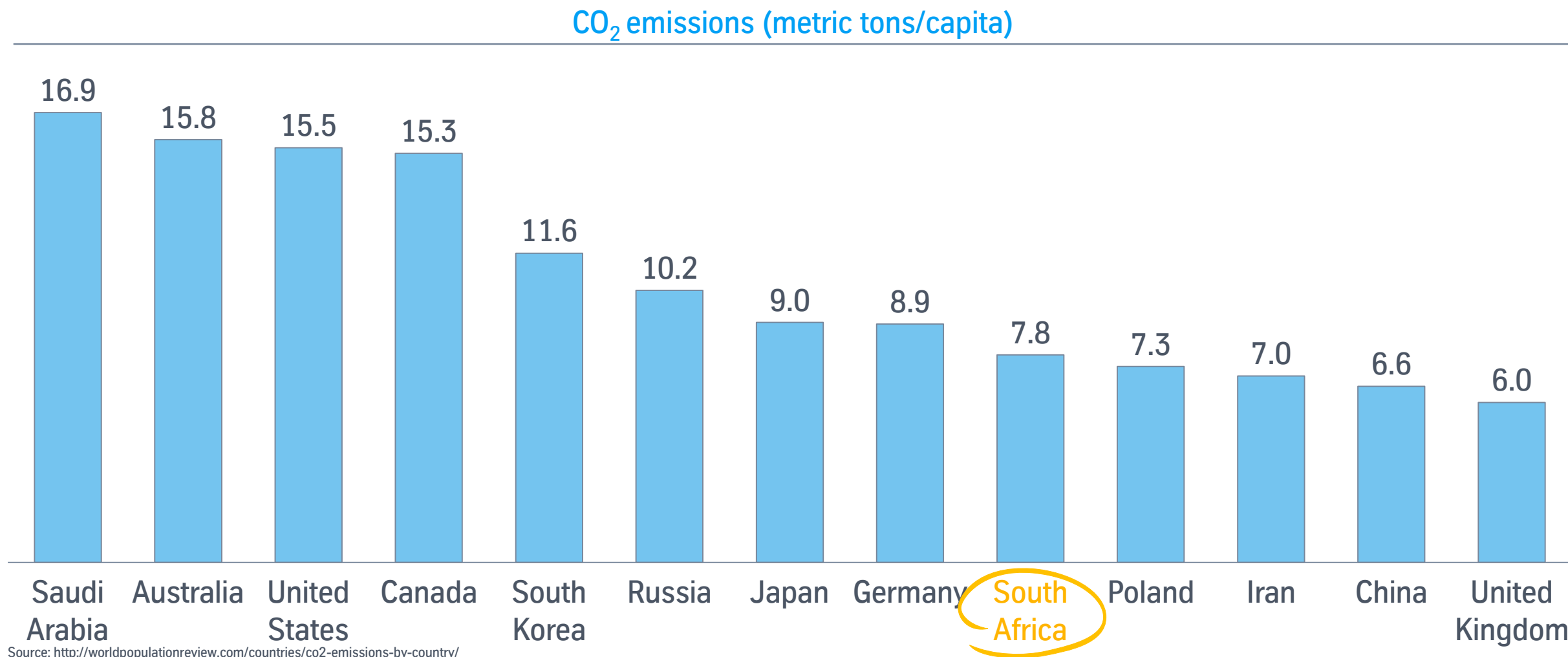
South Africa with high interest in international “green” experience

Germany's Merkel in South Africa encourages a move from coal

“We had really extensive and very informative discussions on energy, and the chancellor was able to share the German experience of how they have been able to move away from coal power stations and getting to renewables,” Ramaphosa said.



South Africa: The world's 9th largest CO₂ emitter (per capita)

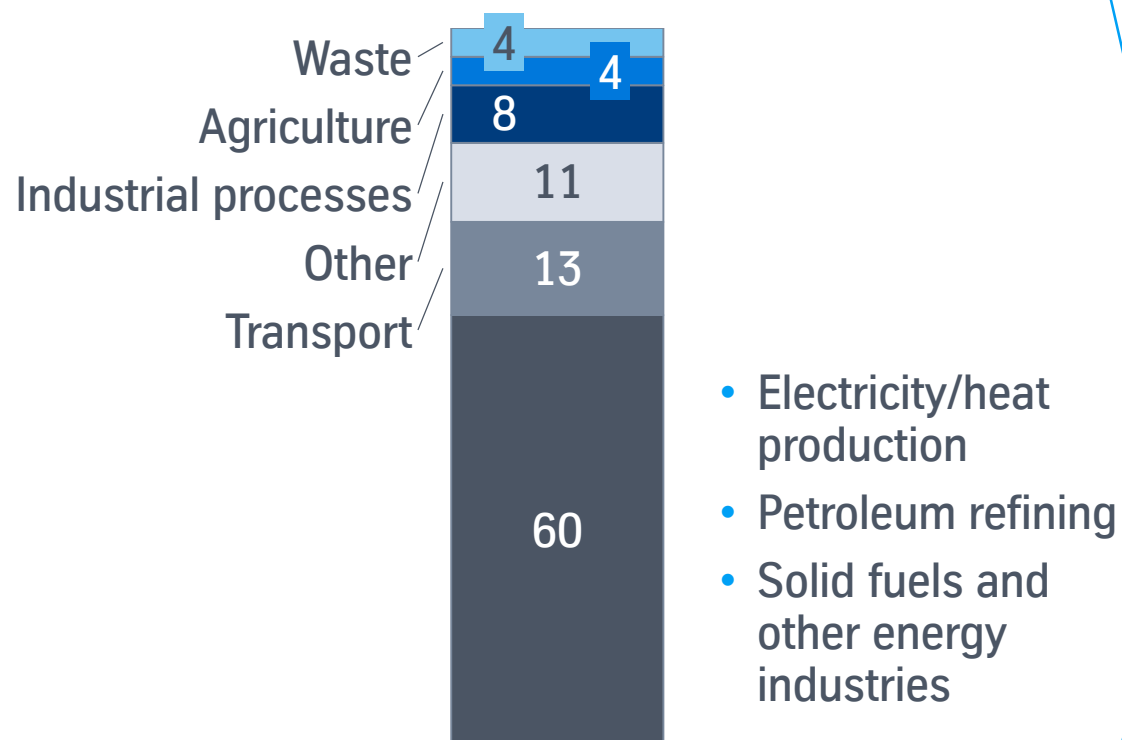


Source: <http://worldpopulationreview.com/countries/co2-emissions-by-country/>



Electricity and fuel production are the main GHG emitters in SA

GHG emissions per sector (% of total)



Approach to transform

Switch to “green” electricity generation

Switch to CO₂ neutral fuel production

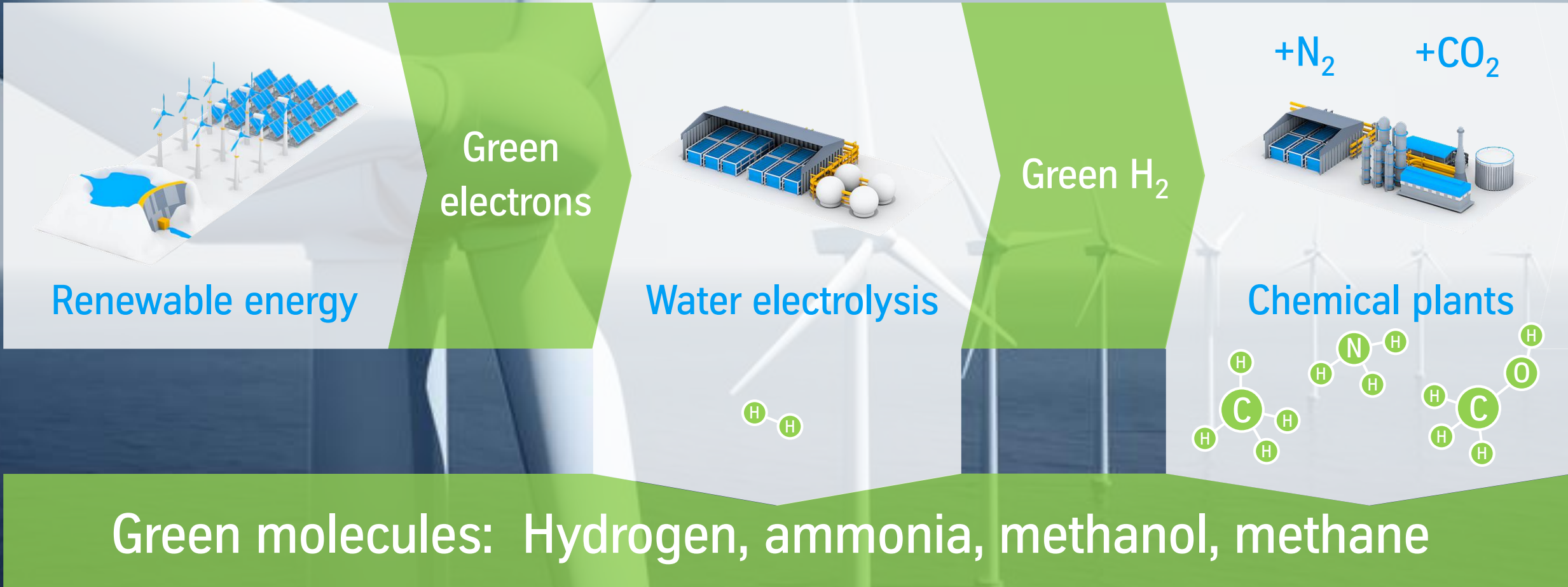
Find applications to “sink” CO₂

Hydrogen can play a vital role in this transformation

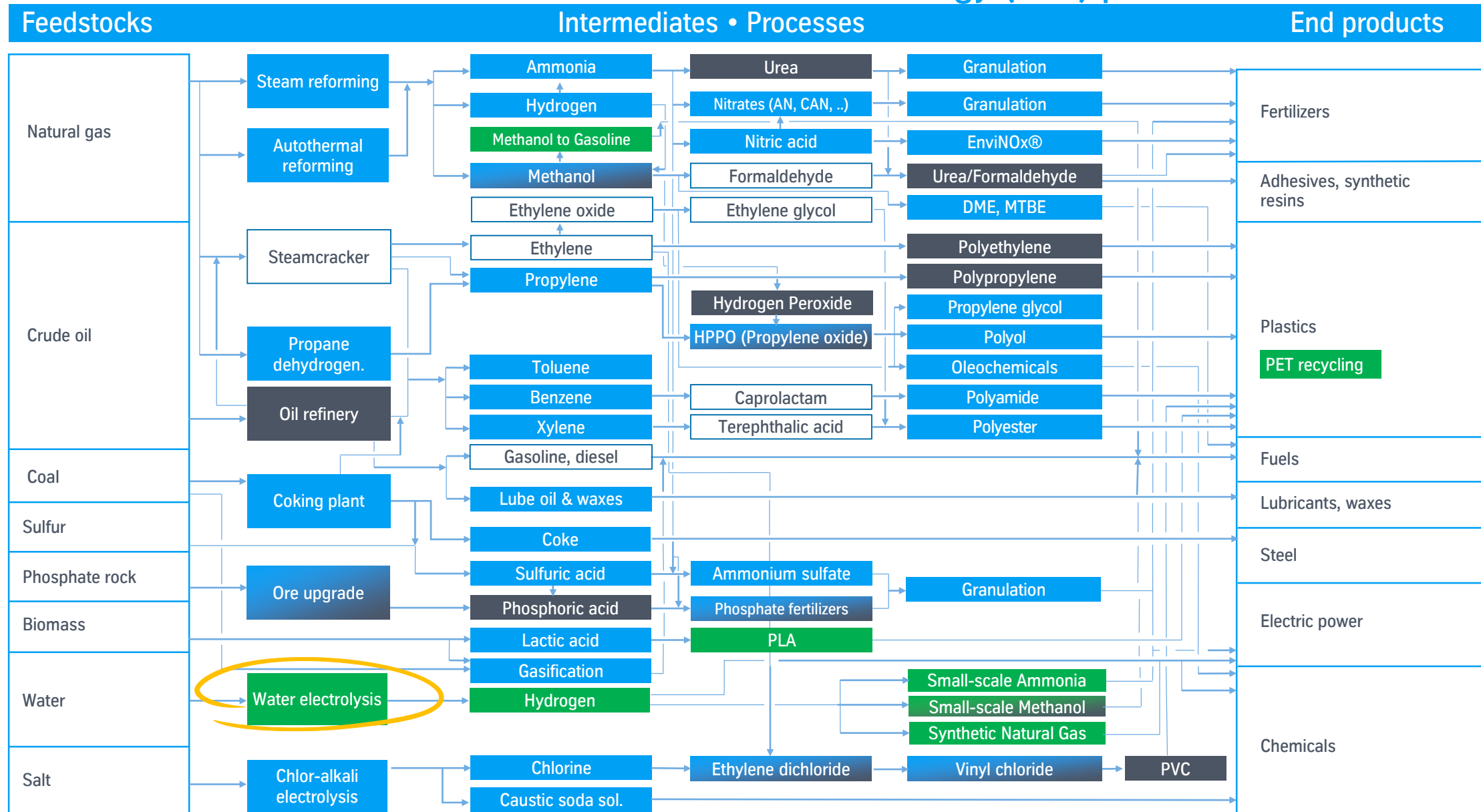
Source: South Africa's 3rd Biennial Update Report to the UN Framework Convention on Climate Change, March 2019



Hydrogen can not only be used for more than just electricity production



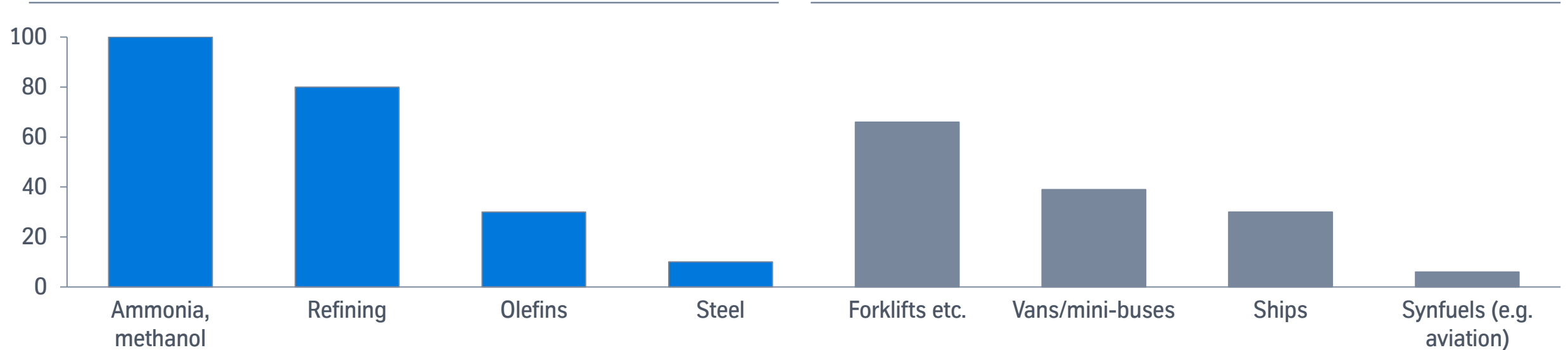
Overview and reminder of our Chemicals Process Technology (CPT) portfolio



External studies underline importance

Industry feedstock

Transportation



Relative importance by 2050

Market share potential in segment (%)

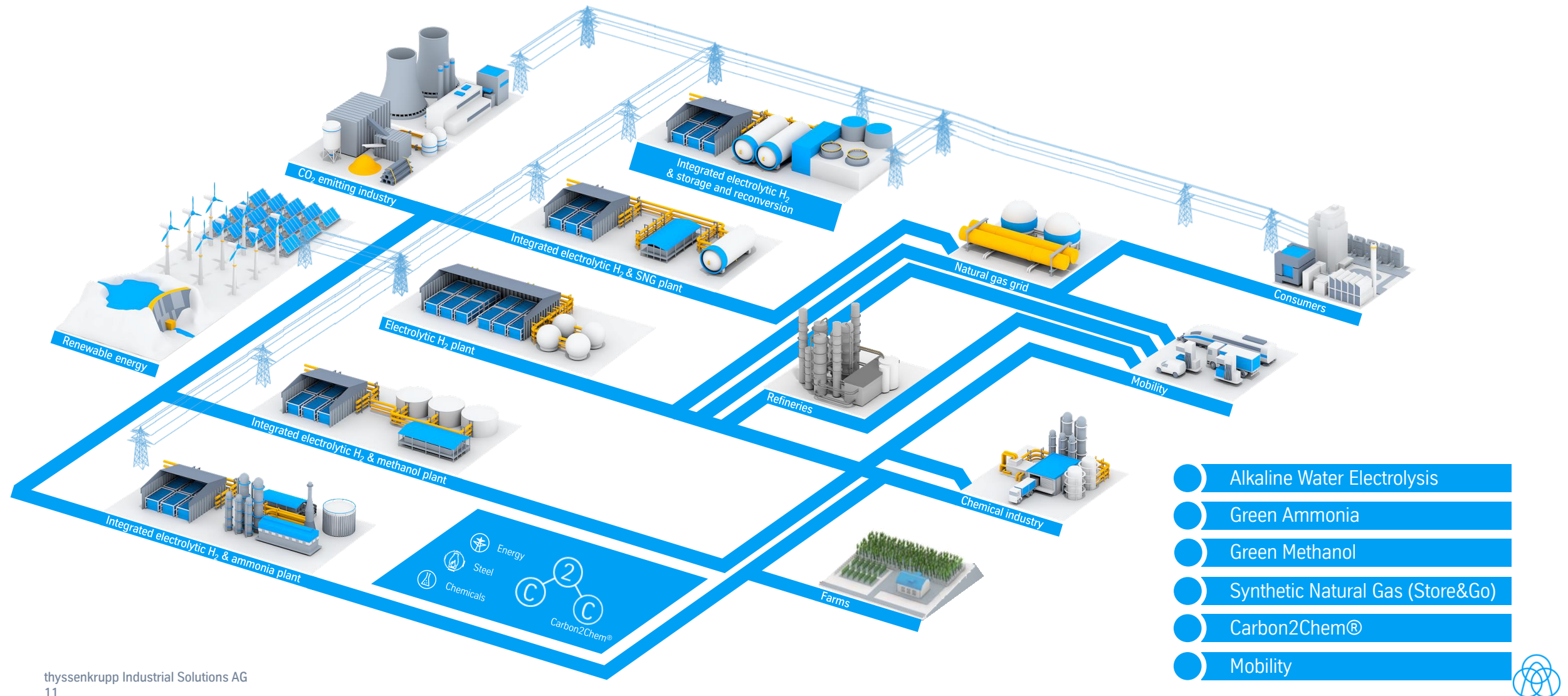
“If companies and governments get it right, the market for low-carbon hydrogen and associated synthetic fuels could reach \$1 trillion by the middle of this century...”

(Source: BCG – The real promise of Hydrogen)

Source: McKinsey/Hydrogen Council, BCG

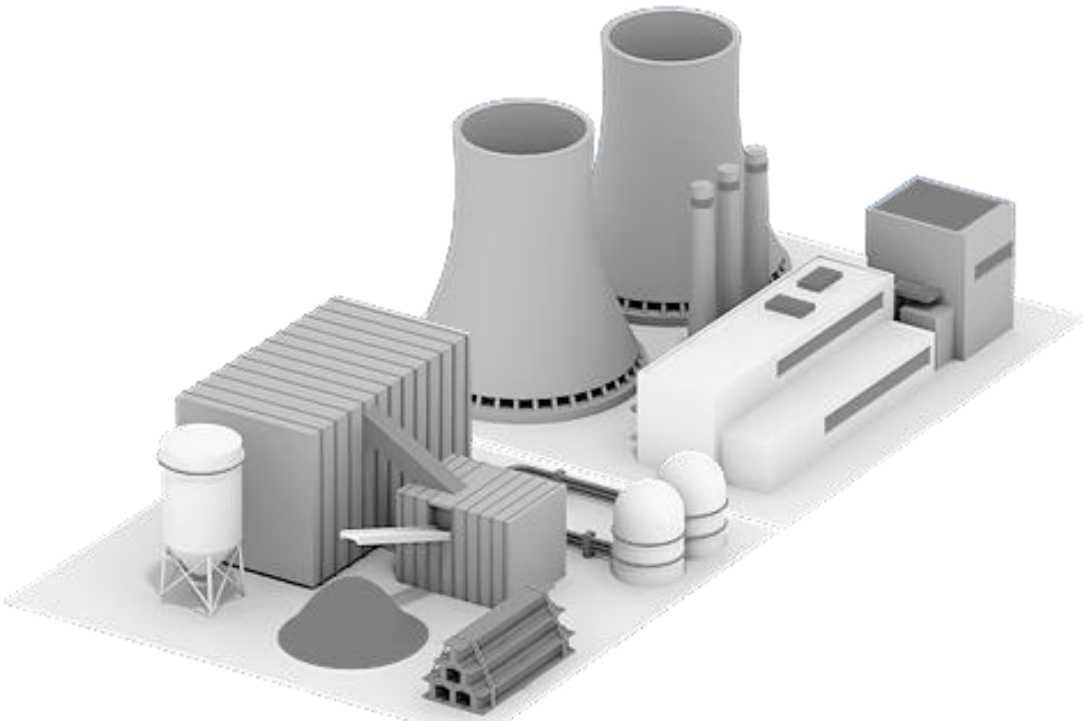


A whole chemical industry can be based on hydrogen, creating CO₂ sinks



CO₂ can be converted to chemicals from any number of sources

Any CO₂ emitting industry



Electricity generation (boilers, etc.)

Coke plants

Cement plants

Refineries, Petrochemicals

Other...

Transformation possible even if significant parts of the economy (e.g. electricity) still rely on fossil fuels



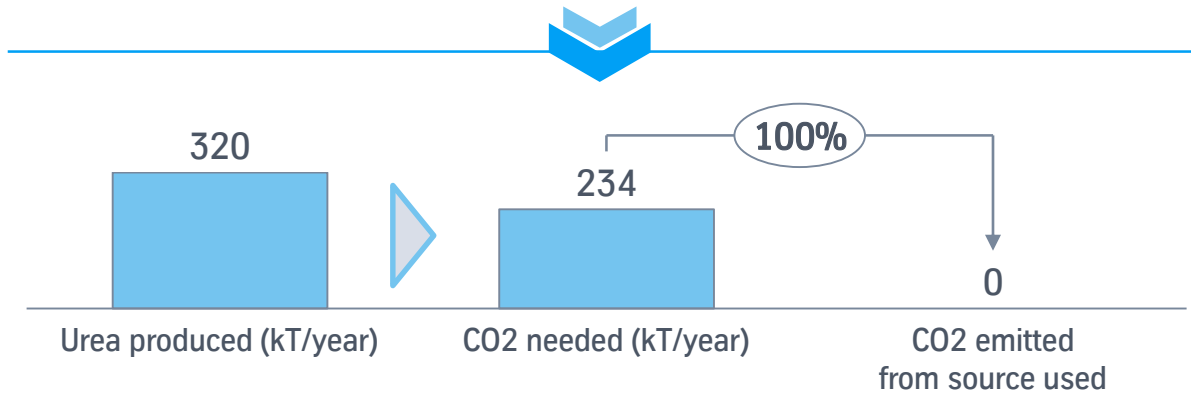
Two examples and their implication for South Africa

1

Green Fertilizers



- 320 kT Urea produced locally
- 1.8 mT/year imported Urea

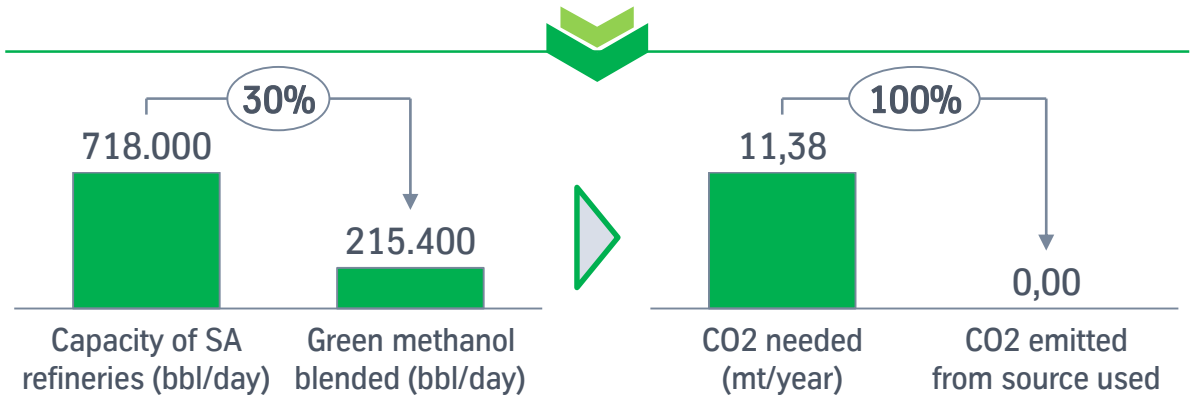


2

Green Fuel



- Total capacity of SA fuel refineries = 718.000 bbl.day



Further use case e.g. synthetic gas possible

All key technologies are available

 Carbon Capture
Gas Separation



“Green”
Ammonia
& Methanol



Green hydrogen
From renewable energy and
advanced alkaline
water electrolysis



Synthetic
Methane from
 H_2 and CO_2



Electrolyzers: Fully modularized units are available

>82 % stack efficiency
(HHV, DC, 4.3 kWh/Nm³)

H₂ purity:
>99.95 % (from electrolyzer, dry
basis)

98% availability
lifetime >30 years

Fast reacting on power markets and
flexible part load operations.

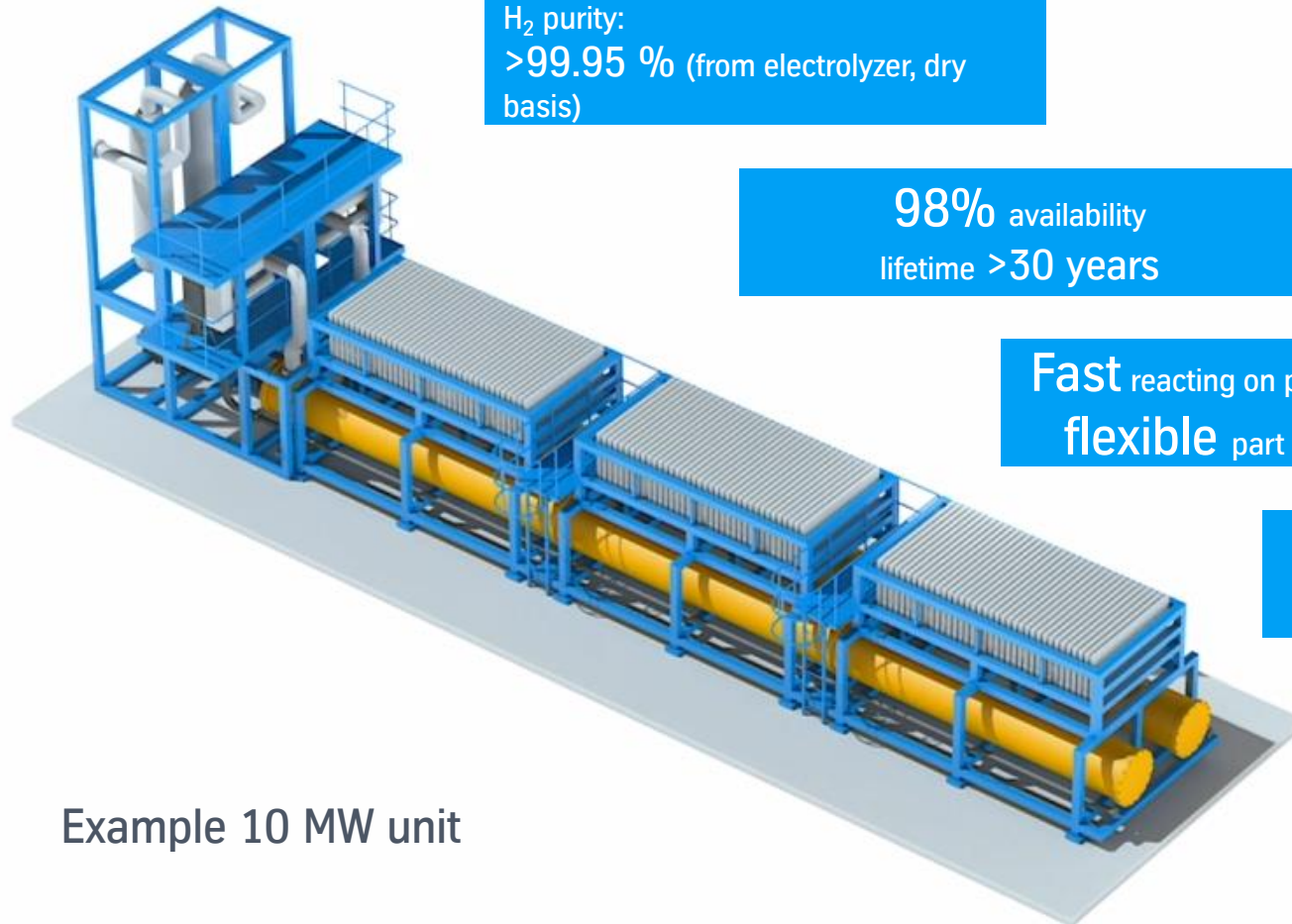
Fully automated operation

skid mounted for cost efficient
installation on site

Digital Features:

- Upgradable dedicated control system
- Data acquisition system for performance evaluation
- Connectivity

Example 10 MW unit



Large EP/EPC plants successfully deployed around the world

120 MW



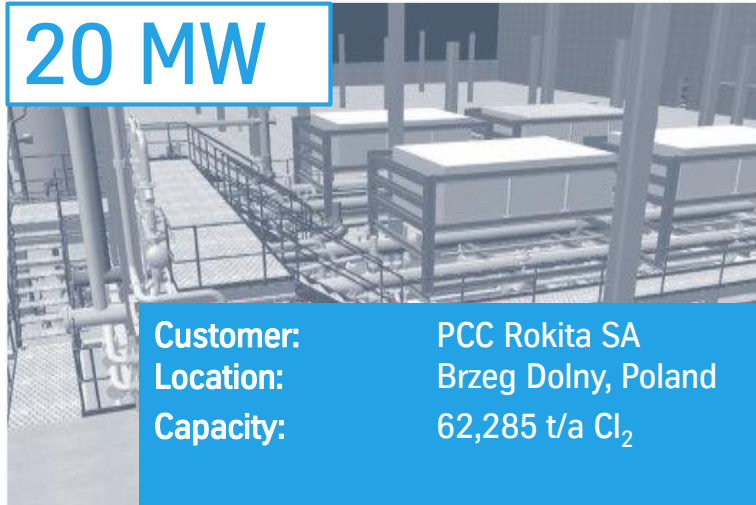
Customer: KEM ONE
Location: Lavera, France
Capacity: 400,000 t/a Cl_2

100 MW



Customer: Tessenderlo
Location: Belgium
Capacity: 306,000 t/a of NaOH
272,000 t/a Cl_2

20 MW



Customer: PCC Rokita SA
Location: Brzeg Dolny, Poland
Capacity: 62,285 t/a Cl_2

80 MW



Customer: Vestolit
Location: Marl, Germany
Capacity: 236,900 t/a of NaOH
210,000 t/a Cl_2

6 MW



Customer: Serba/Junaco
Location: Msufini, Tanzania
Capacity: 16,800 t/a of NaOH
15,000 t/a Cl_2



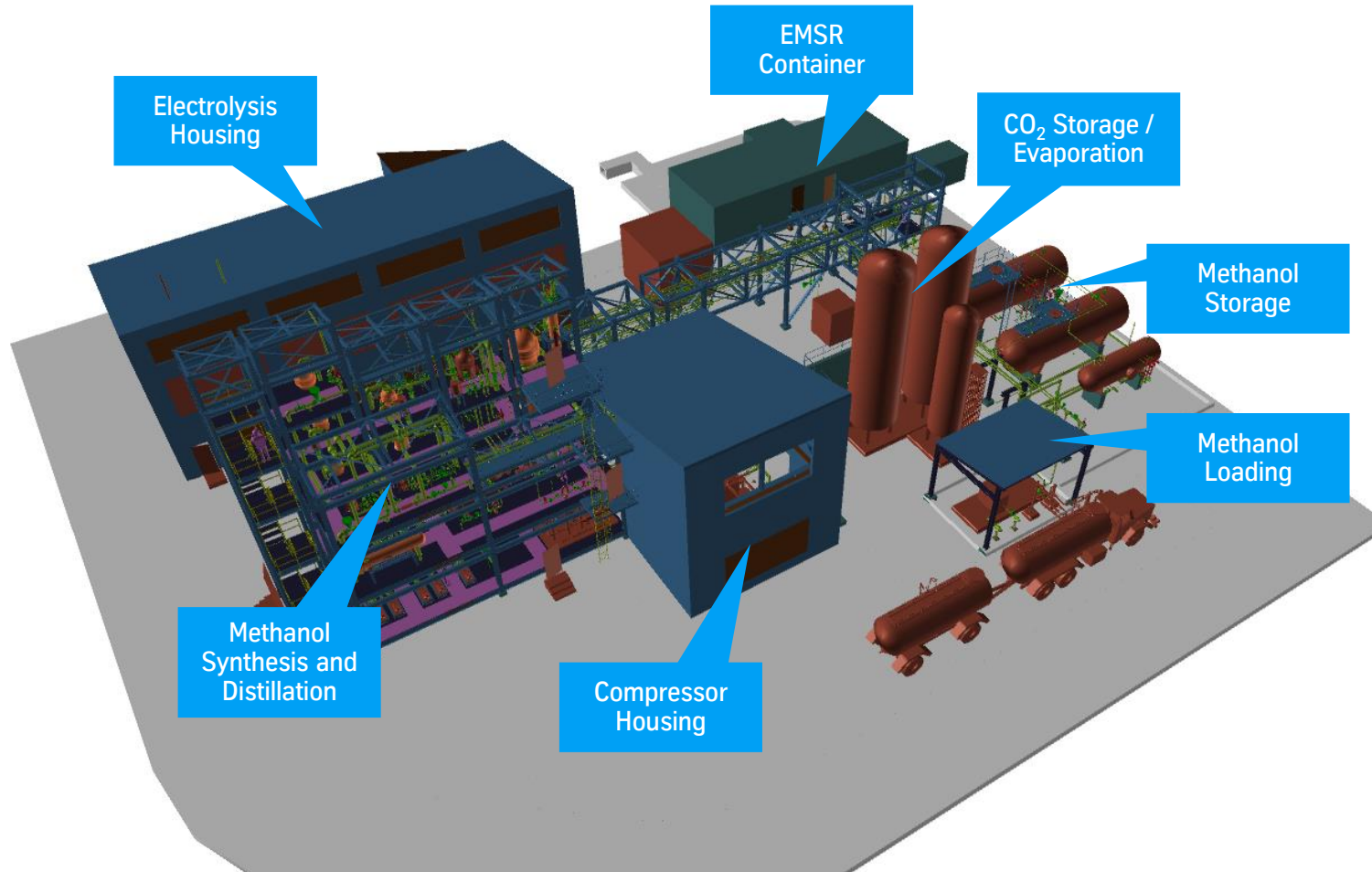
2MW H₂ Electrolysis plant at Carbon2Chem®-site Duisburg



Supported by

Polcyn

Example green methanol plant



Example SLF15 plant
(15 m³/d = 12 mtpd)

- ✓ First capacity template ready to implement
- ✓ tkIS is ready to go

Modularization improves economics, all truckable



Example green SNG plant



Demonstration Site Falkenhagen

Feed

- 210 m³/h H₂
- 53 m³/h CO₂

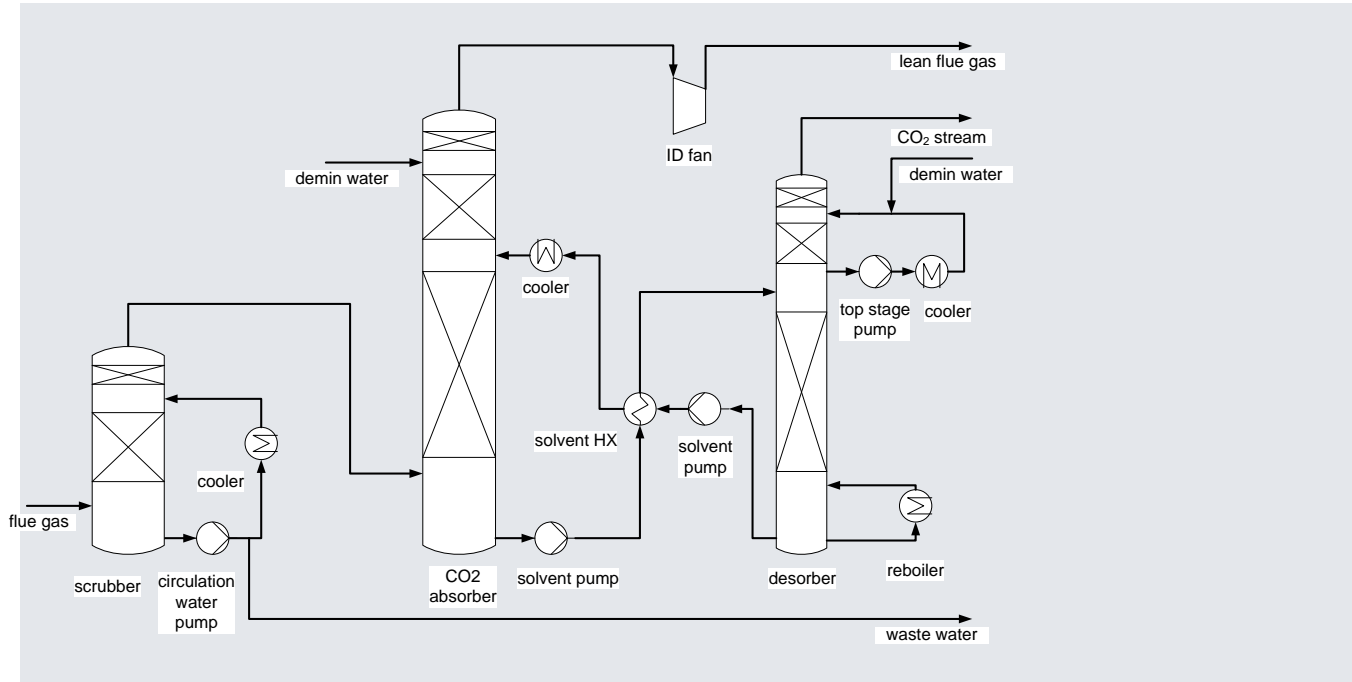
Product

- 57 m³/h SNG
 - > 96 %CH₄
 - < 2 %H₂
 - < 2%CO₂

Injection in gas grid since 01/2019
e.g. for CNG applications



Example CO₂ capturing plant



- Amine CO₂ recovery unit
- Absorber / desorber cycle with pre-scrubber
- Flue gas resistant aqueous amine solution



Pilot plant at thyssenkrupp Steel Duisburg

Smart Solutions for Climate Protection — Carbon2Chem®

From idea to commercial implementation

Carbon2Chem® supported by



BMBF funding numbers 03EK3037 to 03EK3043



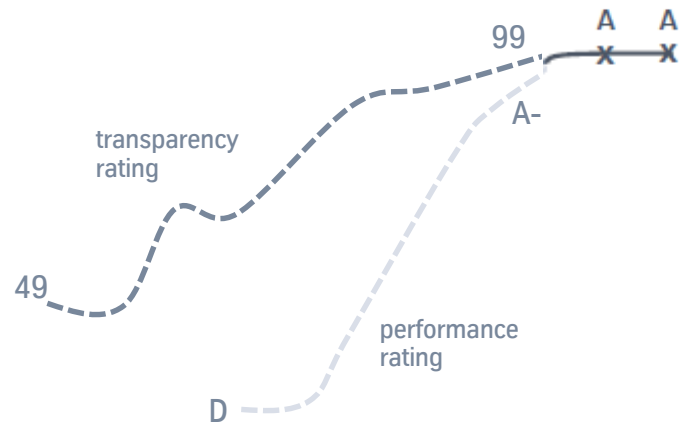
Location of Carbon2Chem® Technical Center
at thyssenkrupp Steel site in Duisburg



We know how it is to start from a low base

thyssenkrupp climate protection ranking 2008-2015

2008-2015: Catching up with leadership



2016-2019: Leadership confirmed four years in a row



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 2400² companies on behalf of 827 investors with US\$100 trillion in assets

¹ Carbon Disclosure Project

² In 2017 reporting companies represent more than 56 % of global market capitalisation

