thyssenkrupp’s role in the global green energy transition

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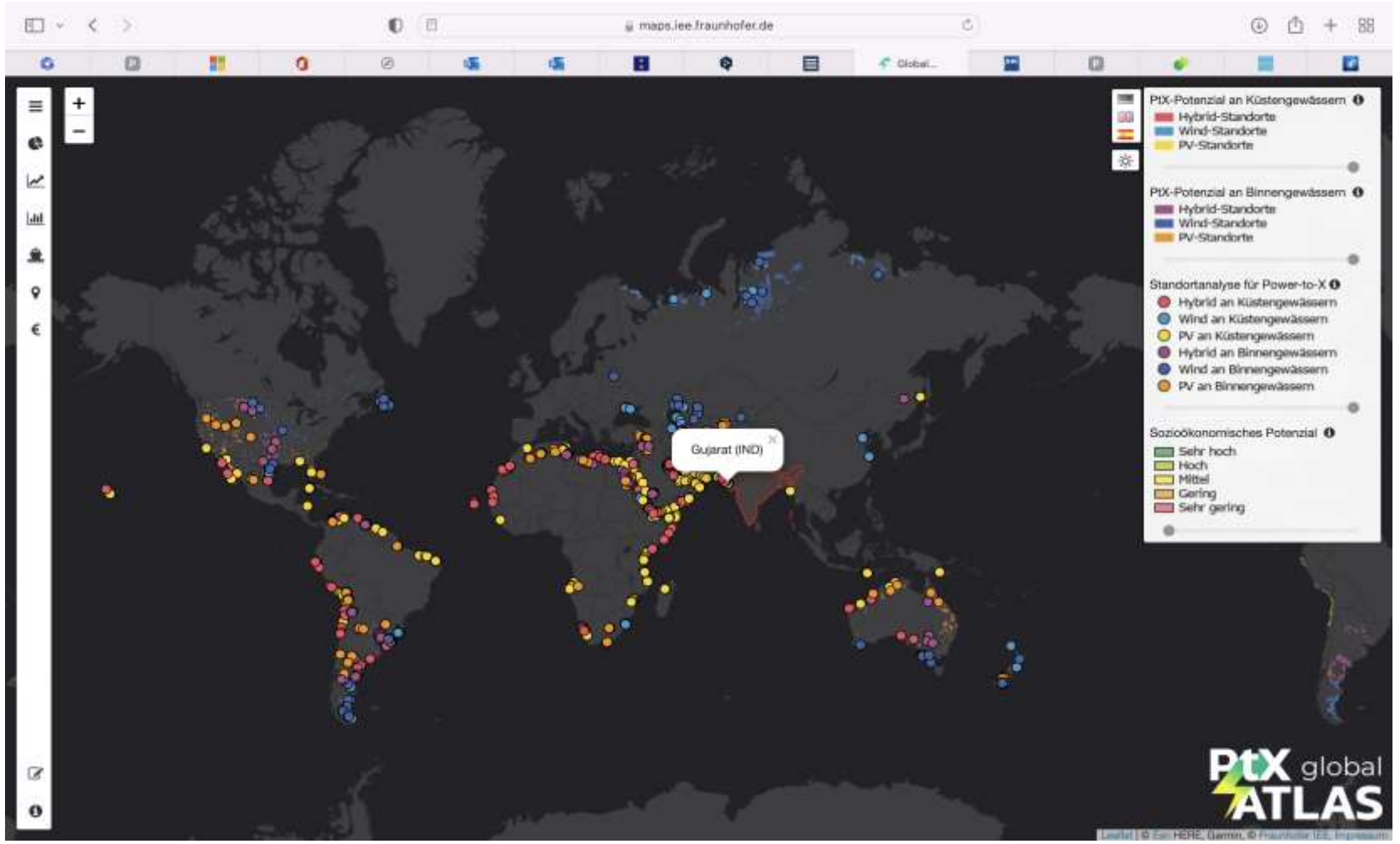
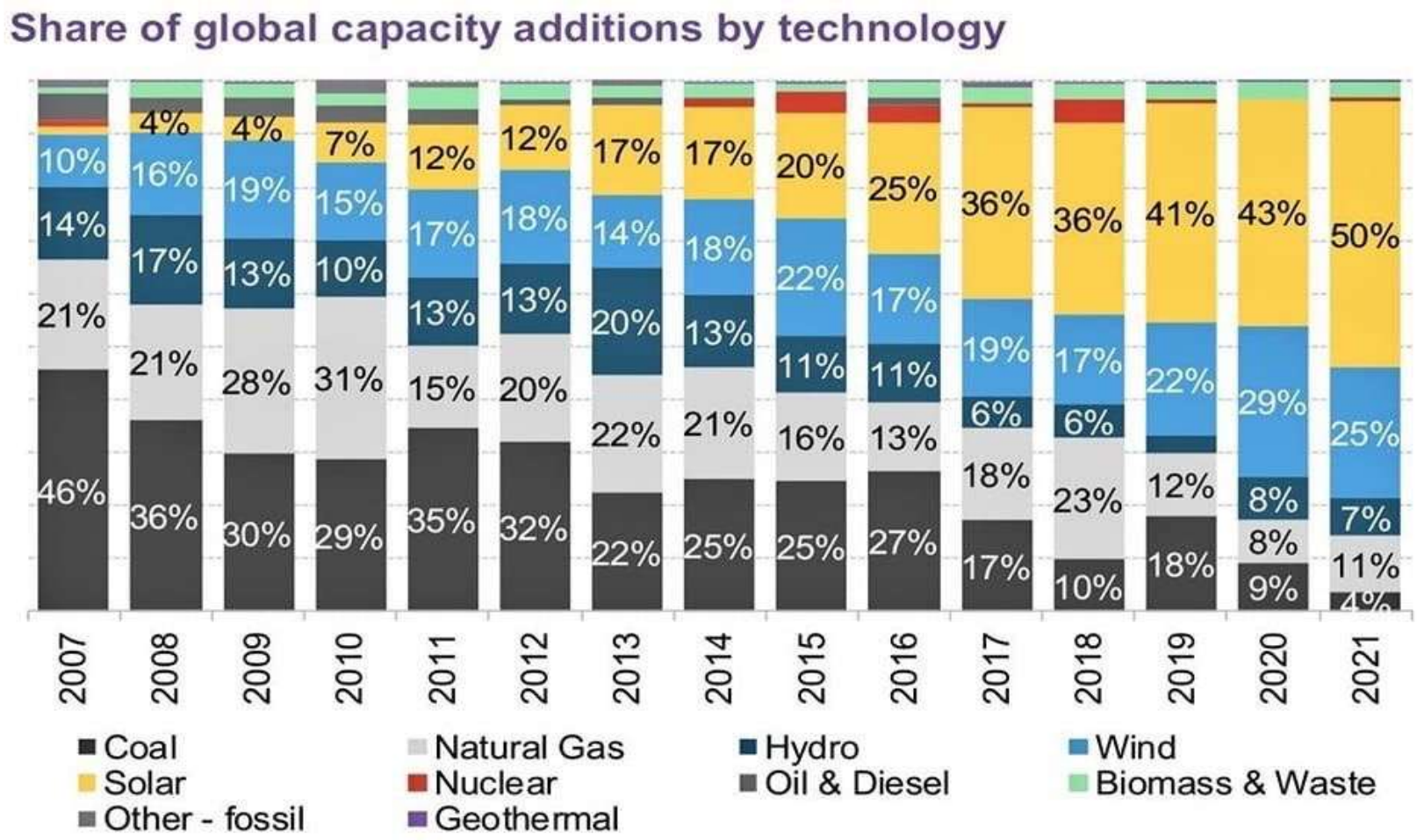
Huge Potential for future fuels in numerous global PtX projects



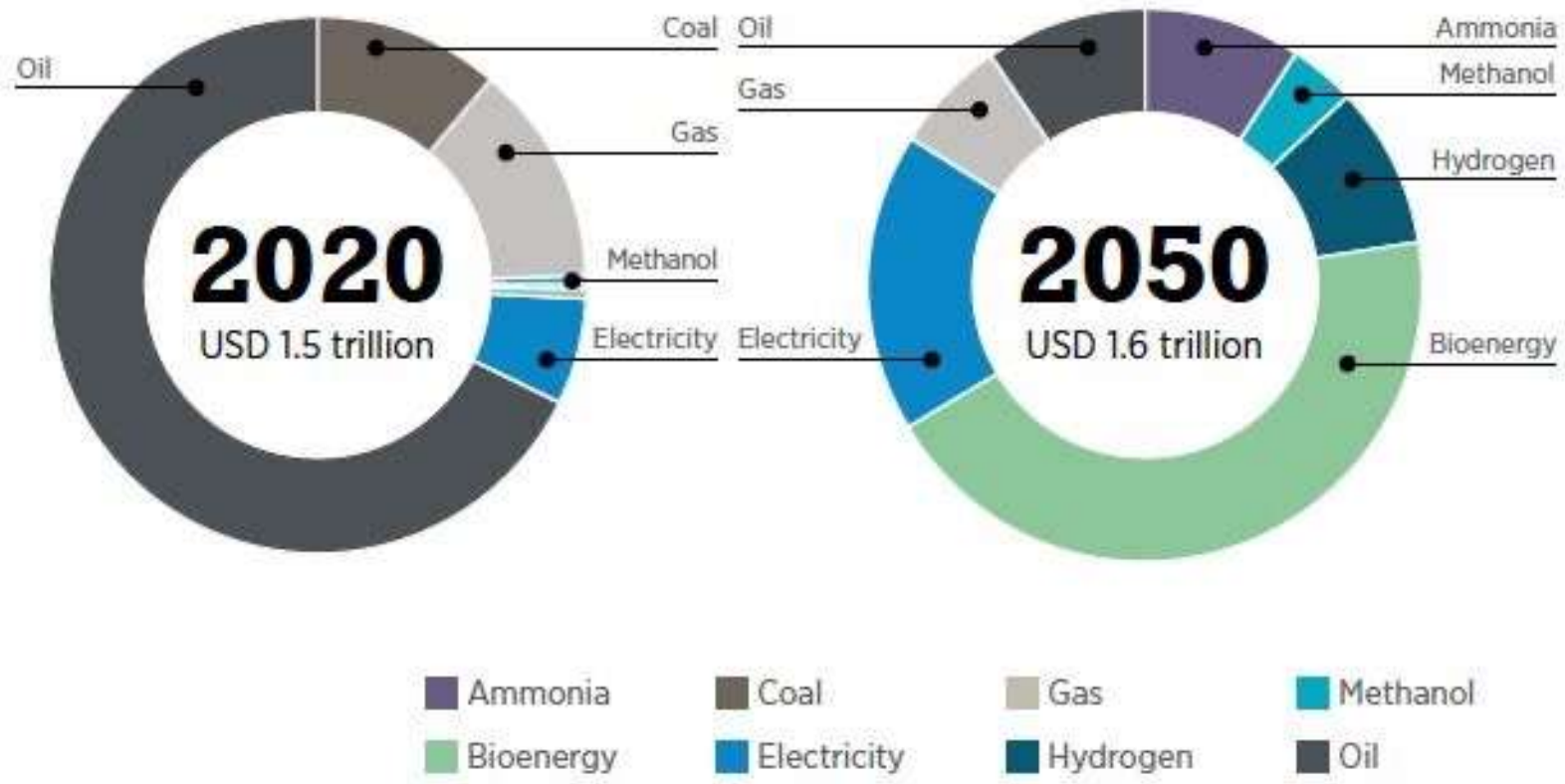
Essential: Fast gobal increase of renewable energy sources



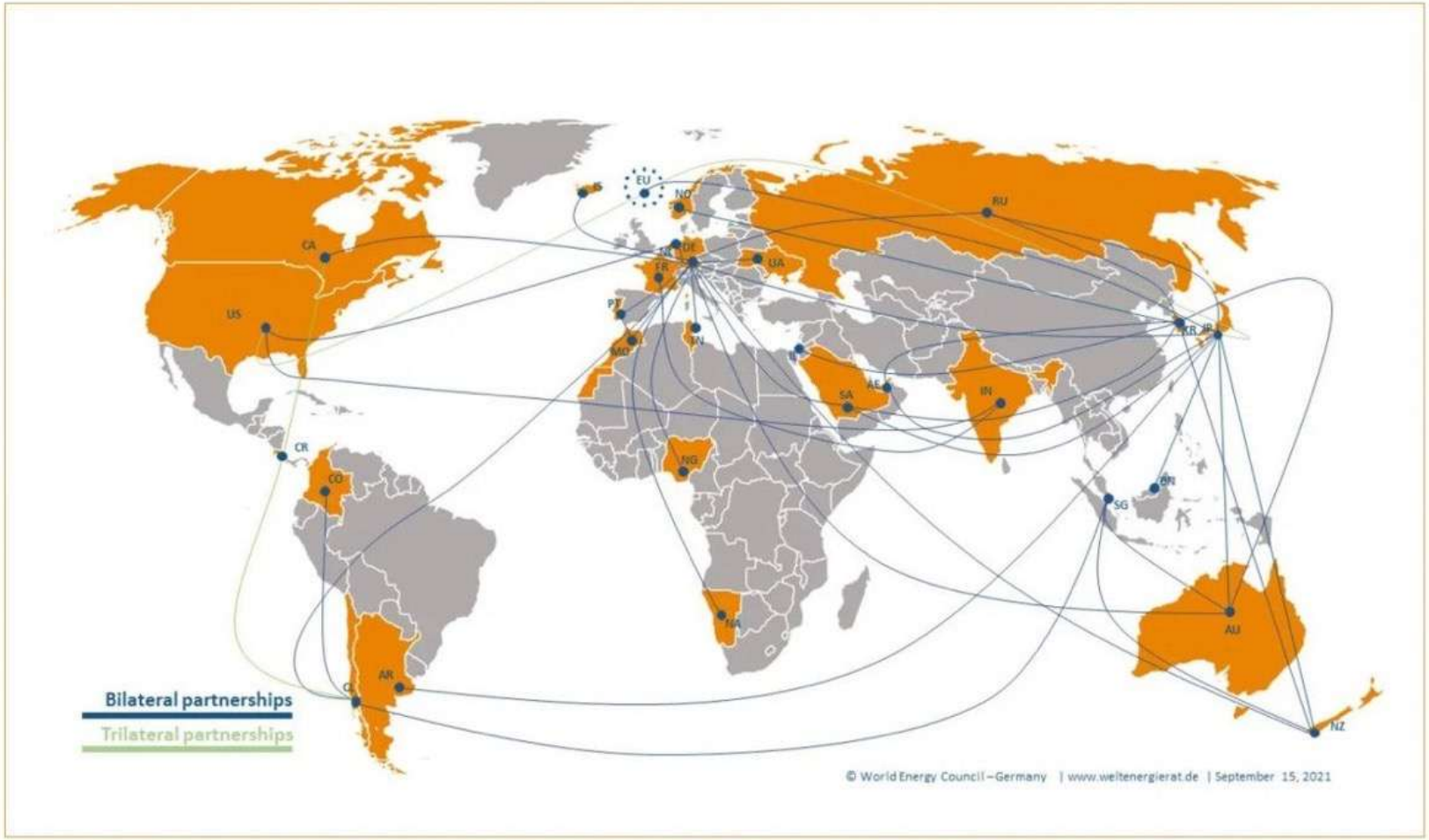
Source: BloombergNEF. Note: Share of global capacity additions excluding retirements.

Expected development of trade in energy commodities

Figure S.1 Shifts in the value of trade in energy commodities, 2020 to 2050

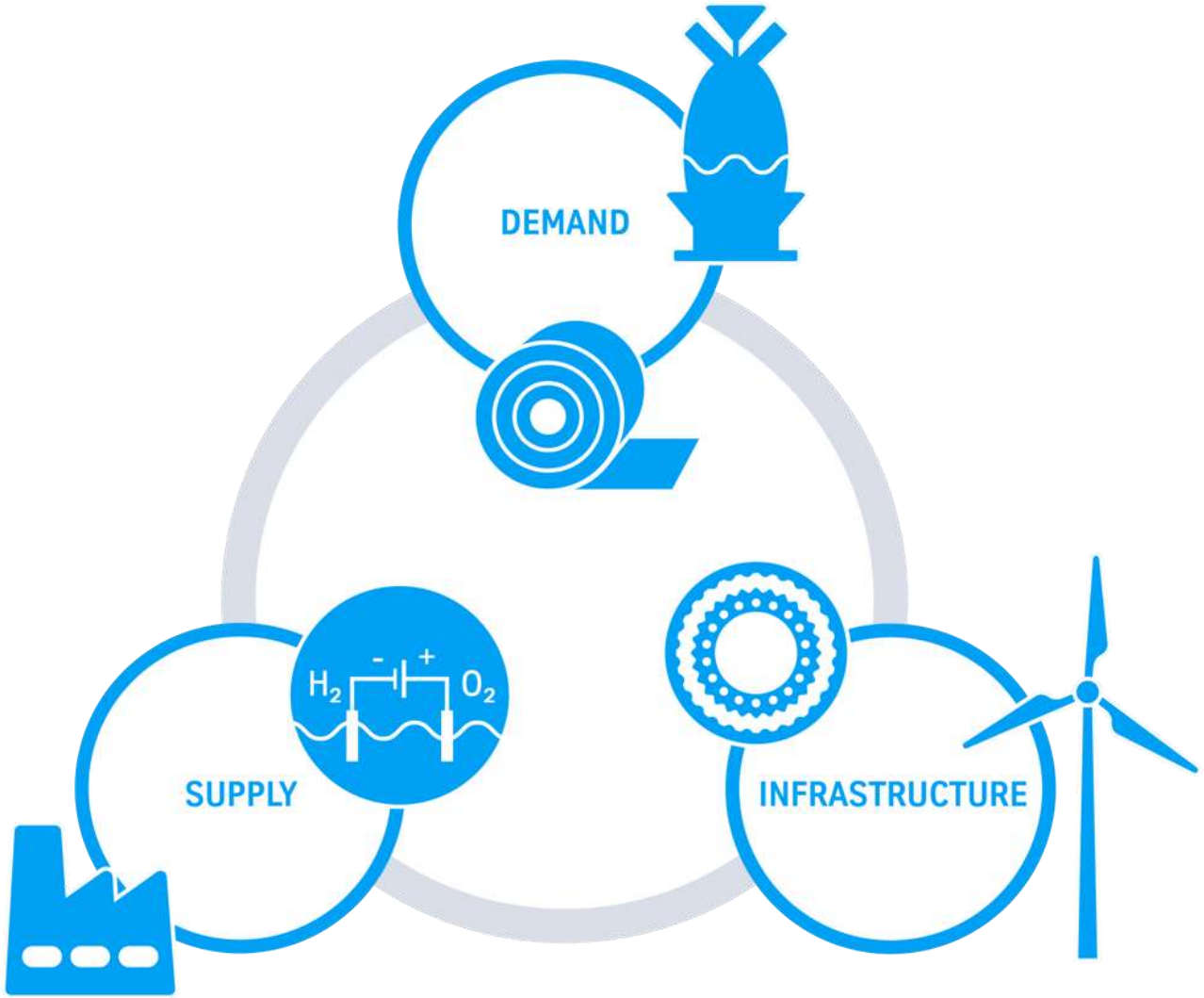


Increasing number of bi- and trilateral partnerships for pushing the green transition



thyssenkrupp: for more than 200 years a synonym for German industrialization and innovative strength

system



We at thyssenkrupp want to be part of the solution for the entire system. Because we as a group of companies have something to offer along the H2-triangle of demand-, supply- and infrastructure-side.

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Decarbonizing thyssenkrupp’s steel production

- The decarbonisation of the steel industry is a very big lever to quickly achieve significant progress towards climate neutrality.
- thyssenkrupp steel has a clear concept for decarbonizing production that is both technologically mature and scientifically recognized.
- We want to reduce emissions in steel by 30 percent by 2030. Climate neutrality is envisaged by 2045 at the latest.
- The electricity consumption required for hydrogen production corresponds to the current consumption of 25 percent of German households – approximately 36 TWh
- Demand in 2026: min. 350,000 t of (green) H2 per

Examination of a stand-alone solution of the steel business

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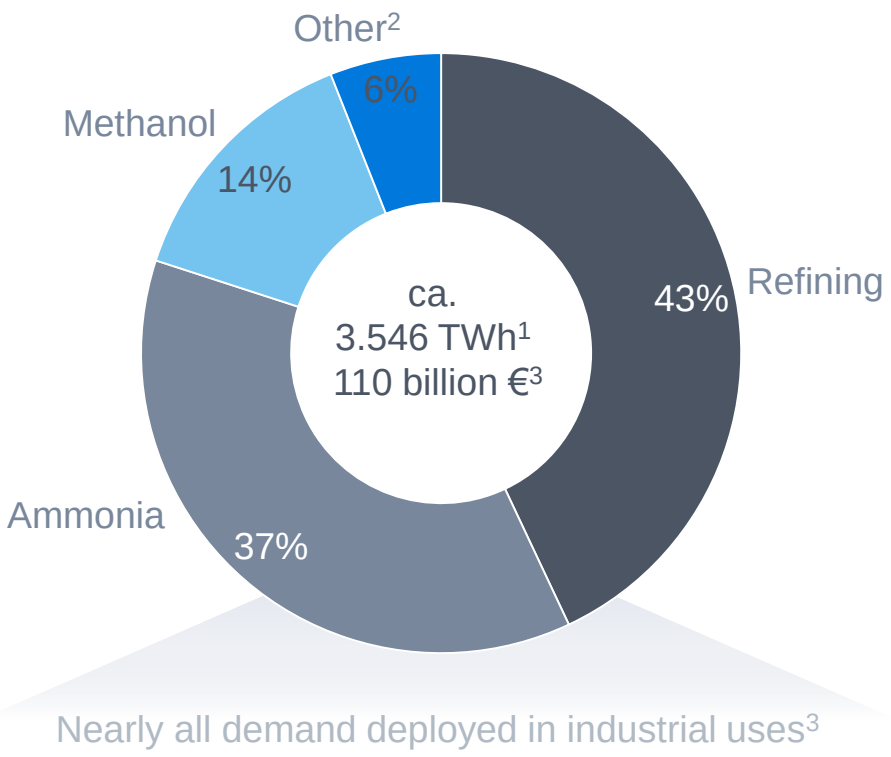
Production of hydrogen on a gigascale level

- thyssenkrupp nucera is one of the few suppliers in the world able to offer technology for the production of hydrogen on a gigascale level.
- With over 600 projects, 240.000 electrolytic cell elements produced and over 10 GW of electrolyzer capacity installed, thyssenkrupp nucera is a market leader in the chlor-alkali sector.
- Here we want to further expand our leading position in electrolysis - with cutting-edge technology and further major international projects.

Hydrogen already has a market demand of more than 3.500 TWh

Hydrogen market demand 2020A[1]



Current H_2 market generates

900

Mt of CO_2 emissions per year[1]…

… Total industry[4] generates 24% of global emissions

2020

~950 GW

electrolysis

…assuming 3.546 TWh at 100 % green H_2 at 75% energy efficiency and 5.000 full load hours of operation p.a.

1. Source: IEA (2021), Hydrogen, IEA, Paris https://www.iea.org/reports/hydrogen 2. Includes DRI and other industrial uses 3. Source: Bloomberg News, Hydrogen Generation Market Worth $201 Billion by 2025, February 16, 2021 4. Refers to 2019 Other Energy Industries and Industry uses

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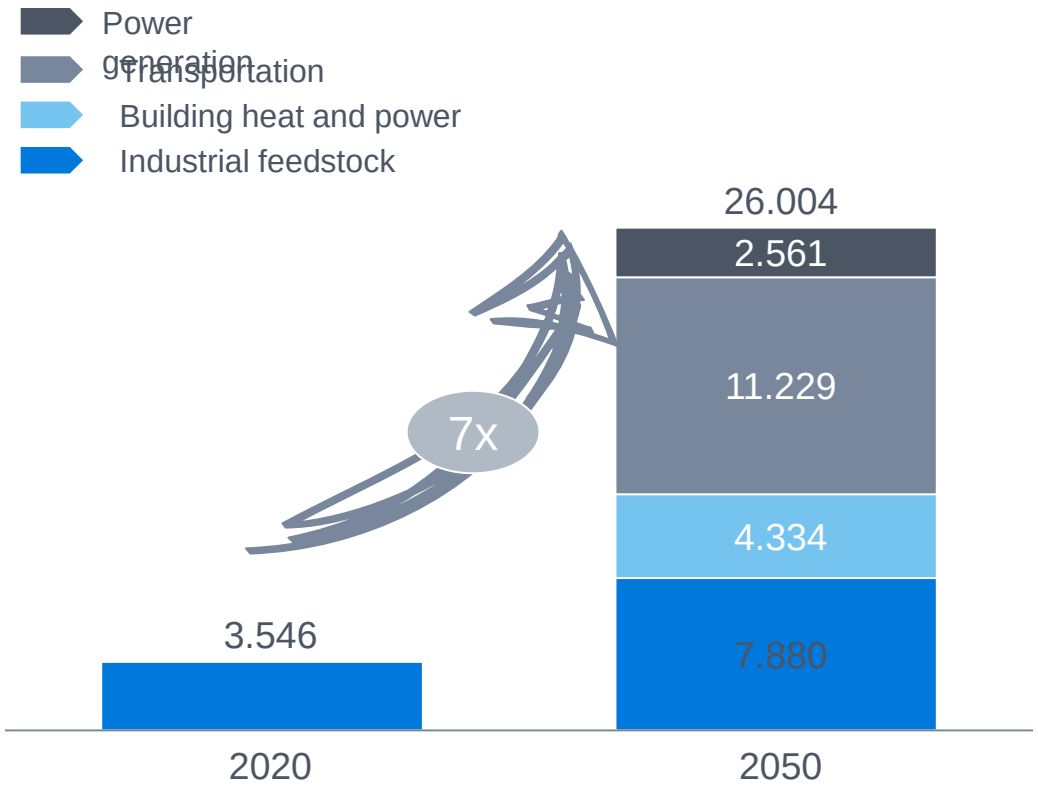
The worldwide hydrogen market is expected to grow sevenfold by 2050

Hydrogen market development until 2050 (TWh[1])[2]



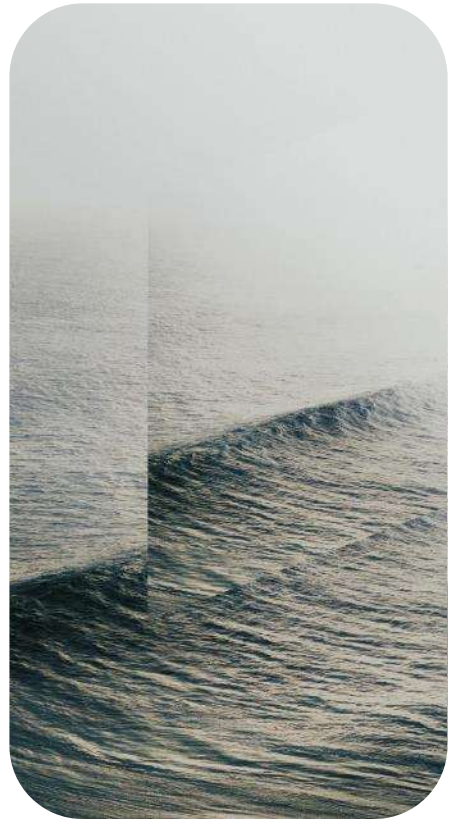
2050: green hydrogen will account for[2]
60 – 80%

80 Gt of CO_2
cumulatively abated by 2050[2]

2030:
>200 GW demand
60-150 GW supply

2050
about
~5500 GW
electrolysis

…assuming 26004 TWh at 80% market share of green H_2 at 75% energy efficiency and 5000 full load hours of operation p.a.



1. Converted from Mt with an energy content of 1kg of hydrogen equal to 141.9 MJ (HHV) = 39.4 KWh
2. Source: Hydrogen Council in collaboration with McKinsey & Company, Hydrogen for Net Zero Report, November 2021

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thyssenkrupp nucera's proven experience in chlor-alkali business provides a strong technology basis for AWE scale-up

	Chlor-Alkali Electrolysis	Alkaline Water Electrolysis
	A global leader with proven experience with over 600 projects & 240,000 cell elements >10 GW of electrolyzer capacity installed	Building on chlor-alkali experience to be #1 in AWE
Market Readiness	• Industrial-scale installations • Quality proven supply chain of 1 GW cell manufacturing capacity p.a.	• Industrial-scale hydrogen plants • Expand to a 5 GW supply chain
Product	• A technology leader for electrolysis • Handling of hydrogen as a by-product	• Standardized AWE product with leading TCO[1] • Hydrogen as the main product
Organization & Network	• Holistic life cycle services • Global network with partners	• Successful service model • Automation and digitalization

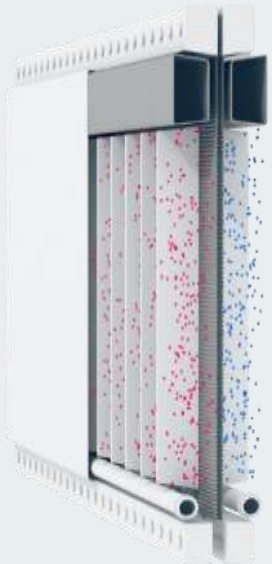
Key enabler of hydrogen production

1. Total cost of ownership

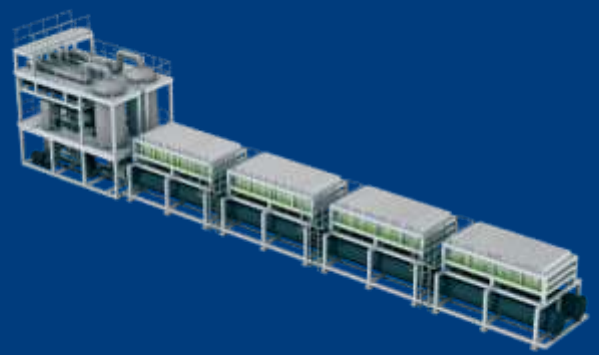
1

thyssenkrupp nucera offers an efficient and highly scalable module concept to match highest market demands

AWE single element



20 MW electrolyzer unit



Highly scalable GW plants

1

thyssenkrupp nucera has the largest contract backlog[1]

“NEOM” Project

>2 GW

2026 Start-up

“Shell” Project

200 MW

2024 Start-up

thyssenkrupp nucera has an AWE order backlog of approx. 0.9 bn €□ and a CA and Service order backlog of approx. 0.4 bn €□

[1] As of 31.12.2021

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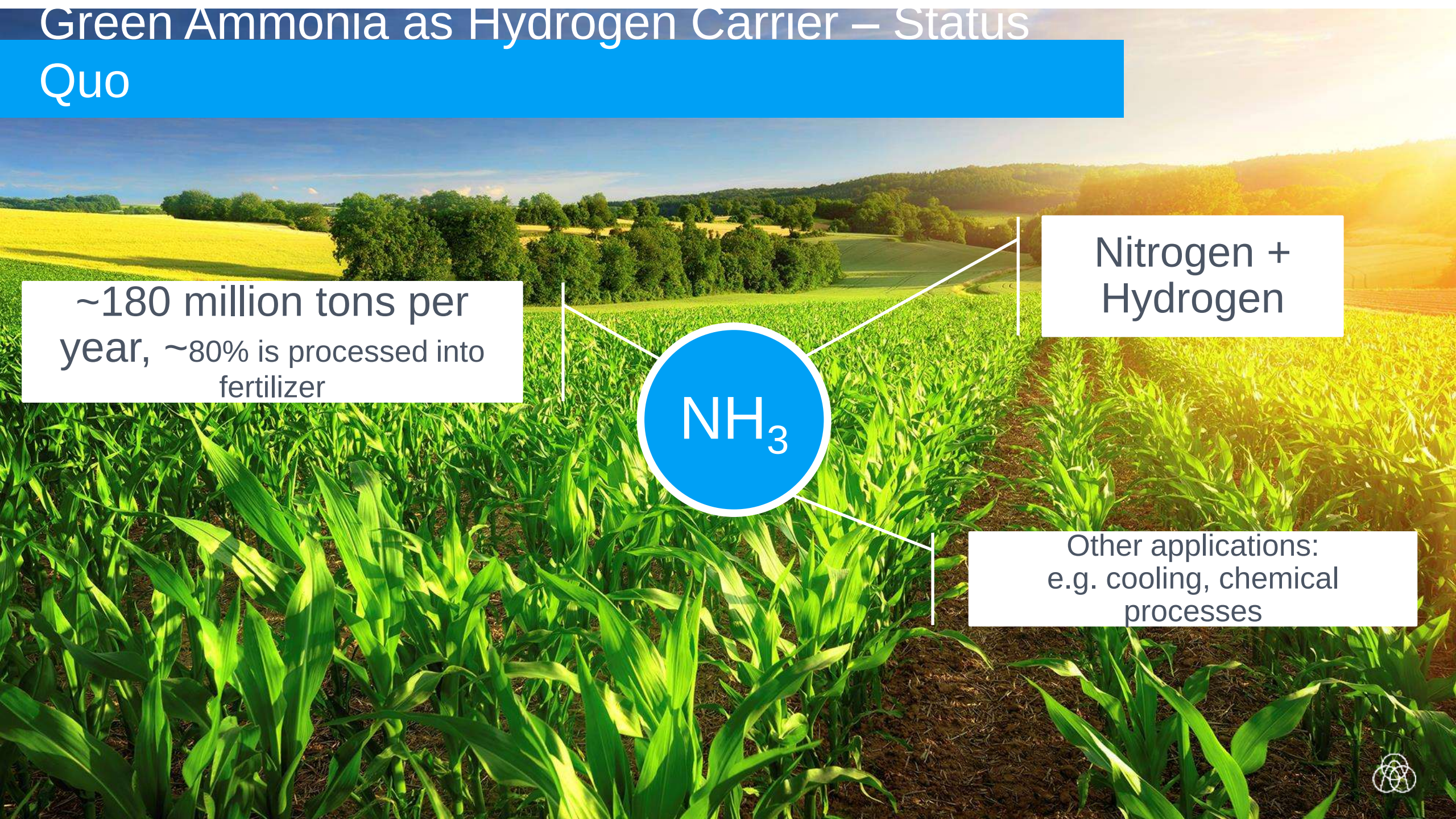
Expansion of wind energy

- With our innovative slewing bearings we are making the boom in wind energy possible in the first place.
- Wherever new wind farms are built, there is a high probability that thyssenkrupp technology is involved.

Hydrogen transport

- Our plant engineers at thyssenkrupp Uhde are experts in the construction of ammonia and methanol plants.
- Ammonia is most likely the future transport media for importing green hydrogen from other regions of the world to Europe.

Green Ammonia as Hydrogen Carrier – Status Quo



Ammonia: an ideal hydrogen carrier

H_2

Hydrogen only liquefies at extremely low temperatures:

-253°C

is consumes up to 40% of the energy bound in the hydrogen

NH_3

Ammonia liquefies at about twice the temperature of a freezer:

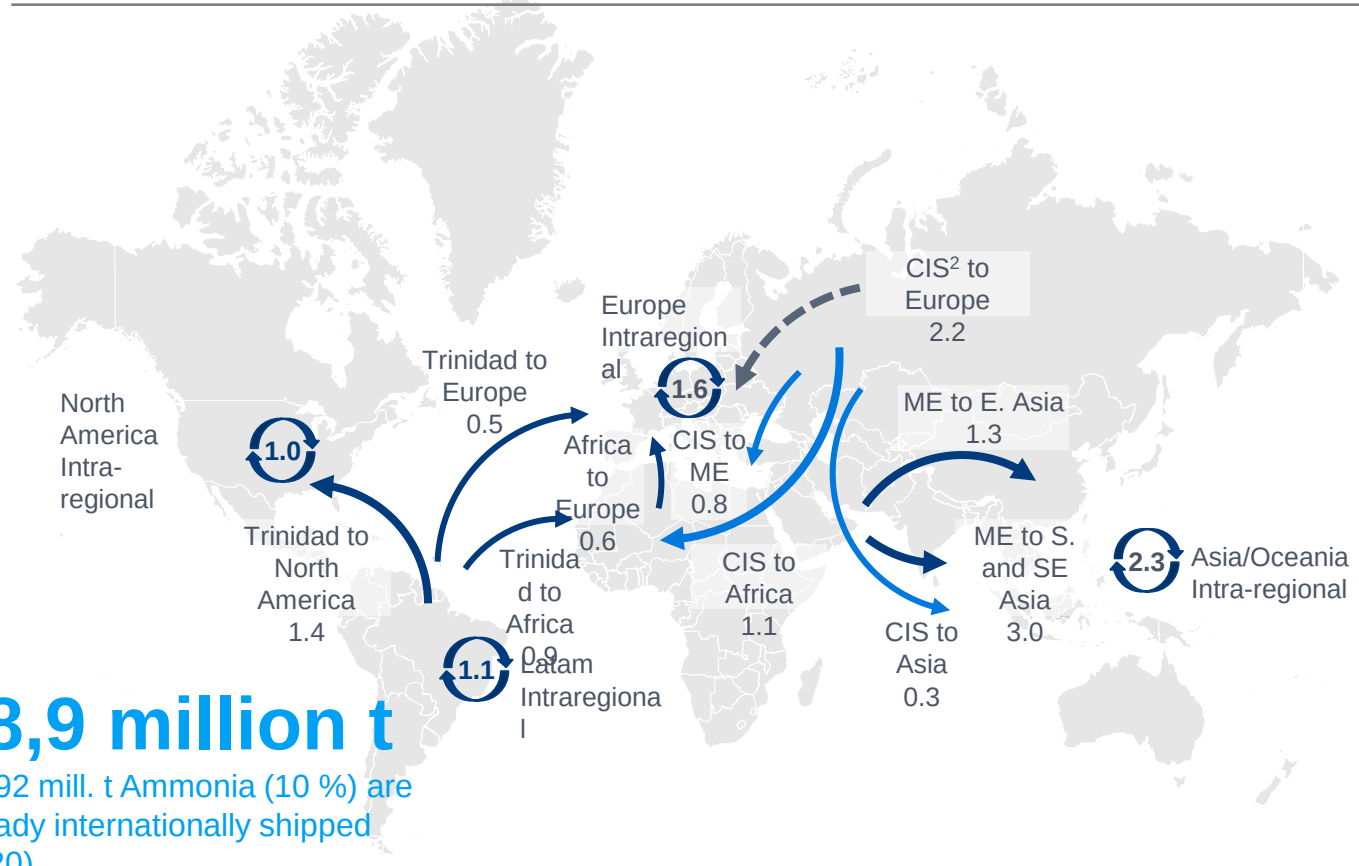
-33°C

…and has a higher energy density than hydrogen (by volume):

33% more energy

Ammonia transportation remains strongly dependent on global transportation via ship

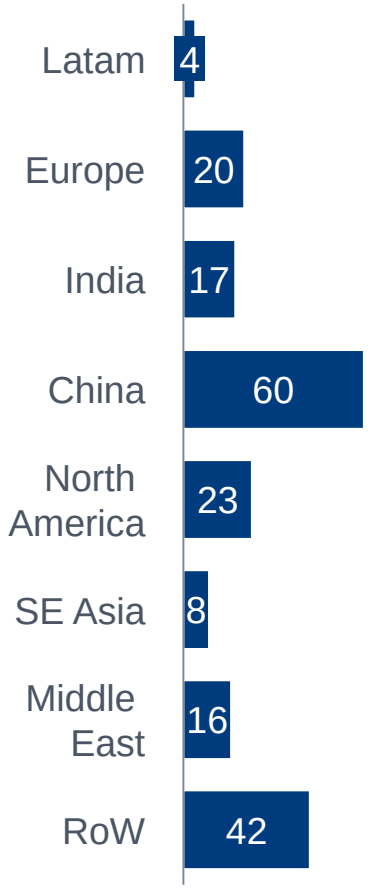
2020: 3.3 million tons of Ammonia imported to Europe



18,9 million t

of 192 mill. t Ammonia (10 %) are already internationally shipped (2020)

Ammonia Consumption[1] 2020, in mill. t



Key Statements

~10 % of the globally generated Ammonia is being **exported**

Main Volume of Ammonia will be furtherly converted (~75 %) => not available for alternative use

LATAM and **Europe** are largest importers (38 % / 24 %)

1. Fertecon
2. CIS (inkl. Russia, Belarus, Armenia, Azerbaijan, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan and Uzbekistan)

Source: Fertecon; IHSM, ITC Trademap, Worldomap, Reuters

These different competencies in forward-looking technologies and different perspectives on green value chains make thyssenkrupp a unique partner for the green transformation.

partnerships

Individual actions will not be enough – because building the necessary global infrastructure for the green transformation is a challenge for society as a whole

We need efficient global cooperation between politics and business to optimize and accelerate the necessary development of the entire infrastructure.

Our 200-year history proves that we think long-term and are interested in stable partnerships, which are of elementary importance for the success of the green transformation.

We strive for global partnerships and win-win opportunities for the green transformation

engineering.
tomorrow.
together.

thank

you!