



Uhde innovate 2024

Closing the green value chain with Uhde ammonia cracking

05.06.2024 | Dr. Christian Renk
thyssenkrupp Uhde

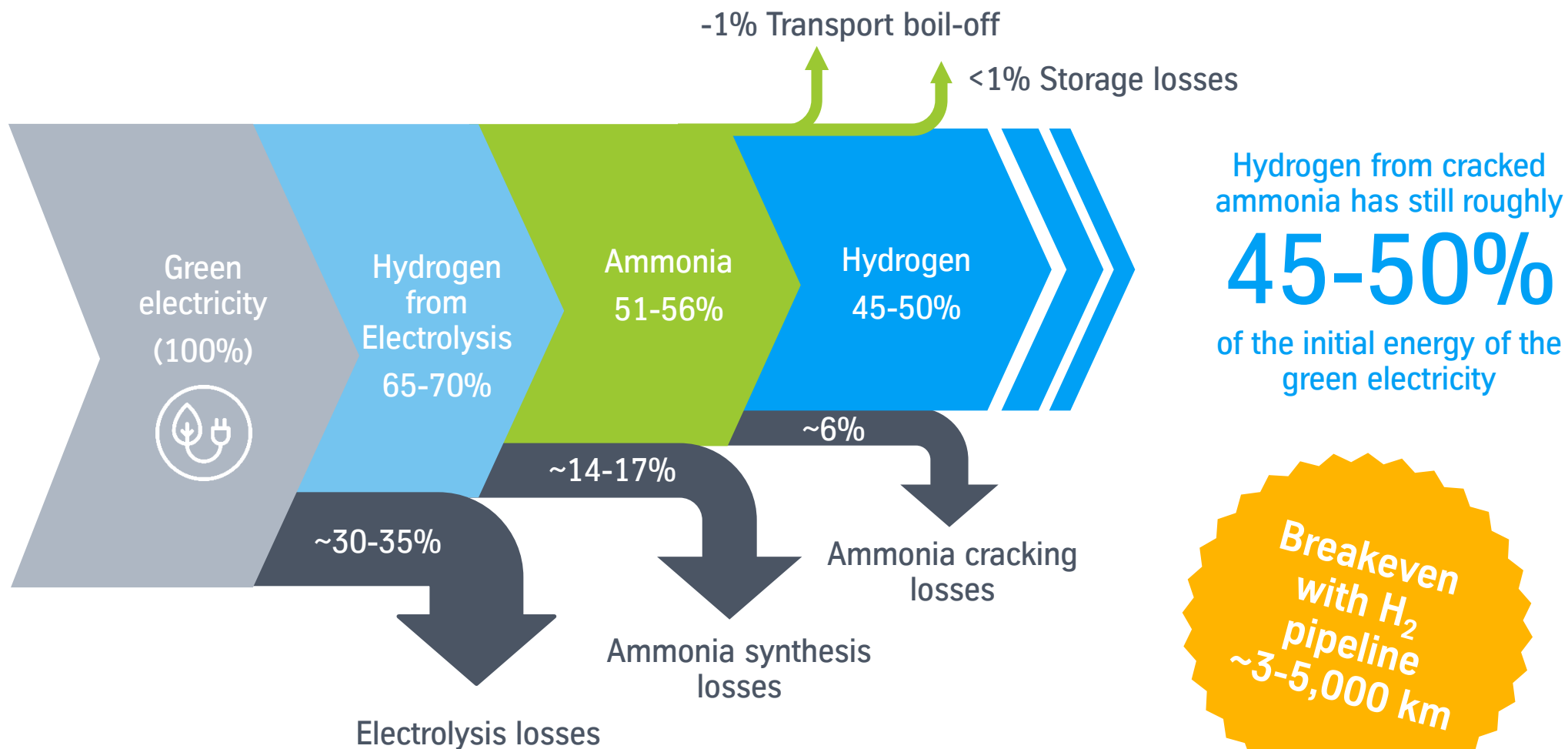
engineering.tomorrow.together.



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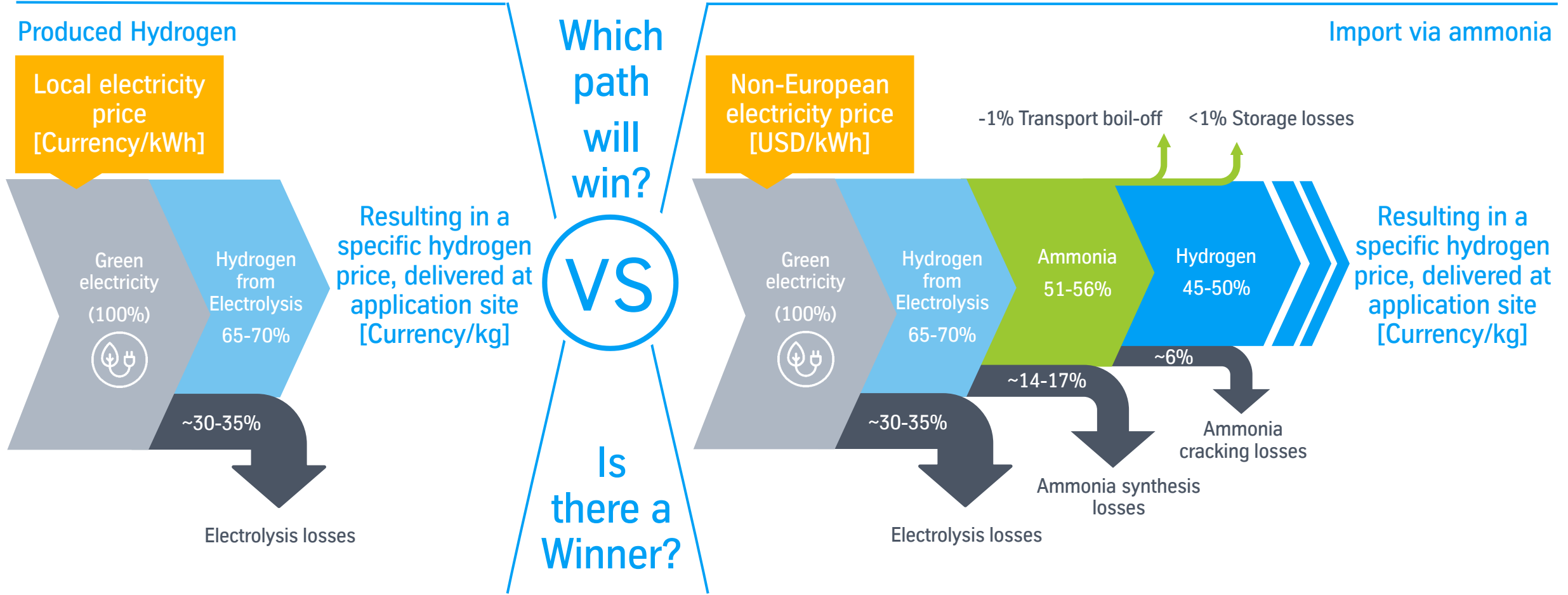
Energy flow diagram

Hydrogen transport via Ammonia and Cracking



Energy flow diagram

Produced Hydrogen vs. import via ammonia

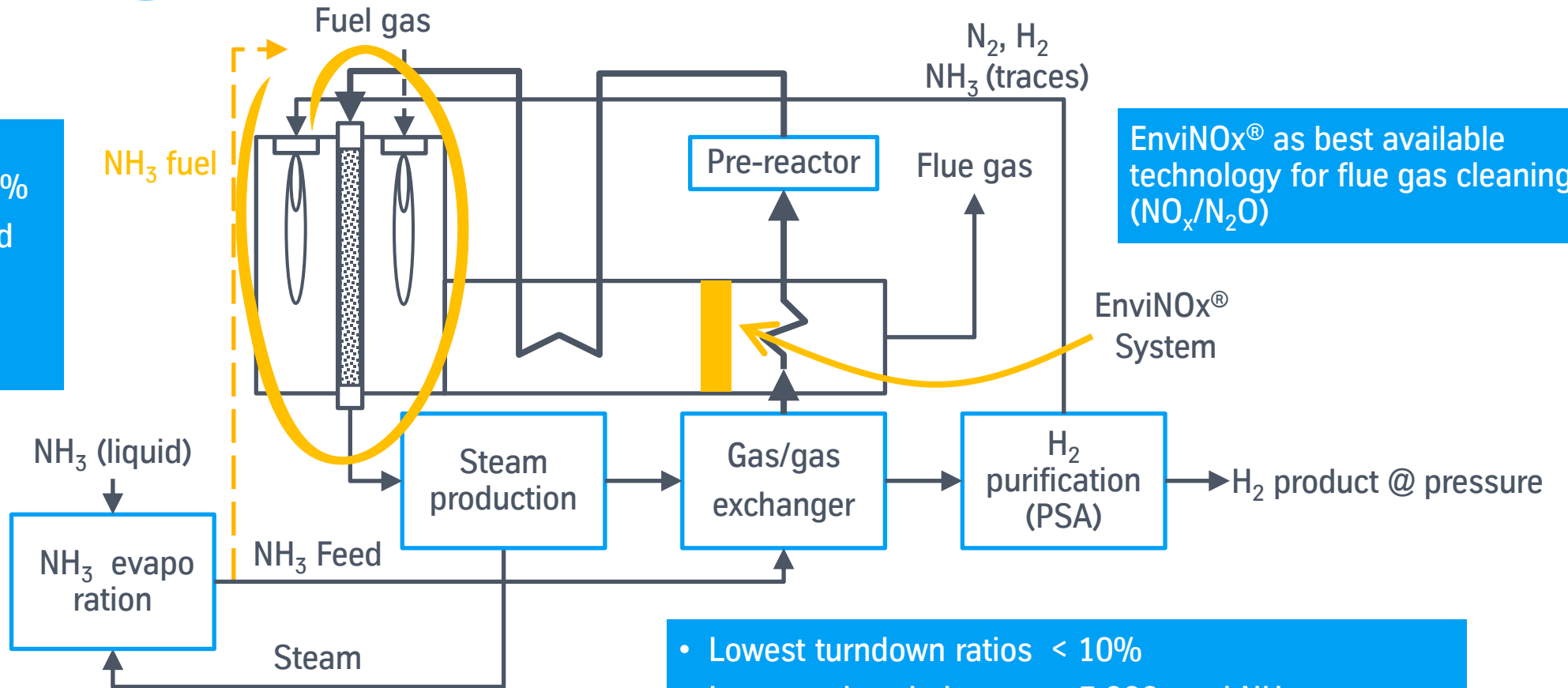


Ammonia cracking process flow – Demo & large scale



Uhde's well proven SMR prop. equipment with more than 100 large-scale installed units

- High catalytic NH_3 conversion to $\text{H}_2 > 98\%$
- Catalyst can withstand water content
- Purities adaptable to requirements of user



EnviNOx[®] as best available technology for flue gas cleaning ($\text{NO}_x/\text{N}_2\text{O}$)

EnviNOx[®] System

- Lowest turndown ratios $< 10\%$
- Large scale solutions over 3,000mtpd NH_3
- Highest energy efficiency



Ammonia cracking

Main challenges and development

Uhde Main Technical Development

Reformer Burner with ammonia
and hydrogen fuel

Burner tests and simulation for stable flame and low
 NO_x and N_2O emission

TRL 6-7



Significant progress and positive outcomes in burner development

Burner and material test

Further Development ongoing: Firing / Burner Technology for firing with Ammonia Gases



New burner technology required for firing with Ammonia, Hydrogen and any mixture

Ammonia cracking

Main challenges and development

Uhde Main Technical Development

Reformer Burner with ammonia and hydrogen fuel

Temperature profile in catalyst bed

Flue gas cleaning

Burner tests and simulation for stable flame and low NO_x and N₂O emissions

TRL 4-5

Lab and demo test facility for optimum utilization of available catalysts (high conversion and long lifetime)

NO_x/N₂O emission at a minimum with Uhde's market leading EnviNO_x® technology

TRL 8



Advancing Catalyst Development with Positive Results

Laboratory Test Facility

Laboratory test facility for optimum utilization of available catalysts (high conversion and long lifetime) for the Ammonia Cracking and the EnviNOx[®] system



Ammonia cracking

Main challenges and development

Uhde Main Technical Development

Reformer Burner with ammonia and hydrogen fuel

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Temperature profile in catalyst bed

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Flue gas cleaning

NO_x/N₂O emission at a minimum with Uhde's market leading EnviNO_x® technology

Heat integration

High efficiency energy

Nitridation

Material testing for hot service equipment



Current status

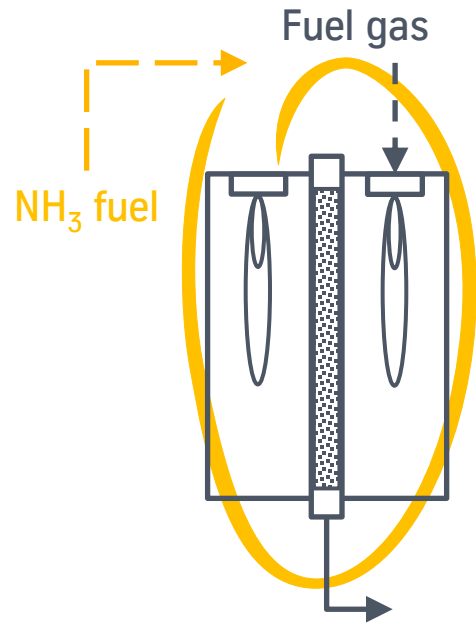
Test facility Demo Cracker

Start-up in early 2026:

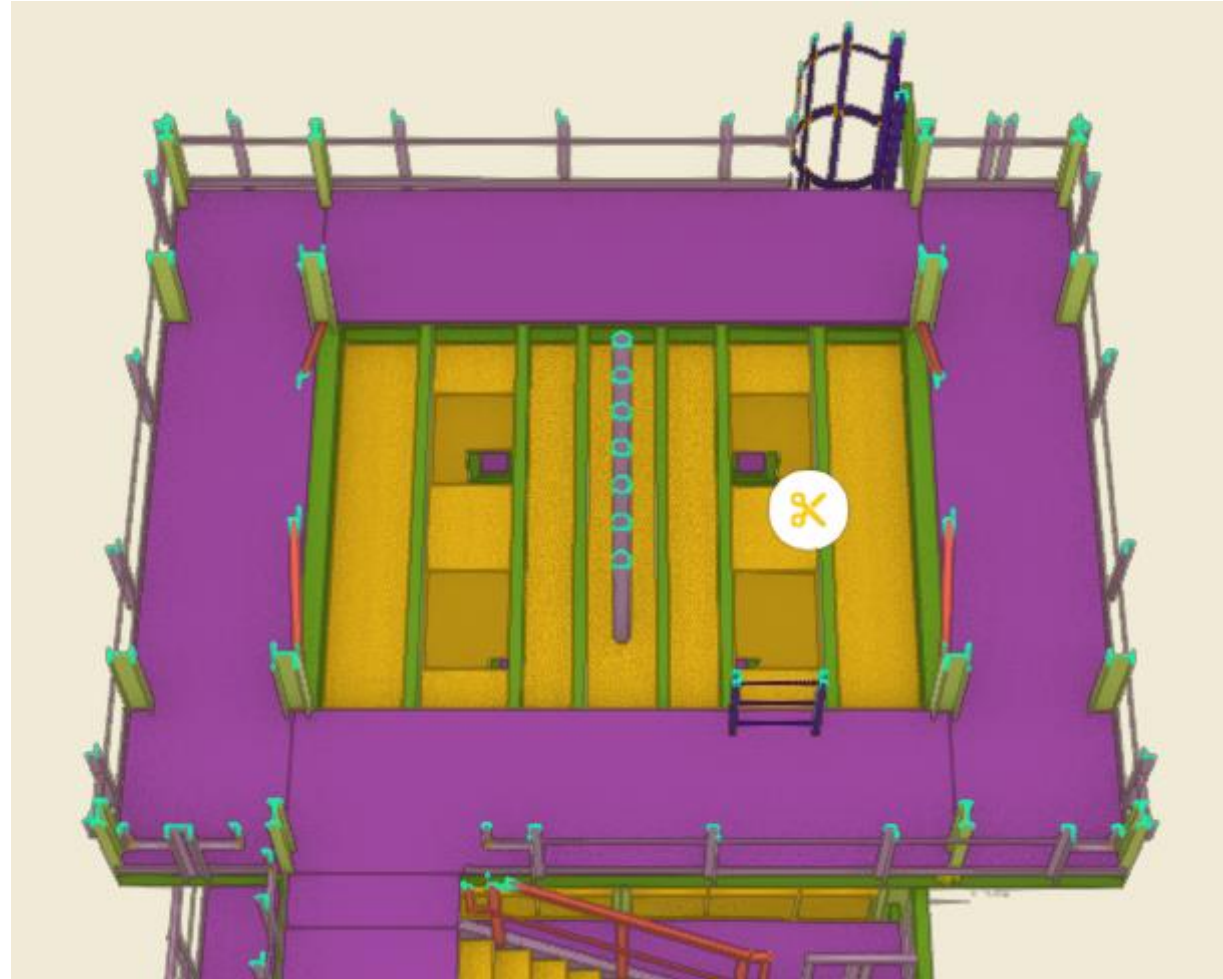
Uhde Ammonia Cracking Demo Plant



Ammonia cracking process flow – Reformer



- Demo Plant is a “cut out element” of future large scale Crackers
- Tubes with industrial length
- No scale-up but numbering up
- Reaching TRL 9 directly



Current status

Test facility Demo Cracker

Start-up in early 2026

uhde Ammonia Cracking Demo Plant

- Capacity of 28 mtpd ammonia
- Commercial size tubes for easy up-numbering to large scale application
- Flexibility in operation (pressure, temperature, throughput)
- Flexibility in design (burner and catalyst type, material)
- Flexibility in firing (ammonia and hydrogen)

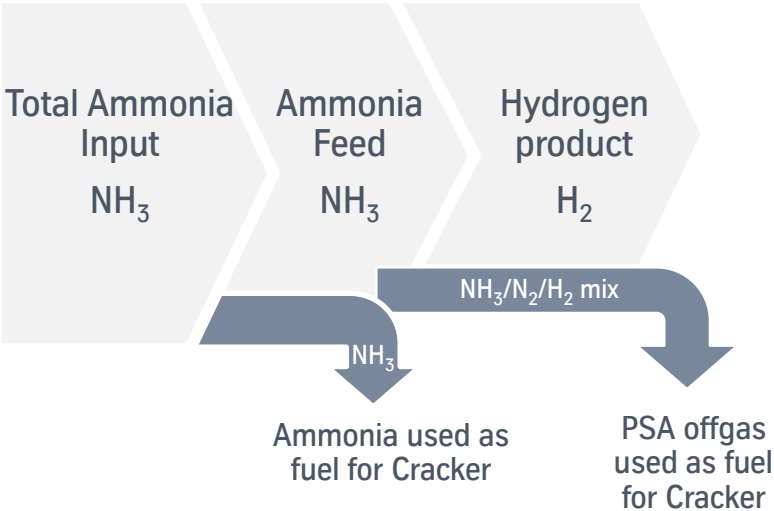
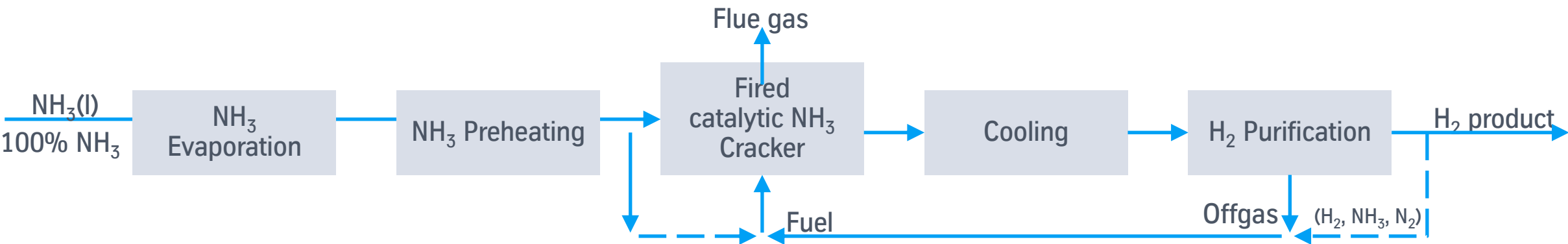


Ready for
Pre-FEED and
FEED from
Mid-2025



Hydrogen from ammonia - ammonia cracking

thyssenkrupp Uhde developments



Performance

Specific Ammonia Consumption [kg NH3/kg H2]	7.1
Hydrogen efficiency [H2 in product/H2 in ammonia input]	80 wt%
Energy efficiency [LHV out/(LHV in + Power in)]	90 %
Cracking Efficiency [% NH3 Cracked entering the reformer tubes]	>98 %
Direct Carbon Intensity [kg CO2/kg H2]	0





We create a
livable planet





Thank you for your attention



Head of Technology, Innovation and
Sustainability Operating Unit Fertilizer



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