

# Perspectives on hydrogen use in the steel industry

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tkH<sub>2</sub>Steel

engineering.tomorrow.together.



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## We have defined clear climate targets

**-30%** Emissions from our own  
production operations and  
processes<sup>1</sup>

**2030** **-30%** Emissions from  
energy  
procurement<sup>2</sup>

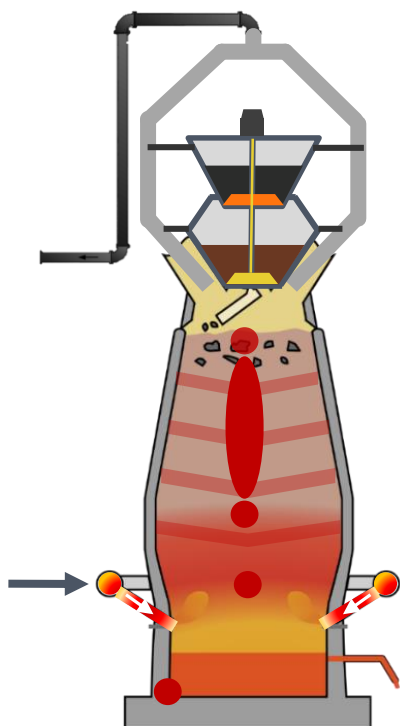
<sup>1)</sup> SCOPE 1-Emissions; <sup>2)</sup> SCOPE 2-Emissions (Base year 2018)



# Gas and electricity will replace coal in future steelmaking

**Blast furnace** needs coke as reduction and structural agent to produce liquid hot metal

Additional  
reduction agent  
(pulverized coal,  
natural gas, coke  
oven gas, H<sub>2</sub>)

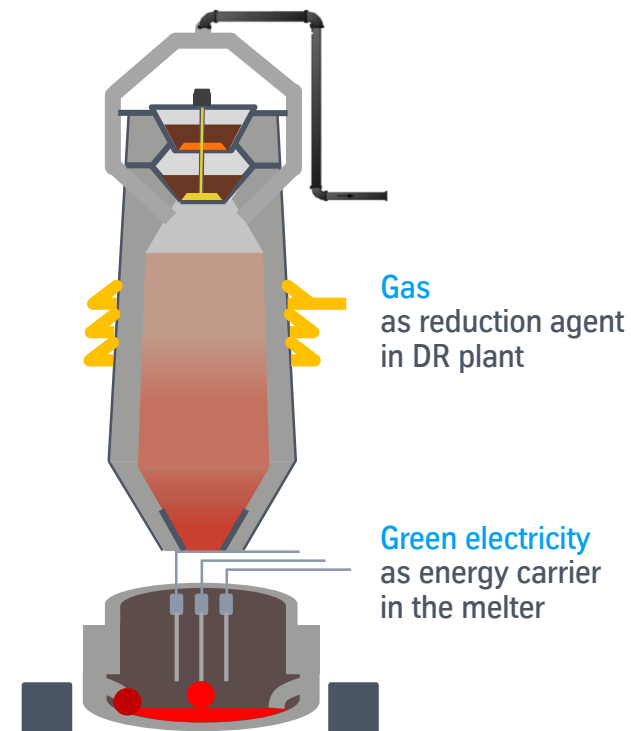


1,800

kg CO<sub>2</sub> emissions per t crude steel

About – 95 %

**Direct reduction plant** uses gas (natural gas, coke oven gas or hydrogen) to produce solid sponge iron subsequently liquefied in **electric melter**



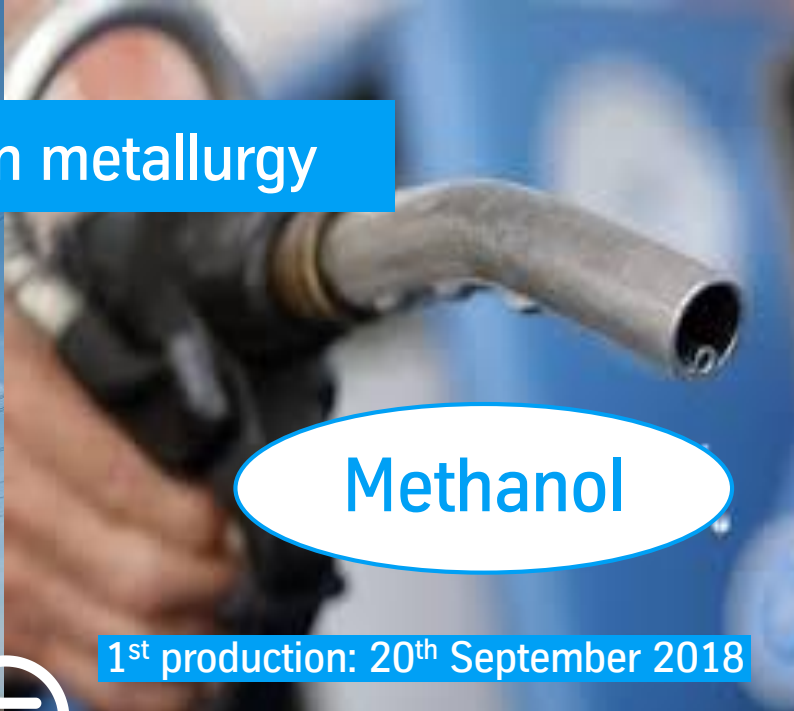
100

(remaining emissions when using  
hydrogen and green electricity)



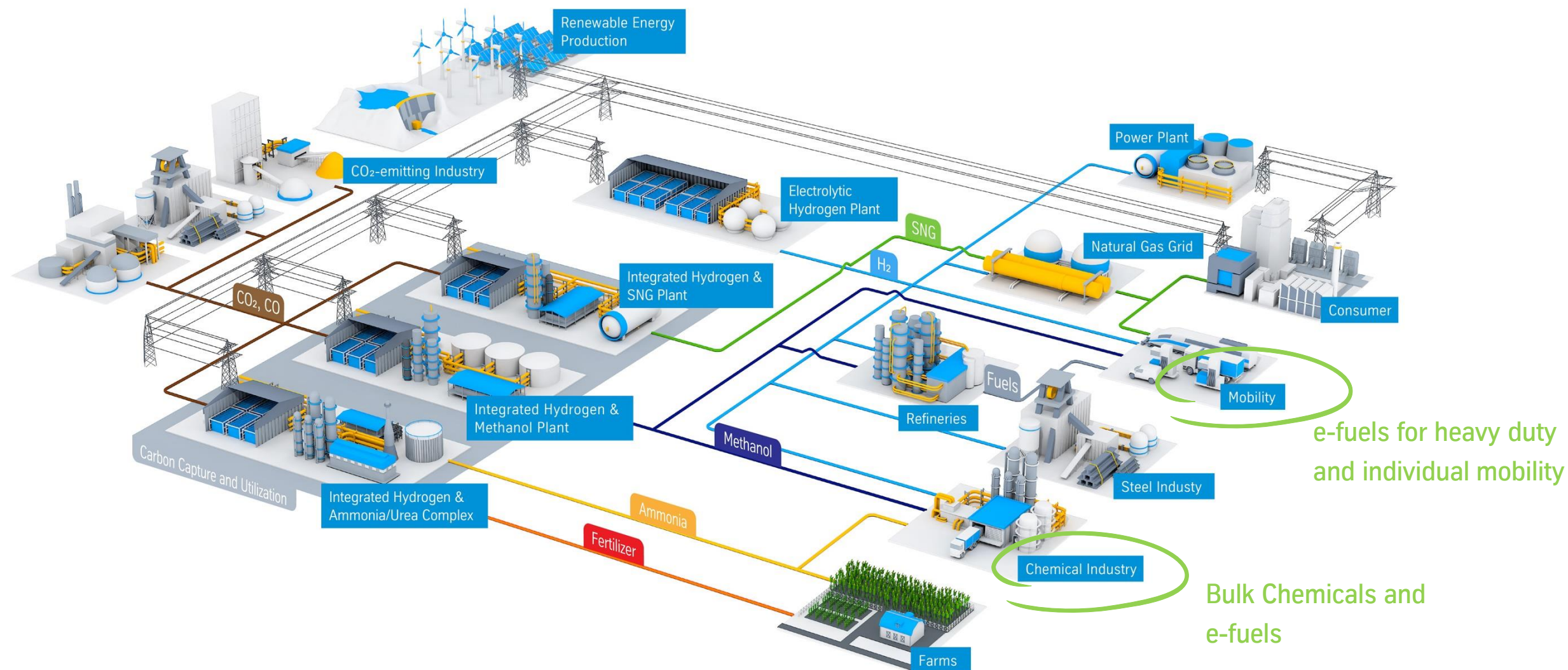


Carbon2Chem® will support decarbonization parallel to hydrogen metallurgy





# Steel mills can be integrated in sustainable green value chains



# Hydrogen for climate-neutral steel

## 2024 onwards The milestone

Using a large-scale direct reduction plant (DR) which will be operated using green H<sub>2</sub> in the future, thyssenkrupp will produce sponge iron which will then be processed in the blast furnaces (BF), allowing a further reduction in emissions.

2019 - 2022

## H<sub>2</sub> in the blast furnace

We have been testing the use of hydrogen in a working blast furnace since 2019. The goal: The equipment of blast furnace 9.

## 2030 onwards The scale-up

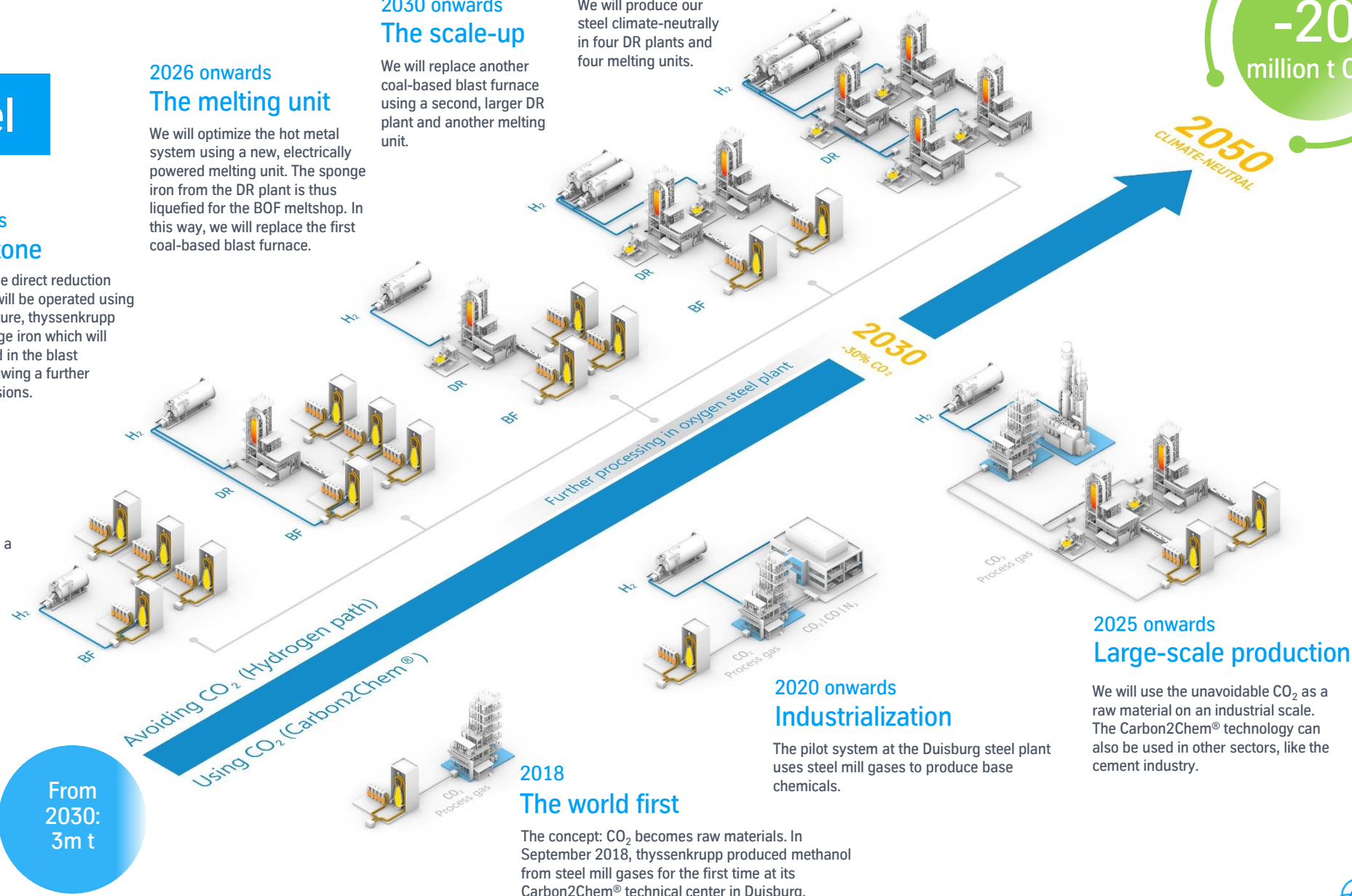
We will replace another coal-based blast furnace using a second, larger DR plant and another melting unit.

## 2050 onwards Climate-neutrality

We will produce our steel climate-neutrally in four DR plants and four melting units.

-20  
million t CO<sub>2</sub>

2050  
CLIMATE-NEUTRAL



Available quantity of  
climate-neutral steel (per year)

From  
2022:  
50,000 t

From  
2025:  
400,000 t

From  
2027:  
950,000 t

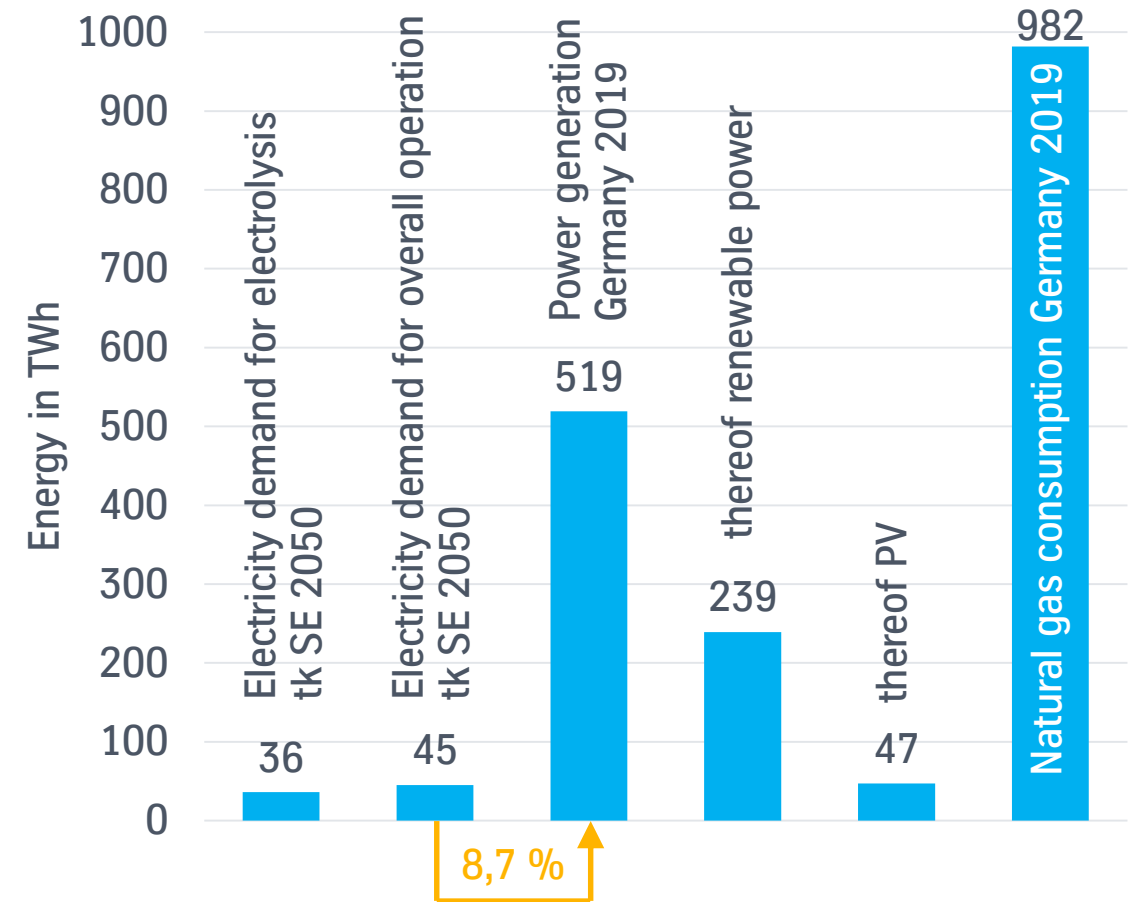
From  
2030:  
3m t



# The energy demand is significant compared to the German electricity and gas market



Assumption: 10 mtpa steel from hydrogen direct reduction, Carbon2Chem not included



Sources:

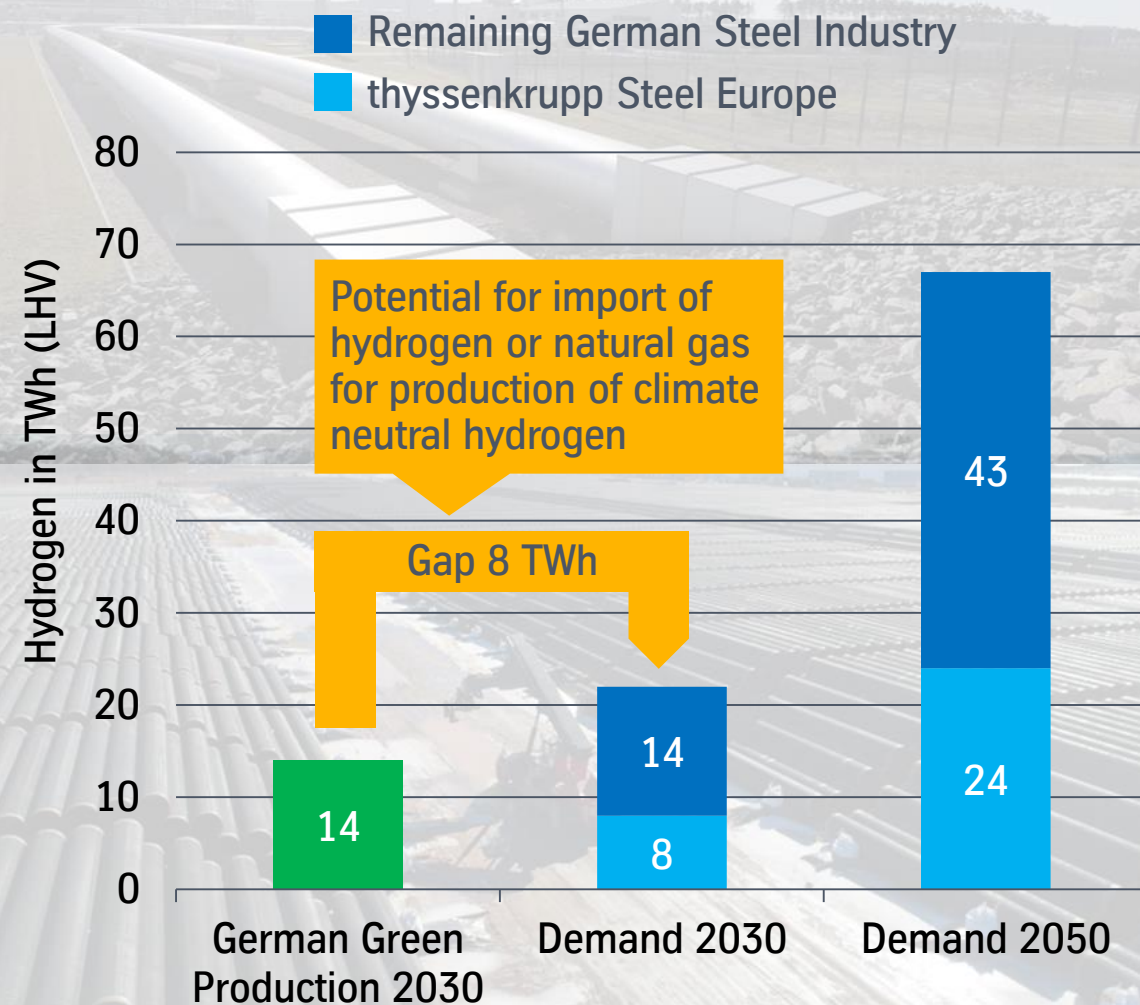
[https://www.energy-charts.de/energy\\_pie\\_de.htm?year=2019](https://www.energy-charts.de/energy_pie_de.htm?year=2019)

[https://www.bdew.de/media/documents/Erdgasverbrauch\\_Vgl\\_2018\\_2019\\_monatlich\\_online\\_o\\_monatlich\\_Ki\\_12032020.pdf](https://www.bdew.de/media/documents/Erdgasverbrauch_Vgl_2018_2019_monatlich_online_o_monatlich_Ki_12032020.pdf)



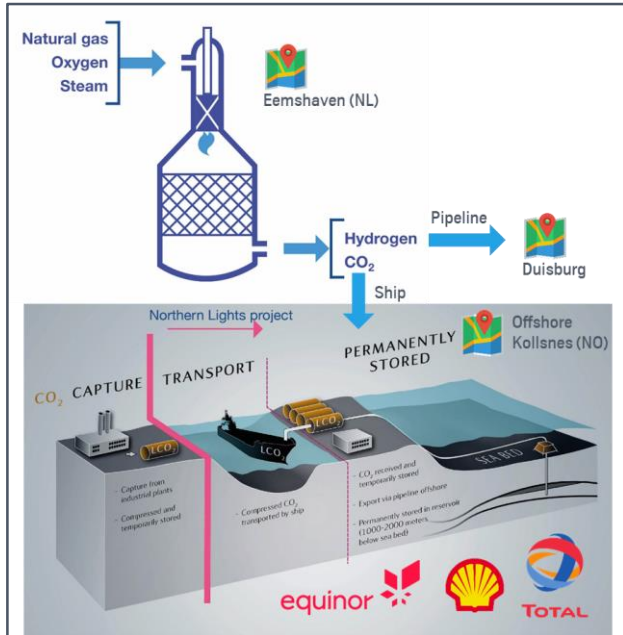


# German green domestic hydrogen production will not be sufficient





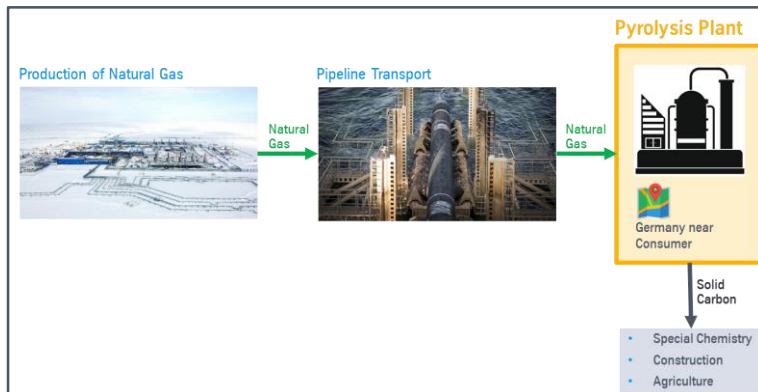
# We follow an technology open approach in hydrogen supply projects



**H2morrow steel**

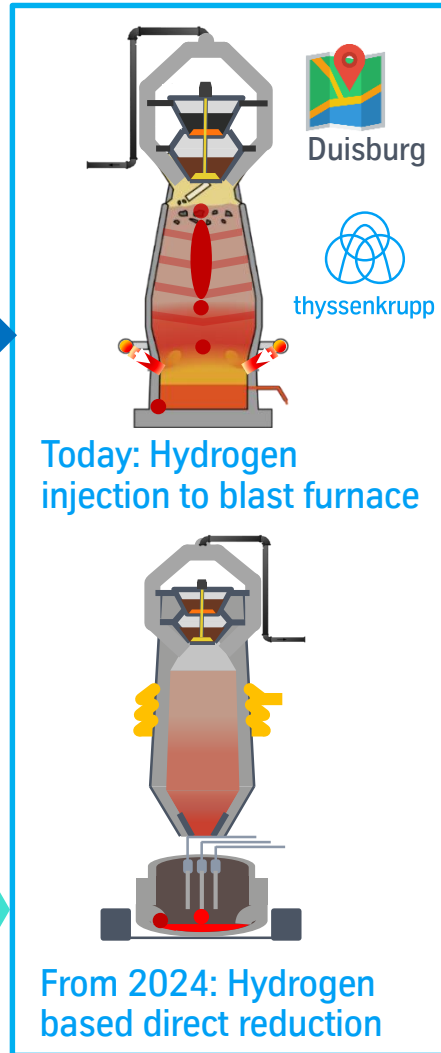
Completed feasibility study for 2.7 GW ATR with CCOS

Blue hydrogen



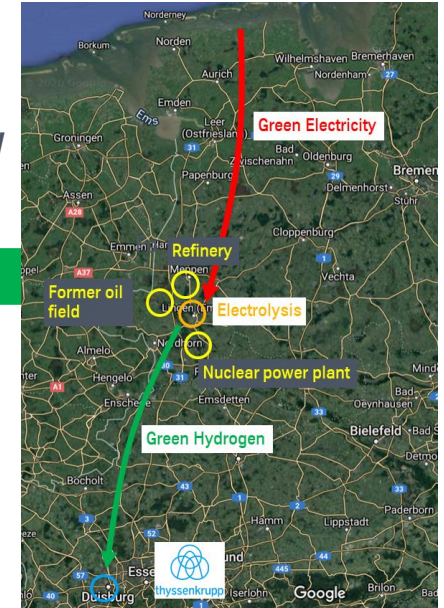
Pre feasibility study

Turquoise hydrogen



Cooperation for 100 MW electrolysis in Lingen

Green hydrogen  
**RWE**

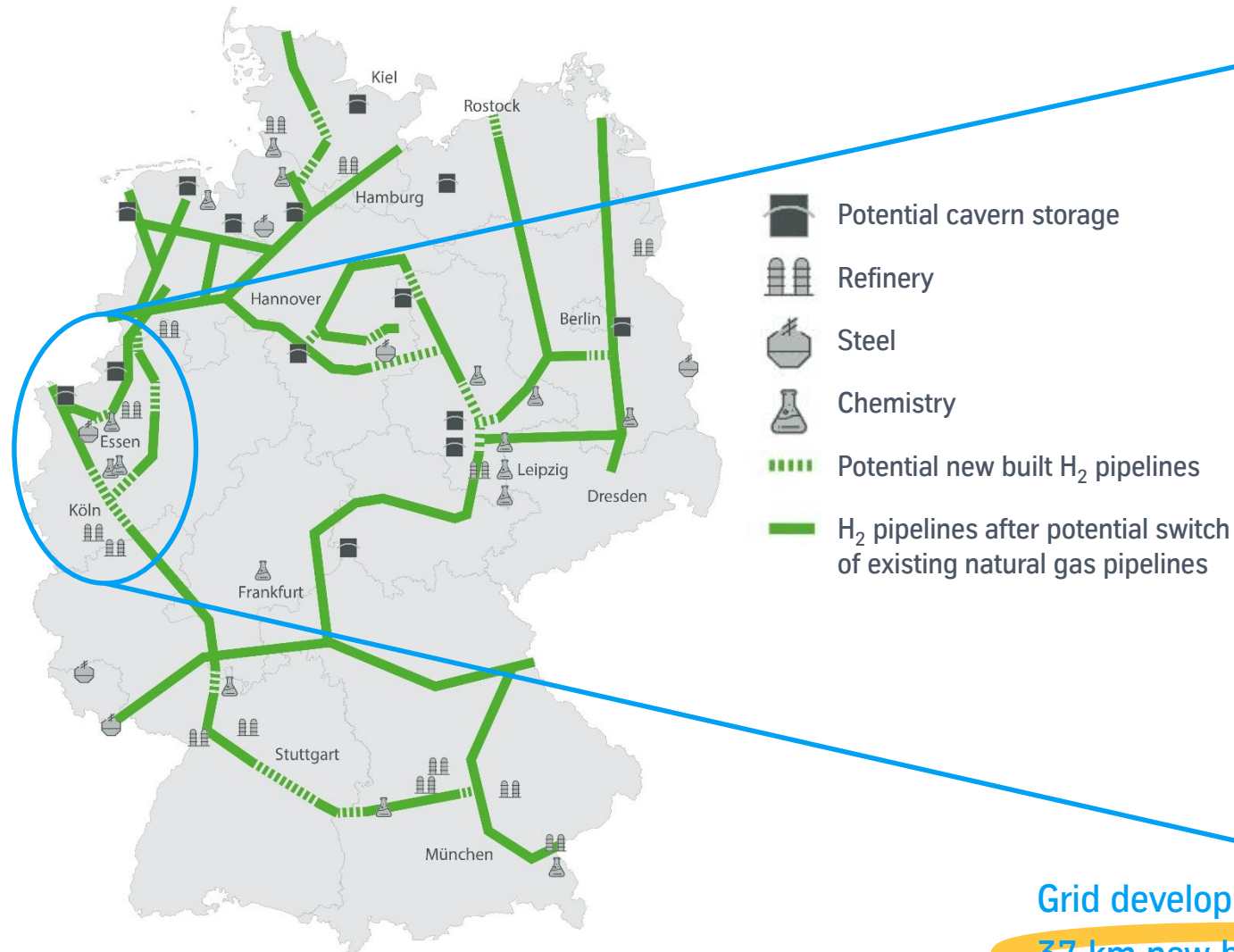


Feasibility study for 500 MW electrolysis in Duisburg-Walsum

Green hydrogen  
**steag**

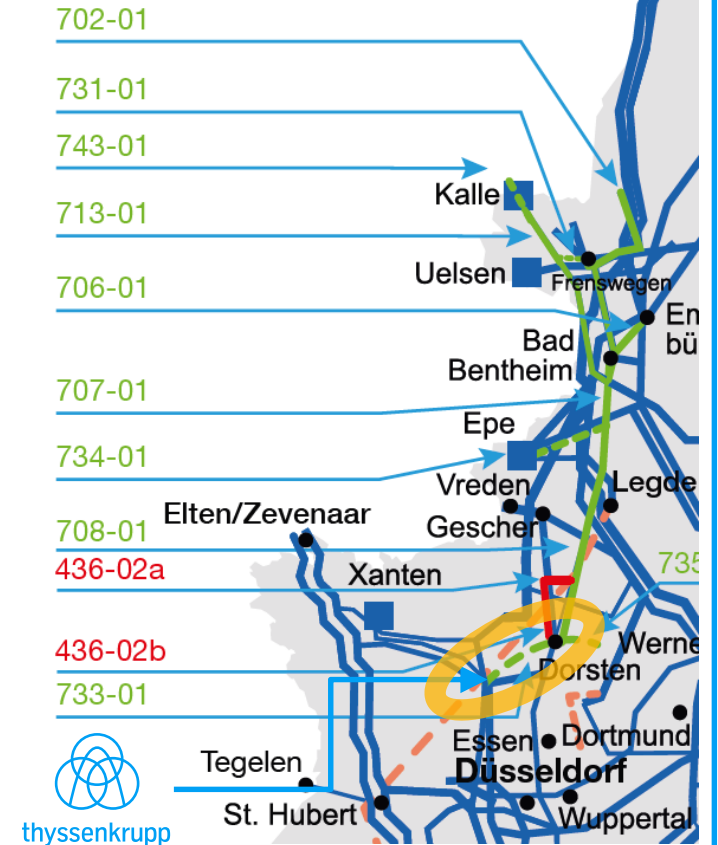


# Hydrogen pipeline connection is a prerequisite for a succesful transformation ...



Source: FNB Gas

Source: Entwurfsdokument NEP Gas 2020-30



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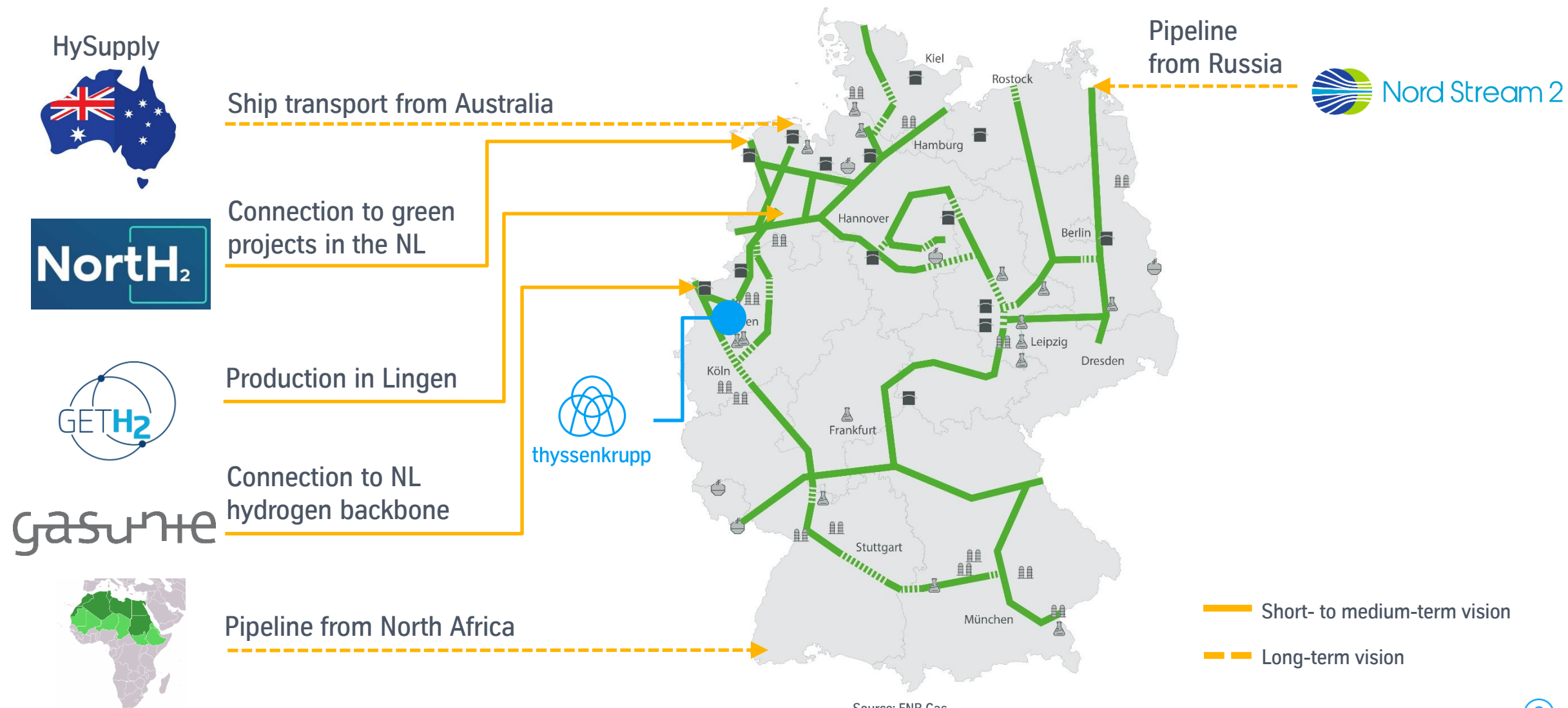
Grid development plan gas 2020-30 (green gas variant):

37 km new built H<sub>2</sub> pipeline and conversion of existing NG pipelines to H<sub>2</sub> for supply of tk SE Duisburg by end of 2026





## ... and enables further future partnerships



Thank you

for your attention!



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