

New Services

Uhde Ammonia Technology Users' Group Meeting

Munich, August 22nd 2023 | thyssenkrupp Uhde



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Optimize fertilizer production by plant digitalization

Uhde Ammonia Technology Users' Group Meeting

Munich, August 22nd 2023 | Dr. Sascha Wenzel | thyssenkrupp Uhde



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Optimize fertilizer production by plant digitalization

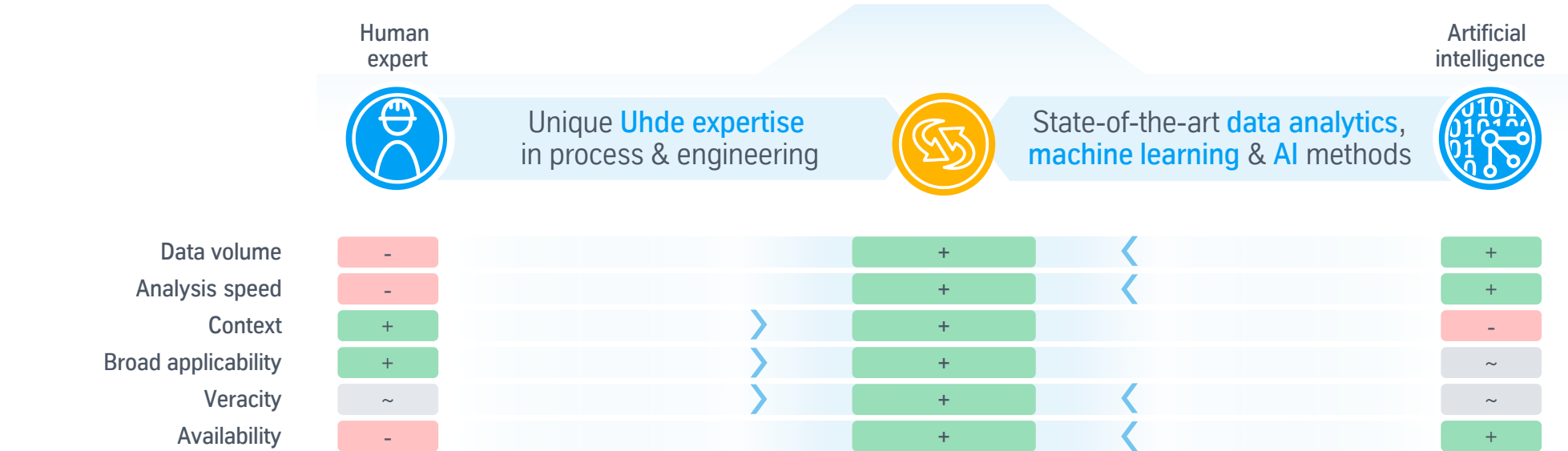
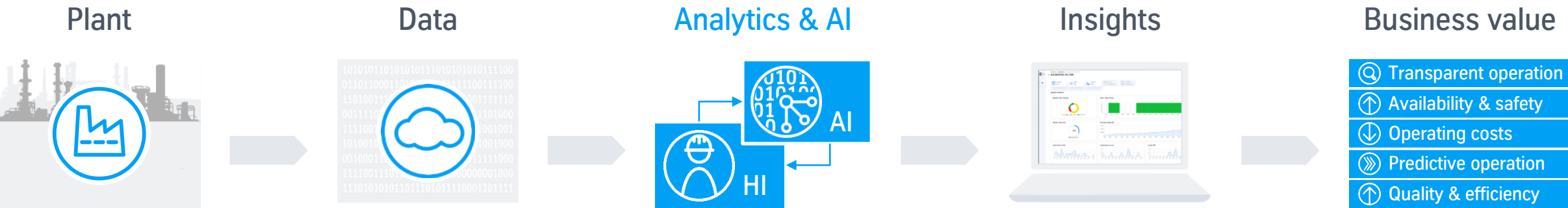
Agenda

- | | |
|---|-------------------------------------|
| 1 | Intro |
| 2 | Remote Performance Monitoring (RPM) |
| 3 | Advanced Process Control (APC) |
| 4 | Digital Twin |
| 5 | Summary and Outlook |



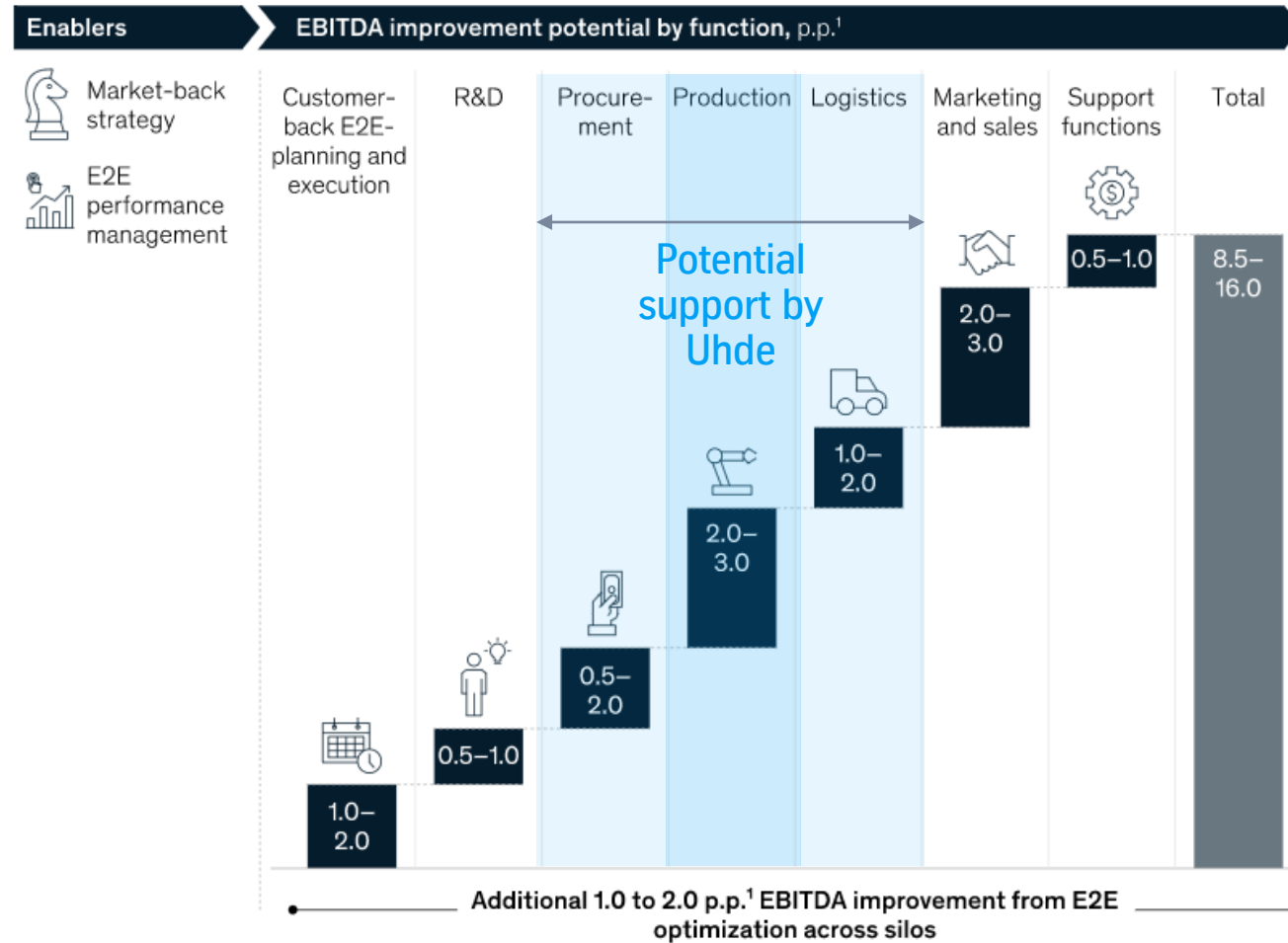
1. Introduction to plant digitalization

The combination of human & artificial intelligence is driving new opportunities



1. Introduction to plant digitalization

Digital technologies can increase customer's EBITDA by 8.5 to 16% along the chemical value chain



¹Percentage point; rough estimate before inflation, assuming a two-to-five-year journey to capture full potential.

Source: "End-to-end digital transformations for chemical companies", McKinsey, 2020

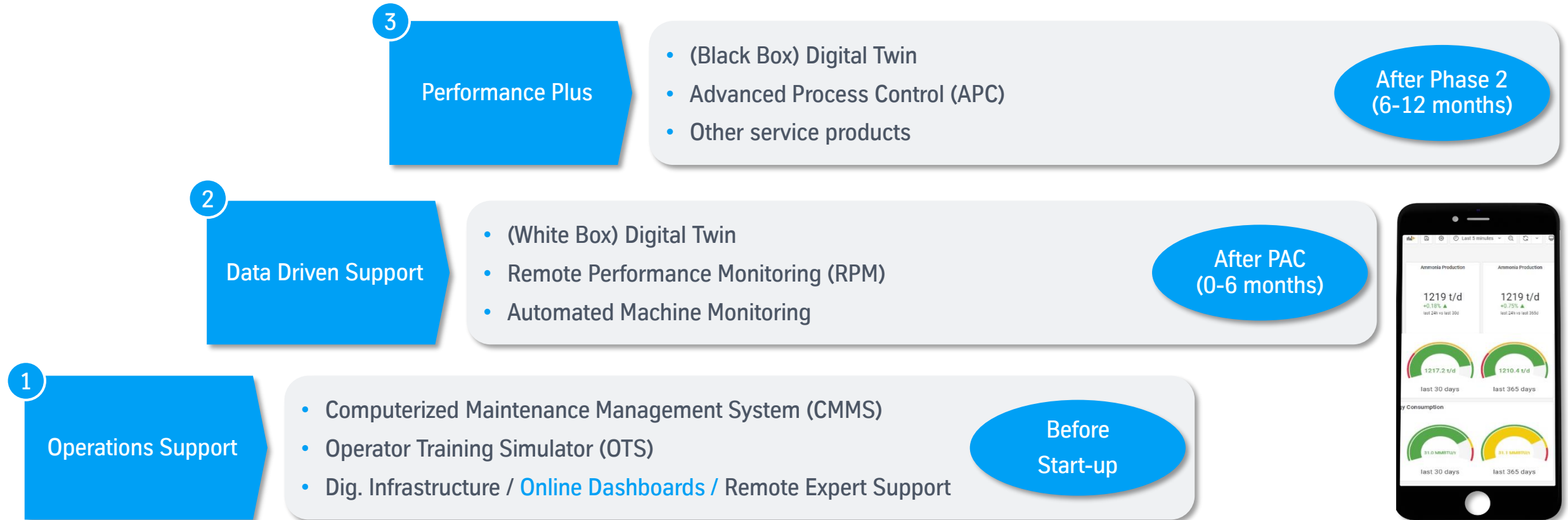
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5 | 22 August 2023 | Uhde Ammonia User's Group Meeting | New Service



1. Introduction to plant digitalization

Step-wise approach for optimized production



Your (data) security is of utmost importance to us

Multi-Factor Authentication

Encrypted data storage

Protected data transmission

Subject to European Data Protection Law

All servers located in the EU

Logical separation of customer data

Regular security checks

Our digital services are based on the trust that you place in us. Therefore, the protection of your data is of utmost importance to us. In order to ensure the highest possible security anywhere and at any time, we apply state-of-the-art security technologies:

- Access to the web applications for users and admins is secured by [Multi-Factor Authentication \(MFA\)](#). Passwords are securely stored as salted hash.
- All data on our servers are protected by the [latest encryption technology](#).
- Data in transit between backend or frontend components is [protected by TLS](#). Edge Device communication is [protected by SSH2](#).
- As a German company we are [subject to the law of the European Union](#), incl. one of the [strictest data protection laws](#) in the world.
- Our [standard platform is located in the European Union](#) and fully meets the European GDPR.
- We pursue the strategy of a [strict logical separation](#). Customer data stored and processed is strictly separated, e.g. role and authorization concept.
- Our data [security standards and roadmap](#) are regularly [checked by internal auditors](#) (CERT, ISO Team) [and by external parties](#) (KPMG), incl. ISO 27001 reviews, penetration tests, Red Teaming Measures.

Optimize fertilizer production by plant digitalization

Agenda

- 1 Intro
- 2 Remote Performance Monitoring (RPM)
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2. Remote Performance Monitoring (RPM)

Online access to plant data and advice by process experts

Scope

- This service is based on operating and analytical data transferred to thyssenkrupp Uhde.
- Online dashboards (incl. mobile access) help management to keep track of KPIs. In addition, regular reports including recommendations for operation and maintenance can be provided.

Benefits & Budget

- Full process transparency based on plant data via tk Uhde's proprietary cloud solution
- Deep process insights will be provided by analysing plant performance and advice will be given by process experts.



Optimize fertilizer production by plant digitalization

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3. Advanced Process Control (APC)

Reduce process variability, increase production



Main targets

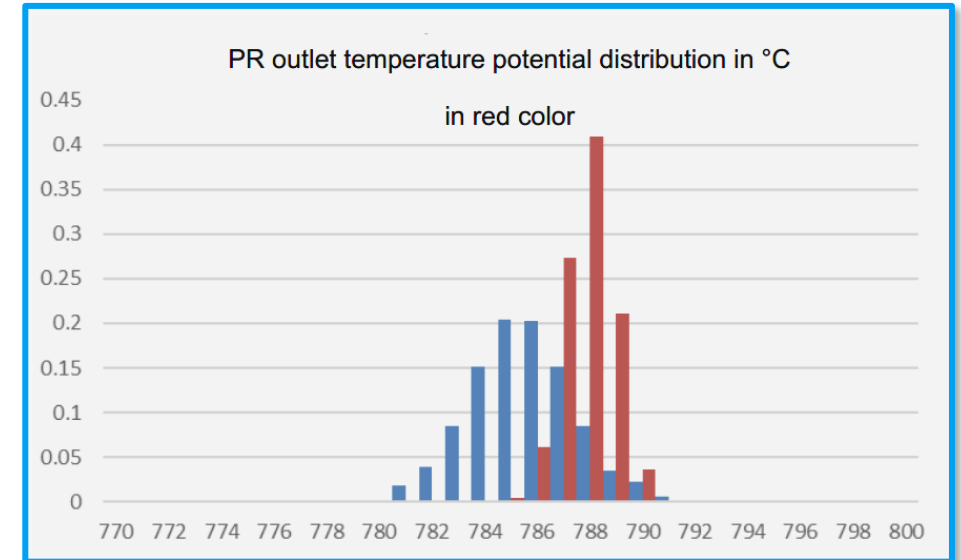
Use built-in or available standard modules of DCS systems to:

- Minimize process variability; typically, an APC application is able to reduce process variability, as measured by standard deviation, by 50%.
- Maximize throughput
- Minimize energy consumption and CO2 emissions



Key Process Variables

- Primary Reformer exit temperature
- Natural Gas supply to the process



3. Advanced Process Control (APC)

Reduce process variability, increase production



Sub-targets of multivariable control

- Stabilize the entire train operation by regulating Controlled Variables (CVs) to set point or constraint limits, maintain Manipulated Variables (MVs) within constraint limits and minimize the effects of external disturbances.
- Maximize the hydrogen yield of the primary reformer by stabilizing the process as close as possible to optimum steam: carbon ratio.
- Minimize variability in riser outlet temperatures by modulation of the furnace firing rates. Minimize methane slippage.
- Minimize energy consumption and CO2 emissions
- Maintain the unit energy balance, optimize the management of the different steam pressure levels and maximize steam export potential.

Benefits: Expected increase of production of minimum 1%



Optimize fertilizer production by plant digitalization

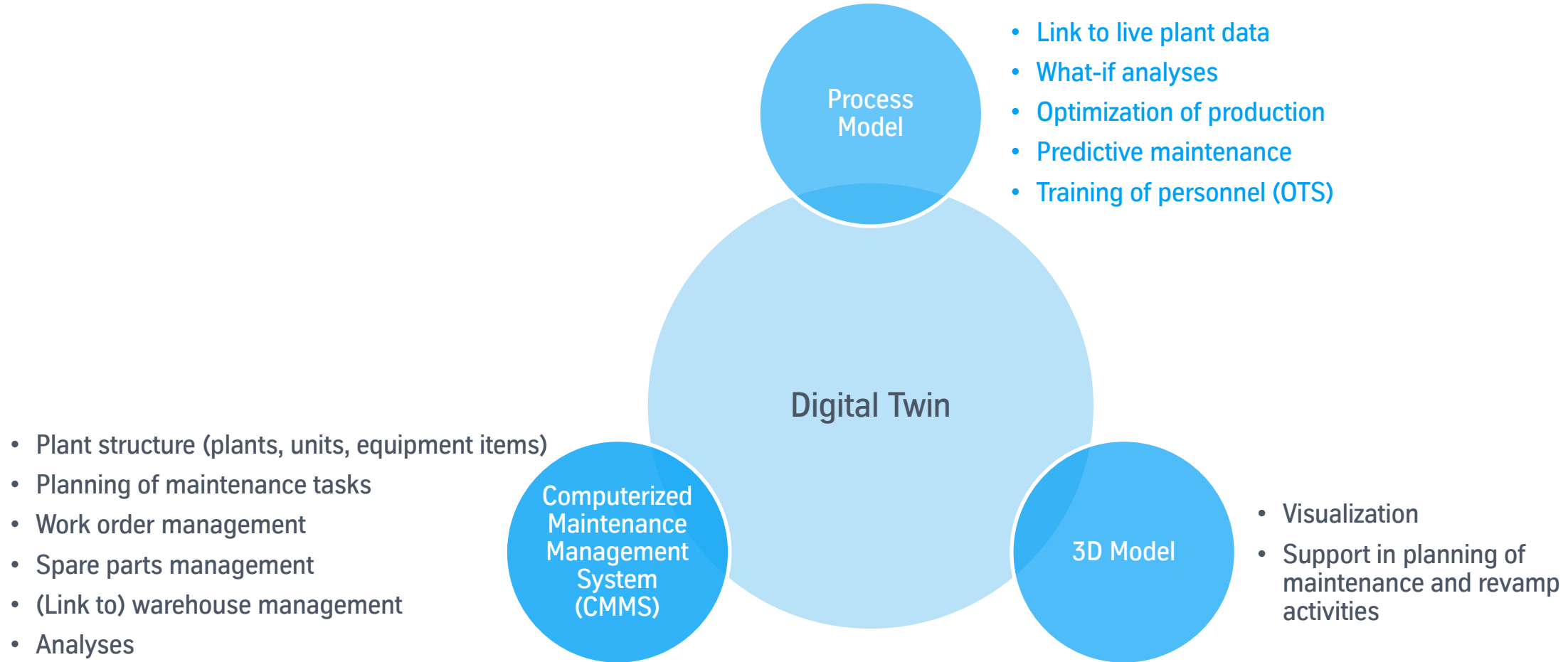
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4. Digital Twins

What elements may a digital twin contain?



Focus on process model



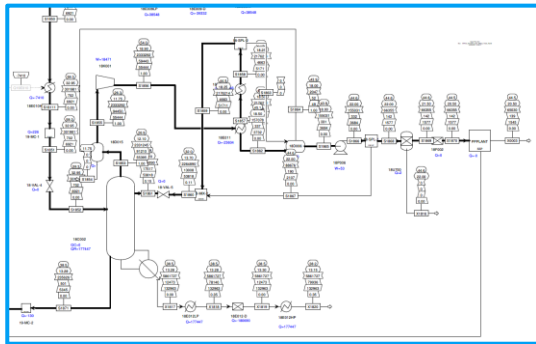
4. Digital Twins

What kind of process models are applied?



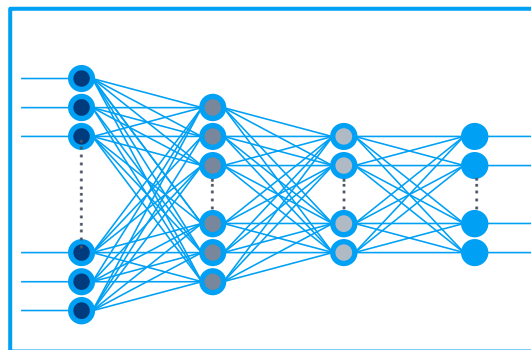
First principles (White-box)

- Based on process simulation
- Advantage:
 - Users can understand the relationship between input and output data
- Disadvantage:
 - Can only be applied for process technologies with known equipment and thermodynamic properties



Statistics & AI (Black-box)

- Based on AI (e.g. expert systems, artificial neural networks incl. machine learning)
- Advantage:
 - Can be applied for all kind of systems, even when system behavior is unknown
- Disadvantage:
 - Relationship between input and output parameters cannot always be understood by users



Hybrid (Grey-box)

- Combination of white and black box models



4. Digital Twins

Examples for benefits

1

Optimization

Find better set-points respecting constraints, identify heat loss, etc.

2

What-if analysis

See how a part of your plant will behave for e.g. different feed conditions, changing pressure or temperature

3

Monitor equipment

Reactor efficiencies, turbo-machinery performance, fouling factors

4

Virtual sensors

Verify existing sensors, estimate fluid & equipment properties where no sensor is installed (i.e. inside equipment), interpolate offline analysis

5

Extended digital twin

Provide training data



Optimize fertilizer production by plant digitalization

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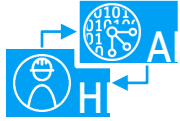
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5. Summary and outlook

Optimize fertilizer production by plant digitalization

Visit us in the lobby for a
live demo of our products



Combination of human and artificial intelligence is ideal for optimization of plant performance



Possible increase of plant EBITDA by several percentage points



Step-wise approach to achieve maximum results



Data security is achieved by several state-of-the-art measures and based on common international standards



Remote Performance Monitoring (including mobile access) provides full transparency via online dashboards and automated reports including comments by process specialists



Digital Twins optimize plant performance based on process models



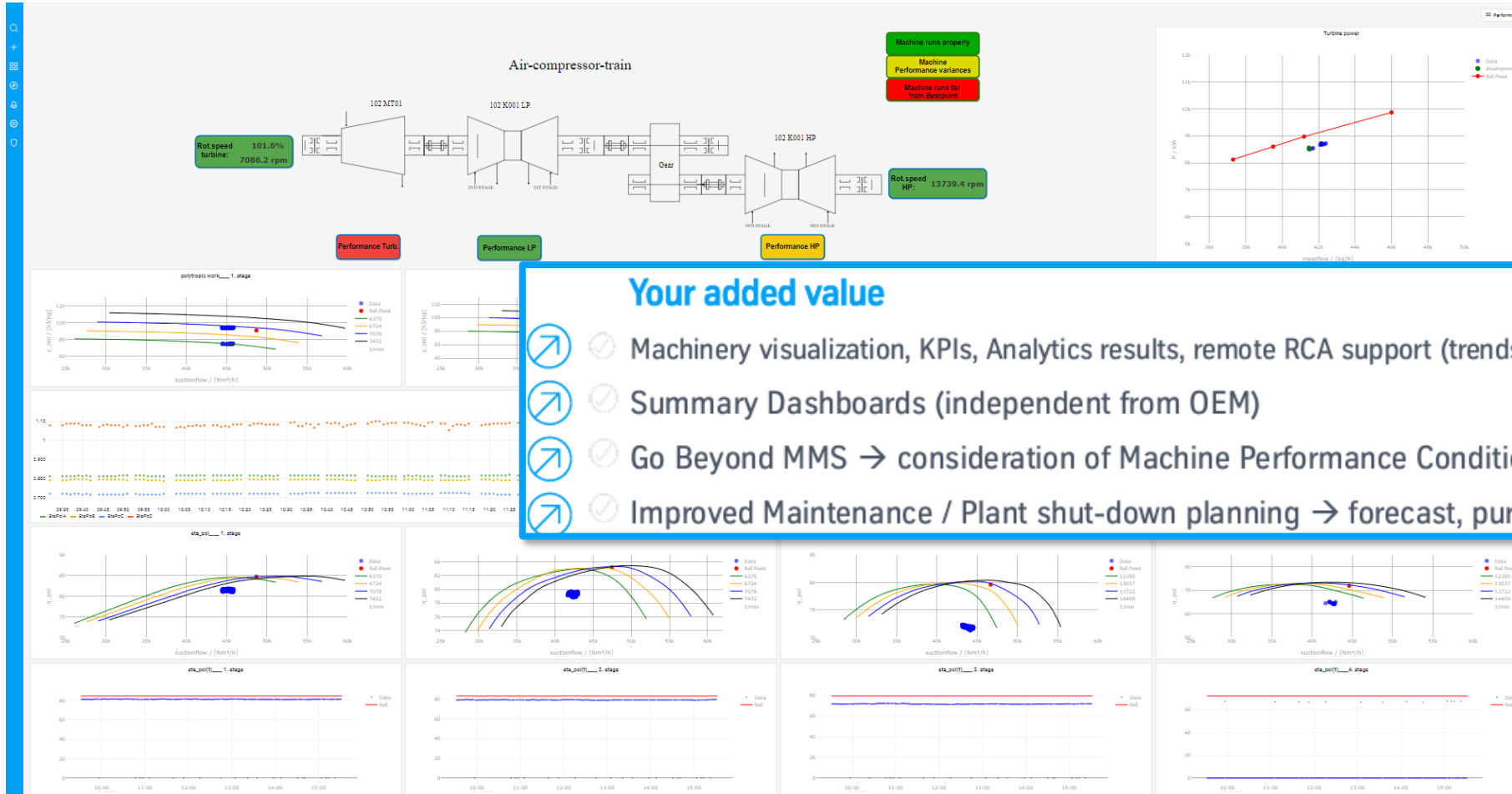
Advanced Process Control (APC) optimizes plant performance based on improved and/or combined (MPC) usage of available sensors



5. Summary and outlook

Machine monitoring as future addition to RPM

Visit us in the lobby for a
live demo of our products



Your added value

- ➡ Machinery visualization, KPIs, Analytics results, remote RCA support (trends, prognosis, condition, wear analysis, ...)
- ➡ Summary Dashboards (independent from OEM)
- ➡ Go Beyond MMS → consideration of Machine Performance Condition
- ➡ Improved Maintenance / Plant shut-down planning → forecast, purchasing of LL items



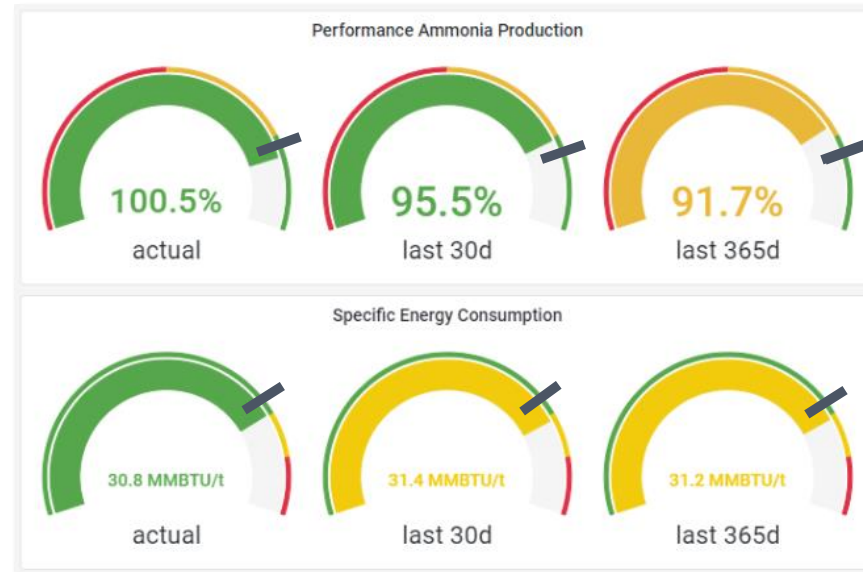
5. Summary and outlook

Benchmarking as future addition to RPM

Visit us in the lobby for a
live demo of our products

- Many customers interested in comparing their production with similar plants
- Good experience from other technologies, e.g. electrolysis

- Example for comparison of plant data (only relative data will be shown to make data comparable):



Indication of average value of similar plants

- **Anonymous:** system shall not allow tracing of company data; minimum number of connected plants to be achieved before service can be started!
- Will be available soon for interested customers.



Thank you for your attention



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Proprietary Equipment Design - Reformer

Uhde Ammonia Technology Users' Group Meeting

Munich, August 22nd 2023 | Thorsten Brakhane | thyssenkrupp Uhde



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Proprietary Equipment Design - Reformer

Agenda



1

Reformer Floor Cooling

2

New Design for Process Gas Cooler Bypass Valve

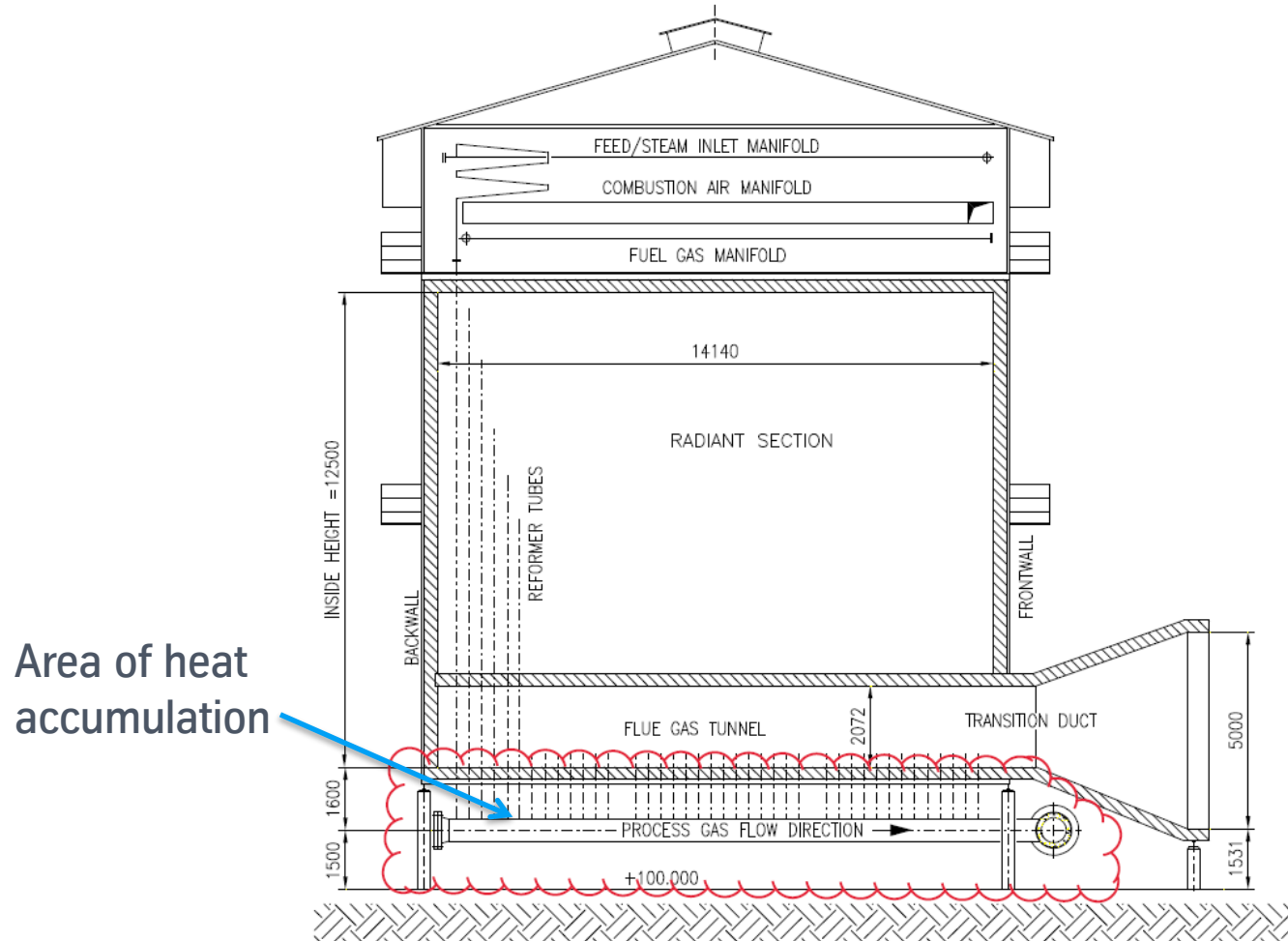
3

NOx Reduction by SNCR for Uhde Steam Reformer

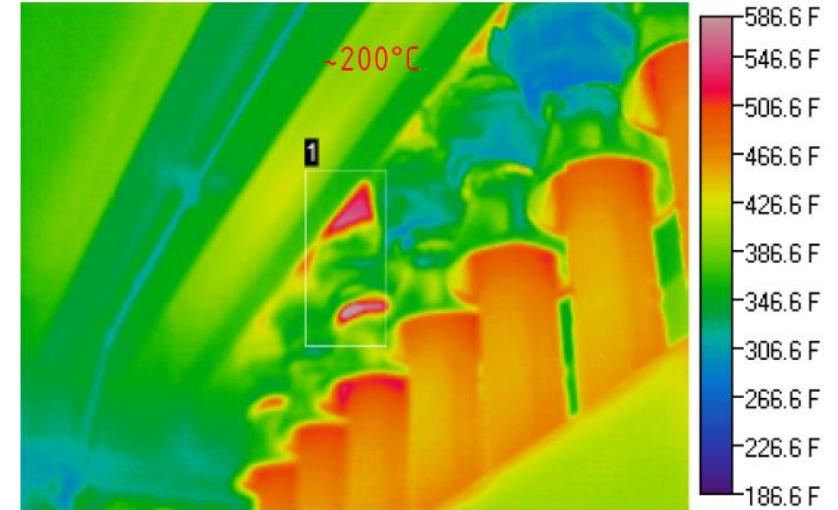


Reformer Floor Cooling

General Layout for Ammonia Primary Reformer



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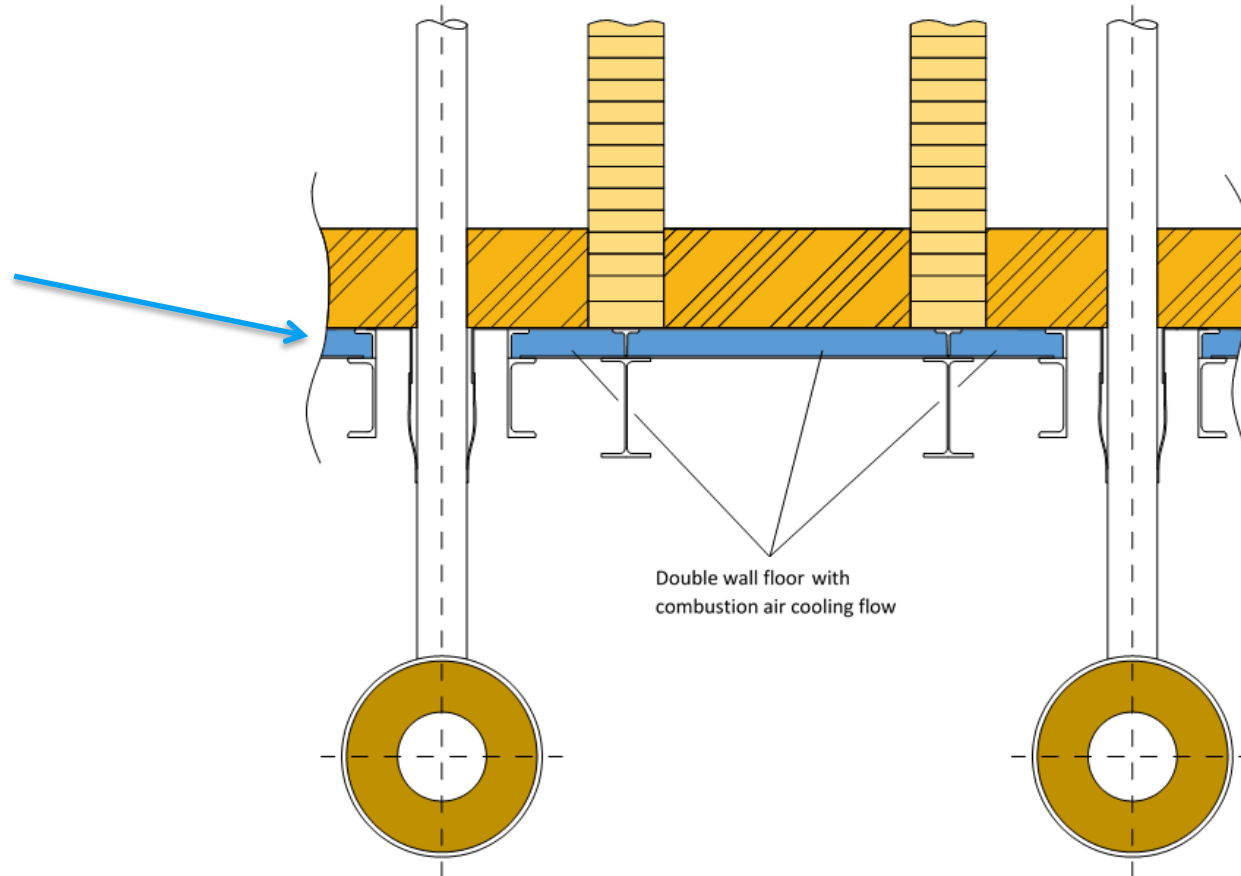
Area of Heat Accumulation



Reformer Floor Cooling

General Layout for Ammonia Primary Reformer

Alternative: Air Cooling of Reformer Floor

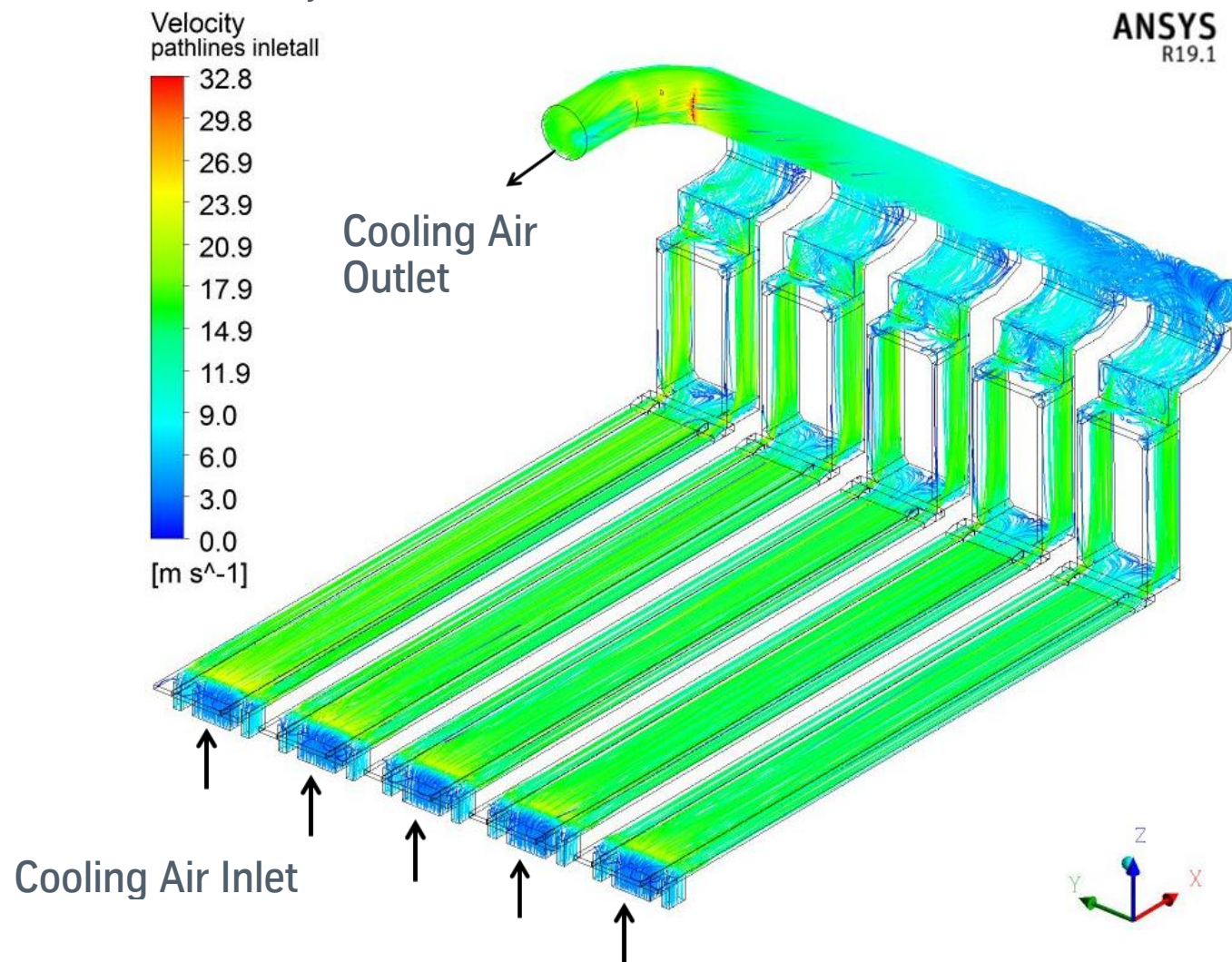


Sandwich Floor Design



Reformer Floor Cooling

General Layout for Ammonia Primary Reformer

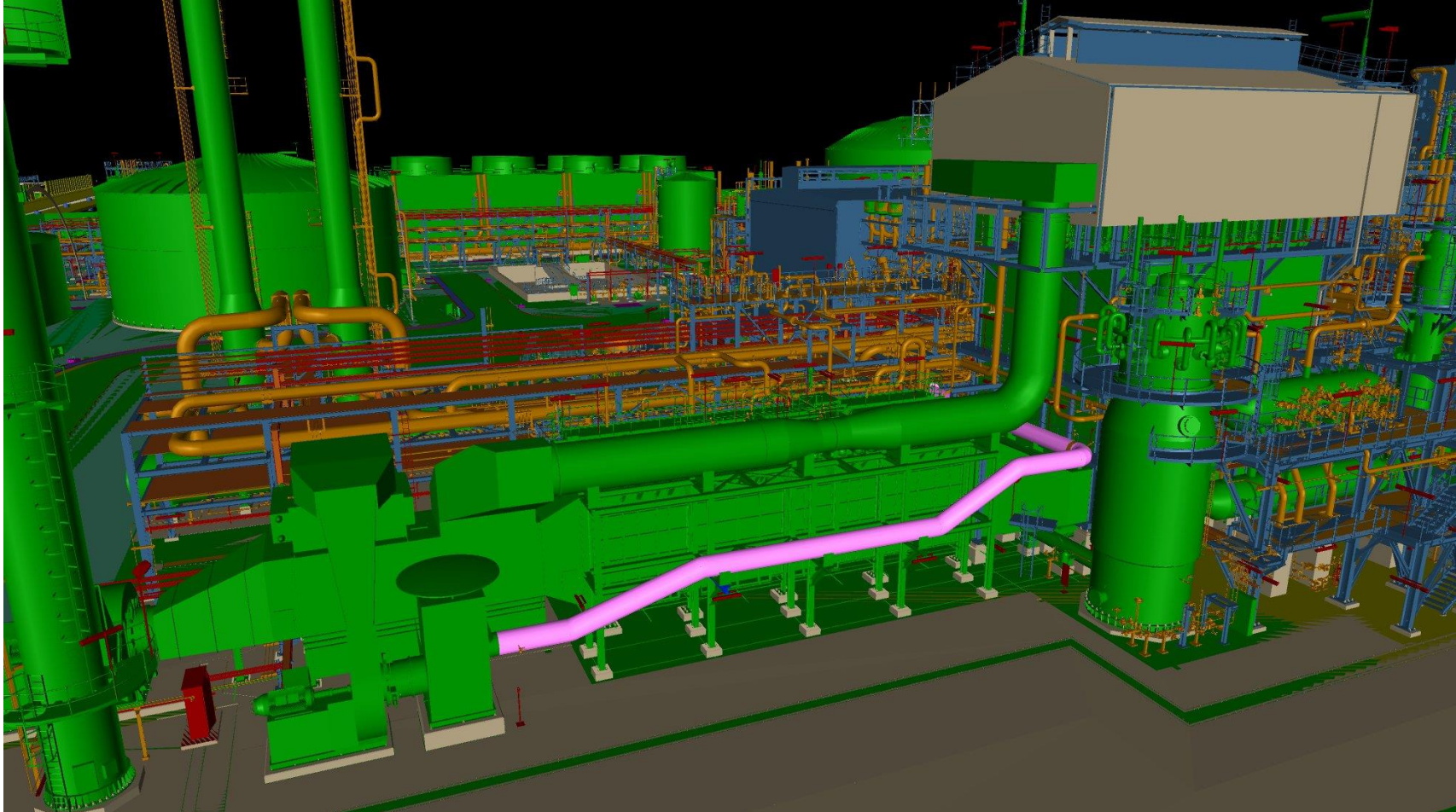


Sandwich Floor Design



Reformer Floor Cooling

General Layout for Ammonia Primary Reformer



Ventilation Air Duct to FD Fan Suction Tower

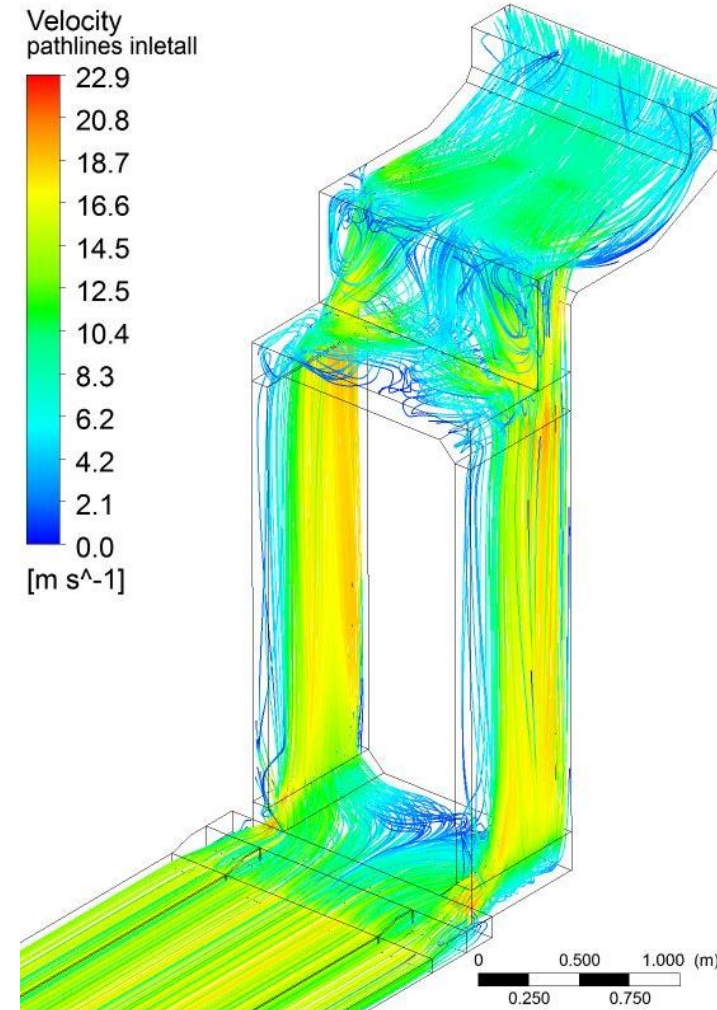


Reformer Floor Cooling

General Layout for Ammonia Primary Reformer

Key Elements:

- ✓ Sandwich panels and air duct connected to suction side of FD Fan (~ 20% of total air flow)
 - no additional fan required
 - combustion air at fan inlet slightly preheated
- ✓ Effective cooling of reformer floor and vent duct
- Additional air damper required at FD Fan inlet tower
- Additional pressure drop for FD Fan ~ 7 - 10 mbar
- ✓ Already in operation at one ammonia plant in Egypt



Sandwich Floor Design



Proprietary Equipment Design - Reformer

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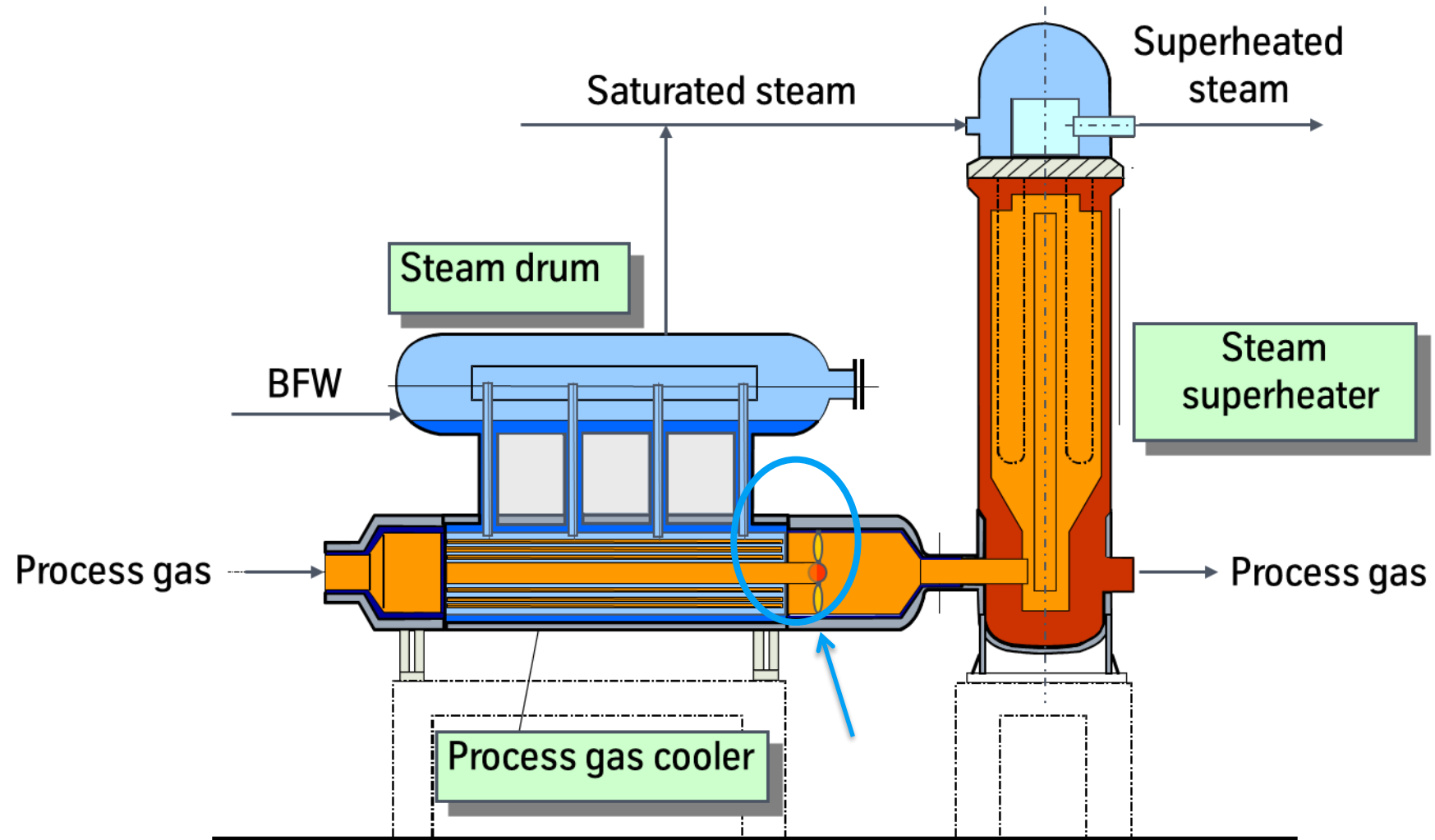


- 1 Reformer Floor Cooling
- 2 New Design for Process Gas Cooler Bypass Valve
- 3 NOx Reduction by SNCR for Uhde Steam Reformer



Uhde's Process Gas Heat Recovery System

New Bypass Control Design



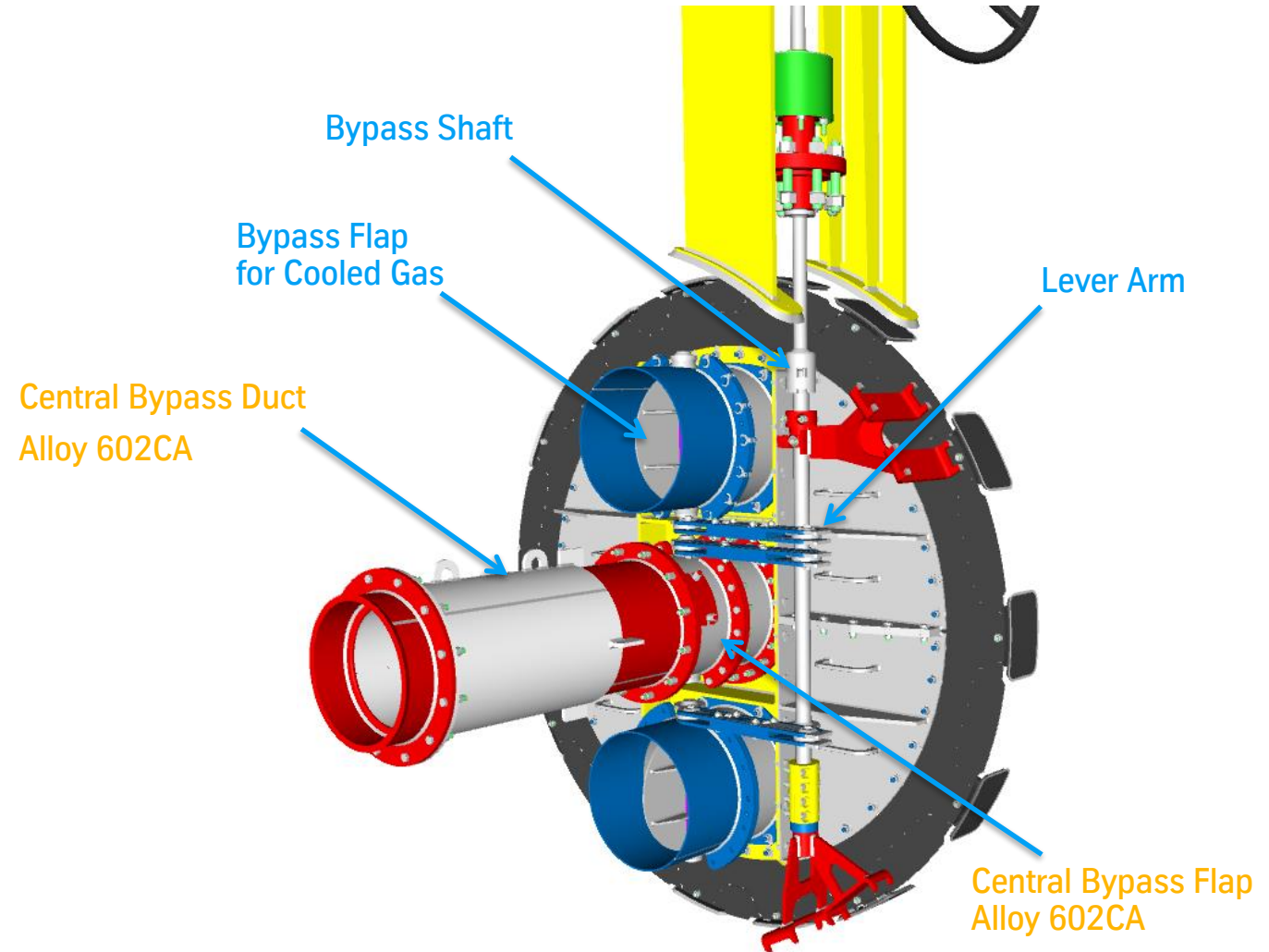
Process Gas Cooler Bypass



Uhde's Process Gas Heat Recovery System

Advantages of the new Bypass Control Design

- Shaft, bypass flaps for cooled gas and lever arms in contact with **cooled process gas only**
- Only central bypass flap operating at the temperature of the **hot bypass gas**
→ made out of Alloy 602 CA
- Except central bypass duct, all other materials are operating either above or below the metal dusting range
- Bypass flaps decoupled from central shaft.
- Easy to maintain
- Same excellent control characteristic than Uhde's steam cooled bypass
- Patented Uhde design



Already in operation at two ammonia plants

Proprietary Equipment Design - Reformer

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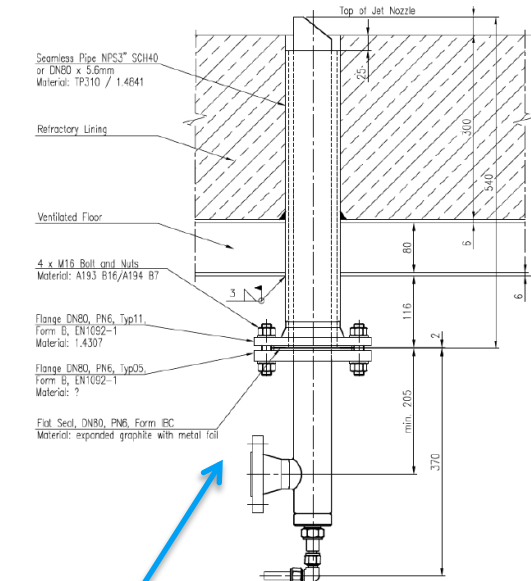
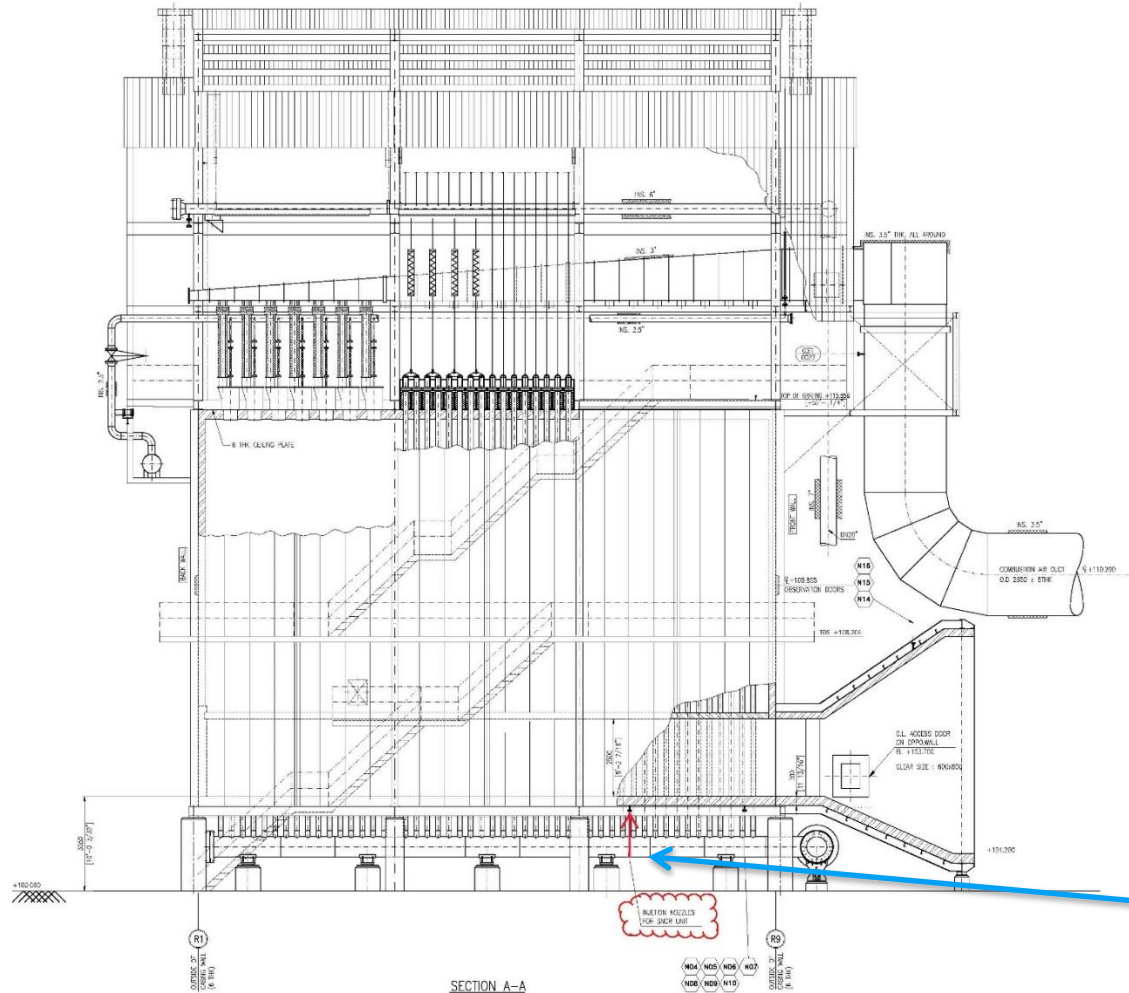


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NO_x Reduction by SNCR

Selective Non-Catalytic Reduction Process (SNCR)



Reducing Agent injection
through Reformer Floor
into Flue Gas Tunnels

Principal Arrangement

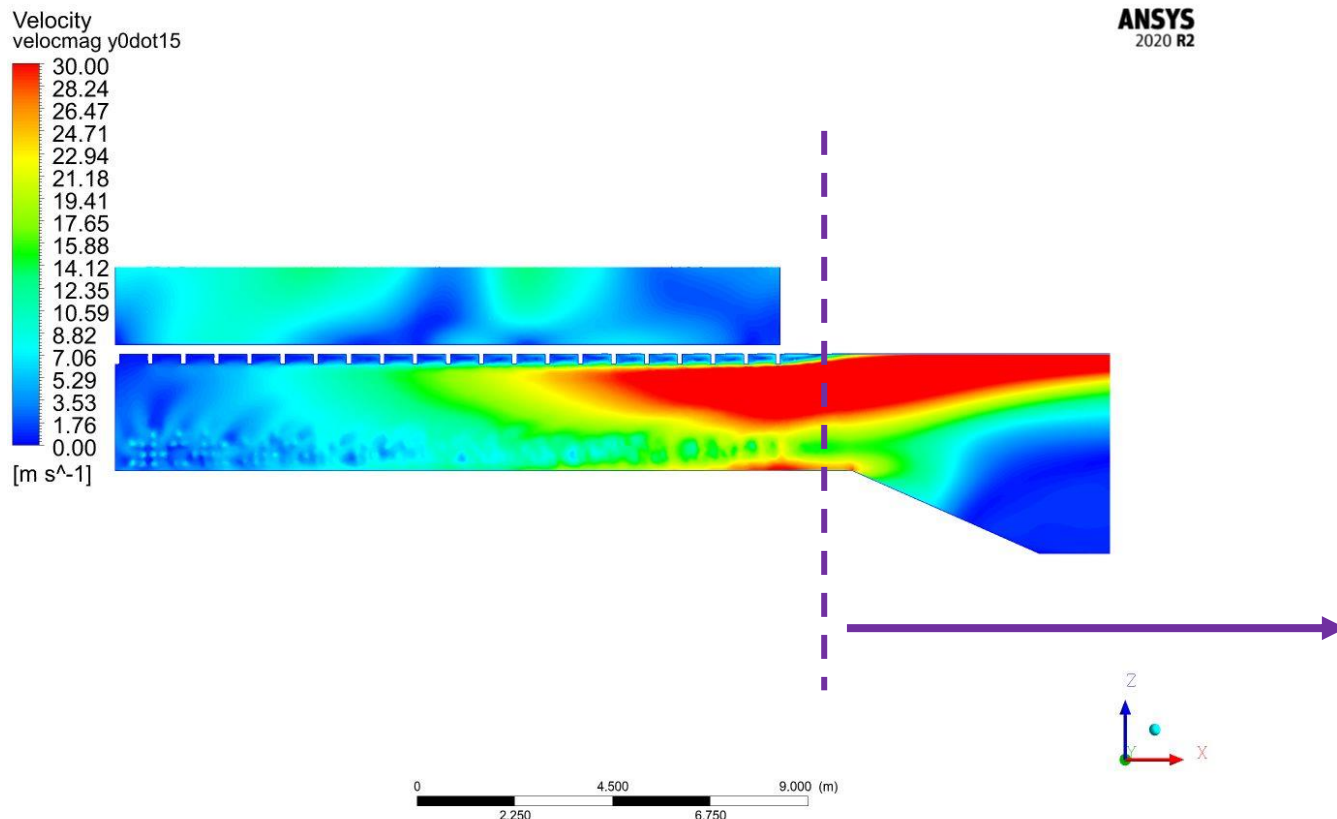


NOx Reduction by SNCR

Selective Non-Catalytic Reduction Process (SNCR)

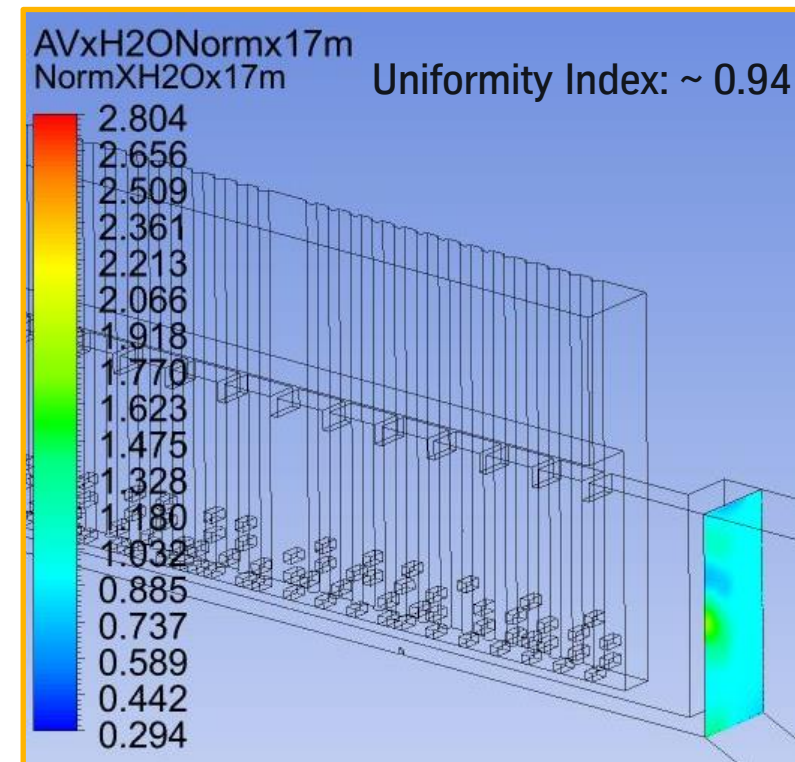
Baseline

Velocity / Mass Flow Distribution



Result

Ratio of Reducing Agent in Flue Gas



Optimization by CFD Analysis



NO_x Reduction by SNCR

Selective Non-Catalytic Reduction Process (SNCR)

Advantages of SNCR:

- No catalyst bed required
 - Lower investment cost than SCR
- NO_x reduction rate 50 - 60%
- No regular exchange of catalyst necessary
- NH₃-slip < 5ppm
- As carrier medium LP steam can be used
- **Convenient for revamps and retrofits**

Optimized for
Uhde
Steam Reformer

Patent Pending

Challenges:

- Slightly higher reagent consumption than for SCR
- Position and design of injection lances have to ensure a good mixing with the flue gas



Thank you for your attention



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Evolution of the Uhde® Ammonia Converter Cartridge

Uhde Ammonia Technology Users' Group Meeting

Munich, August 22nd 2023 | Johannes Distler | thyssenkrupp Uhde



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Evolution of the Uhde® Ammonia Converter Cartridge

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History

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Basic Design

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Design Improvements

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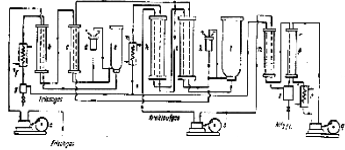
Operational Benefits

5

Latest References - Converter Retrofits



History of Uhde® Ammonia Converters (1/2)



1928 The first Uhde Ammonia plant

Construction is finished in Castrop-Rauxel/Germany with 4 x 25 mtpd NH₃ with operational pressure of 100 bar.

1950 First Ammonia Synthesis with Waste Heat Boiler

The plant by Uhde is finished in Typpi Oy Oulu/Finland with 60 mtpd NH₃ capacity and operational pressure of 318 bar.

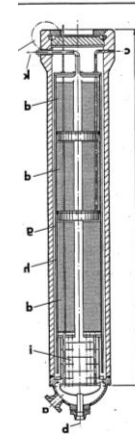
1950 First Ammonia Converter with electrical heating

Expansion Revamp by Uhde at ammonia plant in Arras/France.



1964 Ammonia Converter in operation since 60 years

Plant built by Uhde under EPC contract in Cusco/Peru in 3400m altitude. The 50 mtpd NH₃ production uses electricity generated by hydro power. Only 100% green ammonia plant in operation worldwide.



1973 First Ammonia Converter for 1000 mtpd NH₃ plant

Plant was built by Uhde in Sala/Slovakia with 320 bar synthesis pressure.

1985 Converter with only 85 bar operational pressure

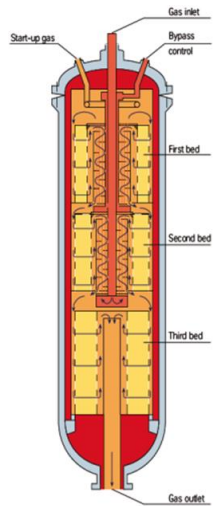
Plant of 1120 mtpd NH₃ capacity was built in Courtright/Canada with first application of KATALCO[™] 74-1 in a large Uhde Converter (Ø 5.7m, 20m lengths, 600t weight, 143m³ catalyst volume).

1986/87 First Ammonia Converter Retrofits

New Converter Cartridges with radial beds and integrated heat exchangers instead of quench were installed in 5 plants.

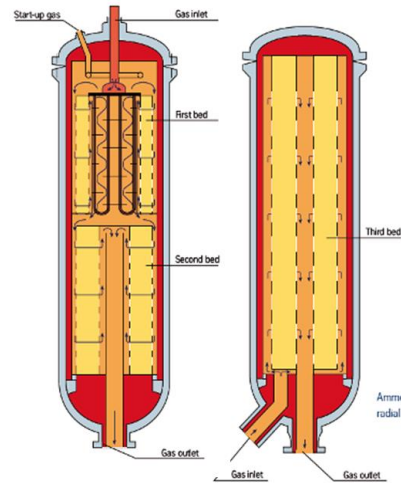


History of Uhde® Ammonia Converters (2/2)



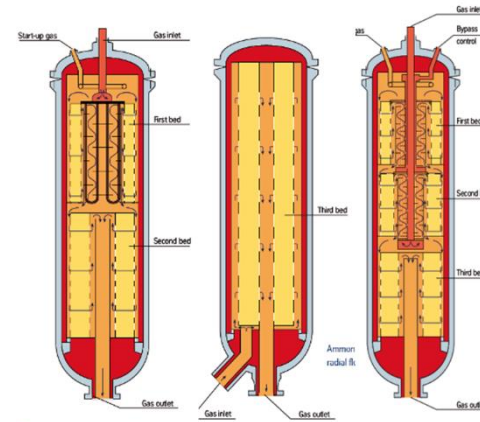
1989 First 3-bed radial Ammonia Converter

First applications in Puyang/China (1000 mtpd NH_3) and Cartagena/Spain (Revamp). Converter was equipped with 3 catalyst beds and interbed heat exchangers for maximum NH_3 conversion per recycle.



1991 First synthesis with two Ammonia Converters

The plant by Uhde was built in Antwerp/Belgium with capacity of 1800 mtpd NH_3 . Waste Heat Boilers after each Converter for increased HP steam production and better energy efficiency.



2007 First 3300 mtpd plant including OT-Synthesis

The SAFCO 4 ammonia plant was the first with 3300 mtpd capacity equipped with first application of Uhde® dual-pressure process. OT (Once-Through)-Converter equipped with KATALCO^{JM} 74-1 as standard for this plant concept.

2017 Plant revamp to 3600 mtpd

The SAFCO 4 plant was revamped including an additional 2-bed OT-Converter and became the largest in the world until today.

Since 2018 Product development project for Uhde® Ammonia Converter Cartridges

Based on the proven core design several optimizations have been implemented in terms of e.g. more catalyst volume, cost efficiency, reliability improvement.

2023 130 References

Uhde has delivered around 130 Uhde® Ammonia Converter Cartridges in total so far and 9 further Cartridges will be installed in the upcoming years.



Evolution of the Uhde® Ammonia Converter Cartridge

Agenda

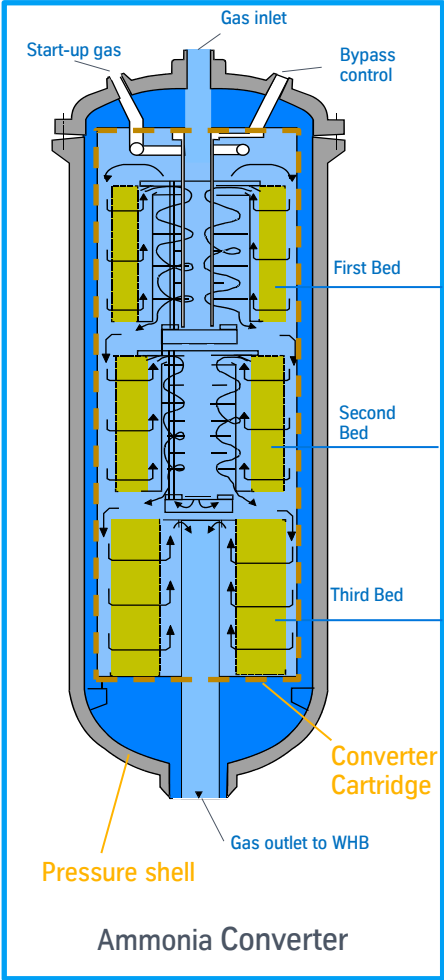


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- 5 Latest References - Converter Retrofits

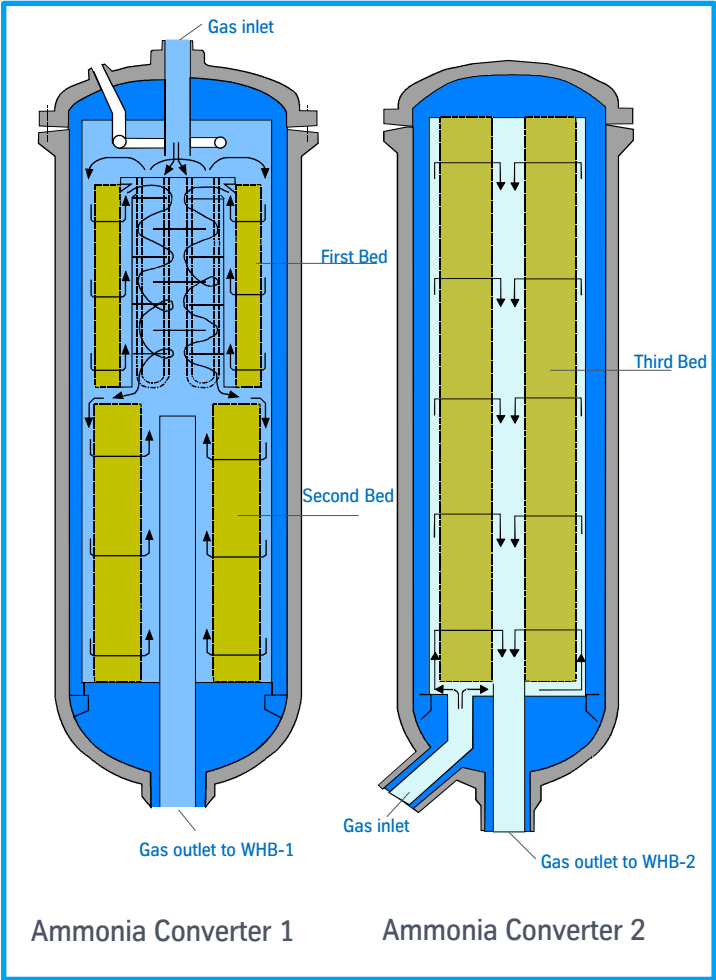


Basic Design – Uhde® Ammonia Converter Concepts

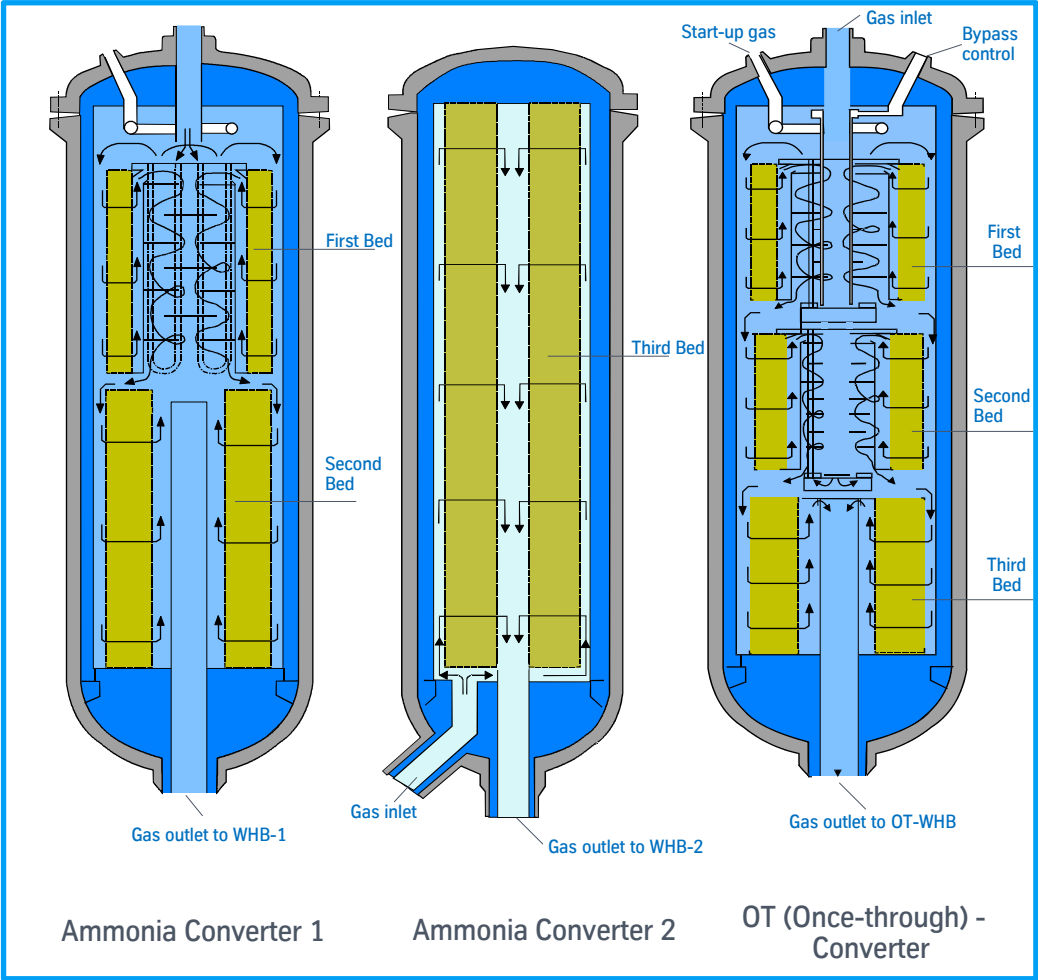
1200 mtpd



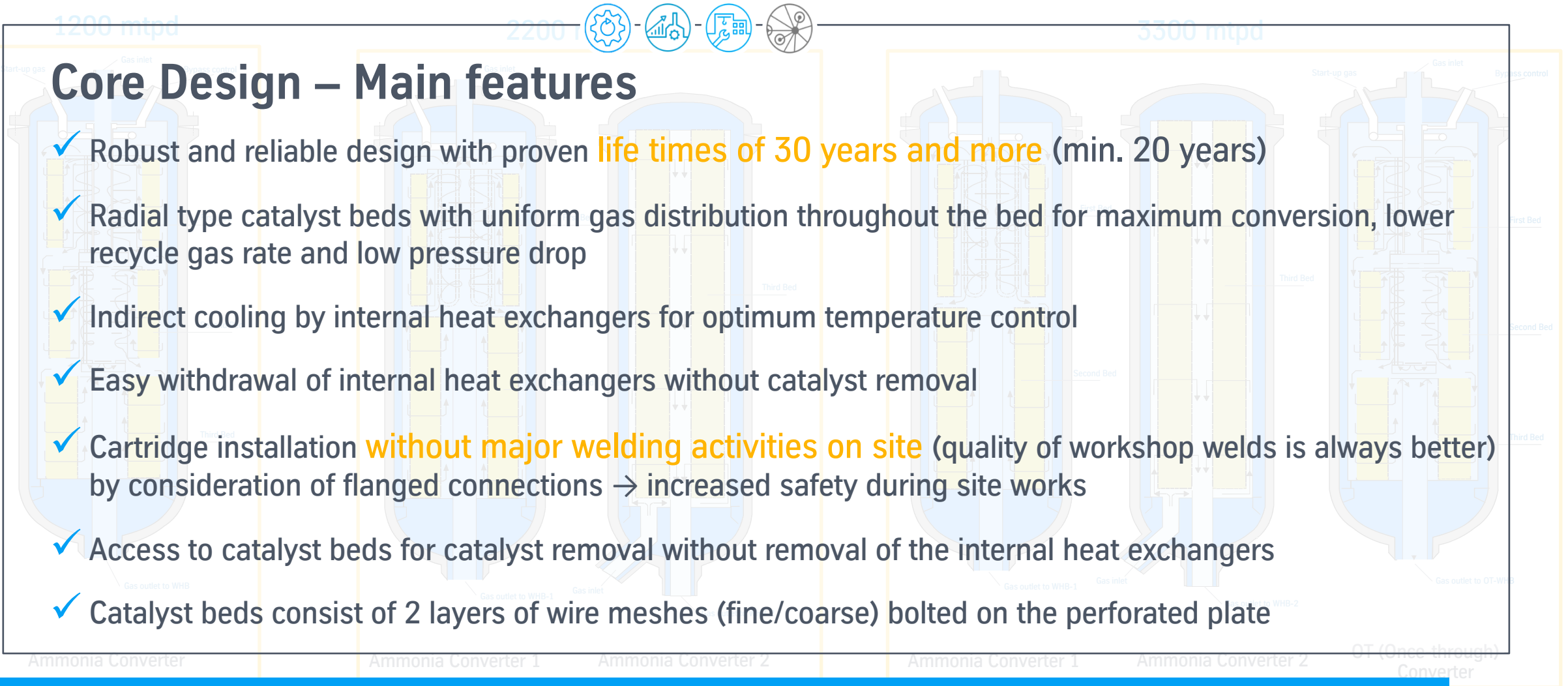
2200 mtpd



3300 mtpd



Basic Design – Uhde® Ammonia Converter Cartridge



Core Design – Main features

- ✓ Robust and reliable design with proven **life times of 30 years and more** (min. 20 years)
- ✓ Radial type catalyst beds with uniform gas distribution throughout the bed for maximum conversion, lower recycle gas rate and low pressure drop
- ✓ Indirect cooling by internal heat exchangers for optimum temperature control
- ✓ Easy withdrawal of internal heat exchangers without catalyst removal
- ✓ Cartridge installation **without major welding activities on site** (quality of workshop welds is always better) by consideration of flanged connections → increased safety during site works
- ✓ Access to catalyst beds for catalyst removal without removal of the internal heat exchangers
- ✓ Catalyst beds consist of 2 layers of wire meshes (fine/coarse) bolted on the perforated plate

The proven Core Design remains unchanged



Evolution of the Uhde® Ammonia Converter Cartridge

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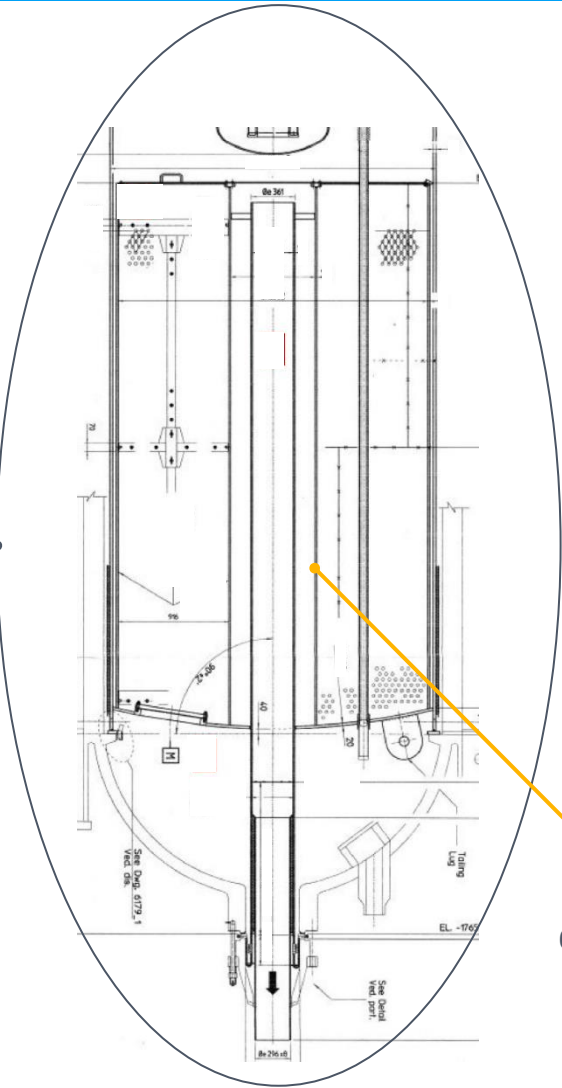
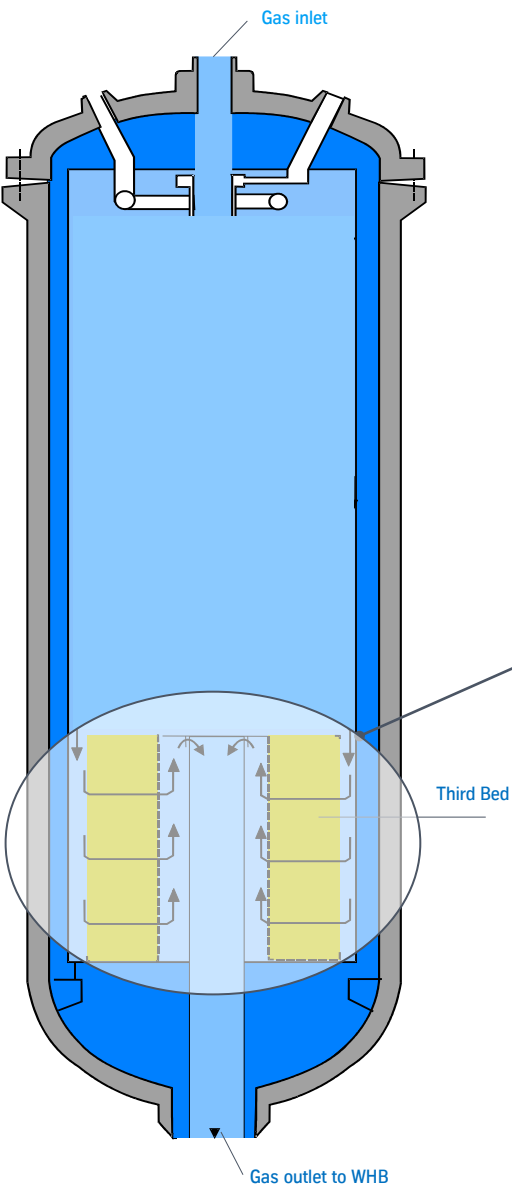


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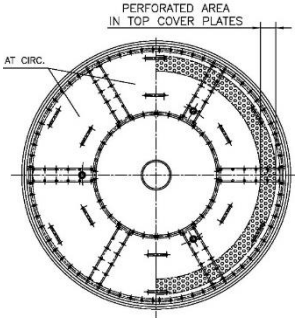
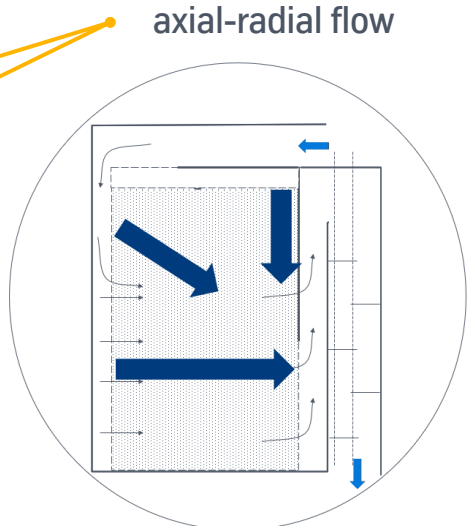
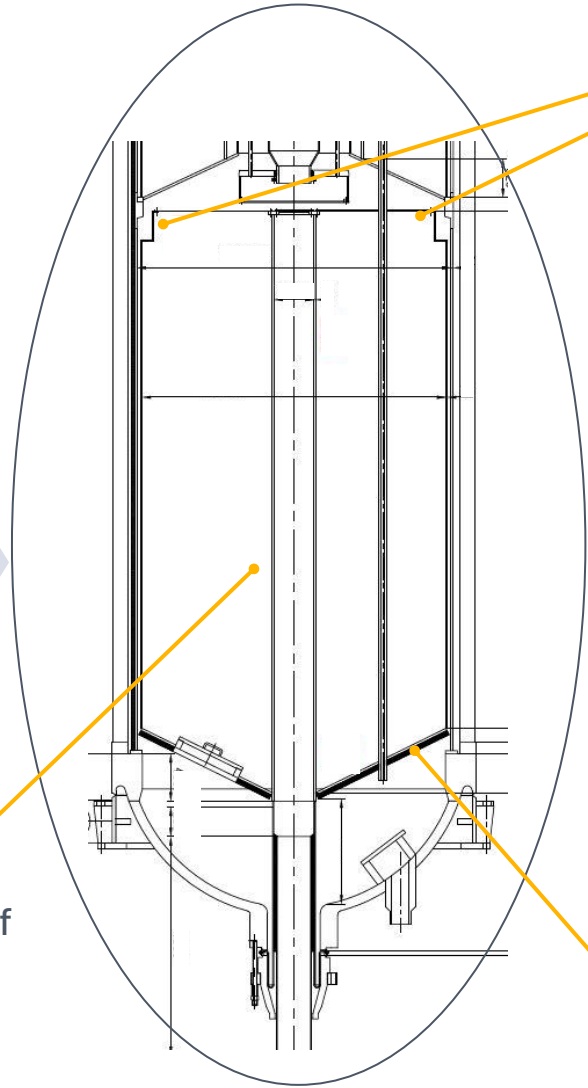


Design Improvements – Bottom catalyst bed

Conventional Design

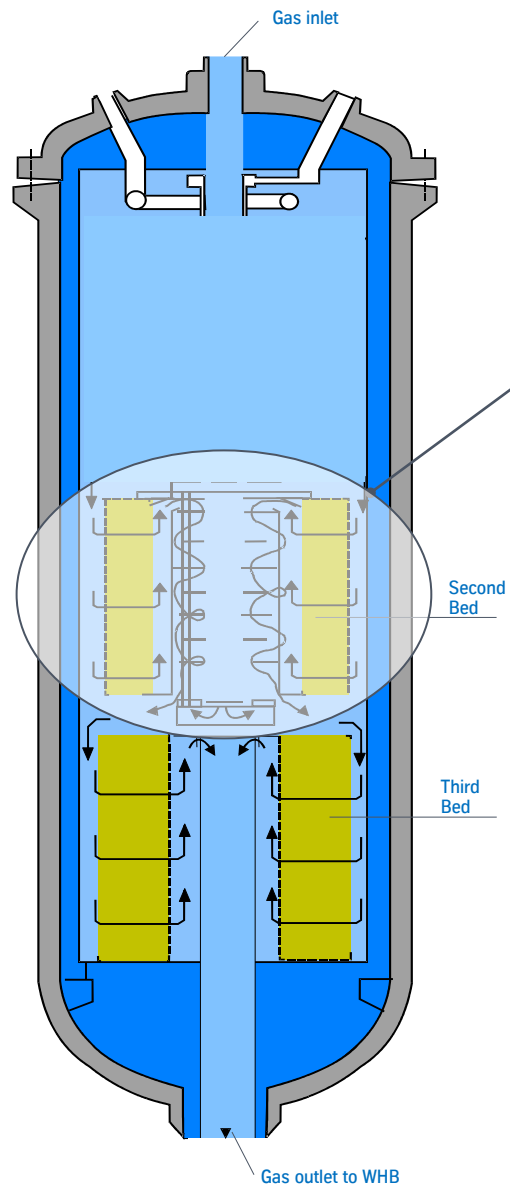


Optimized Design

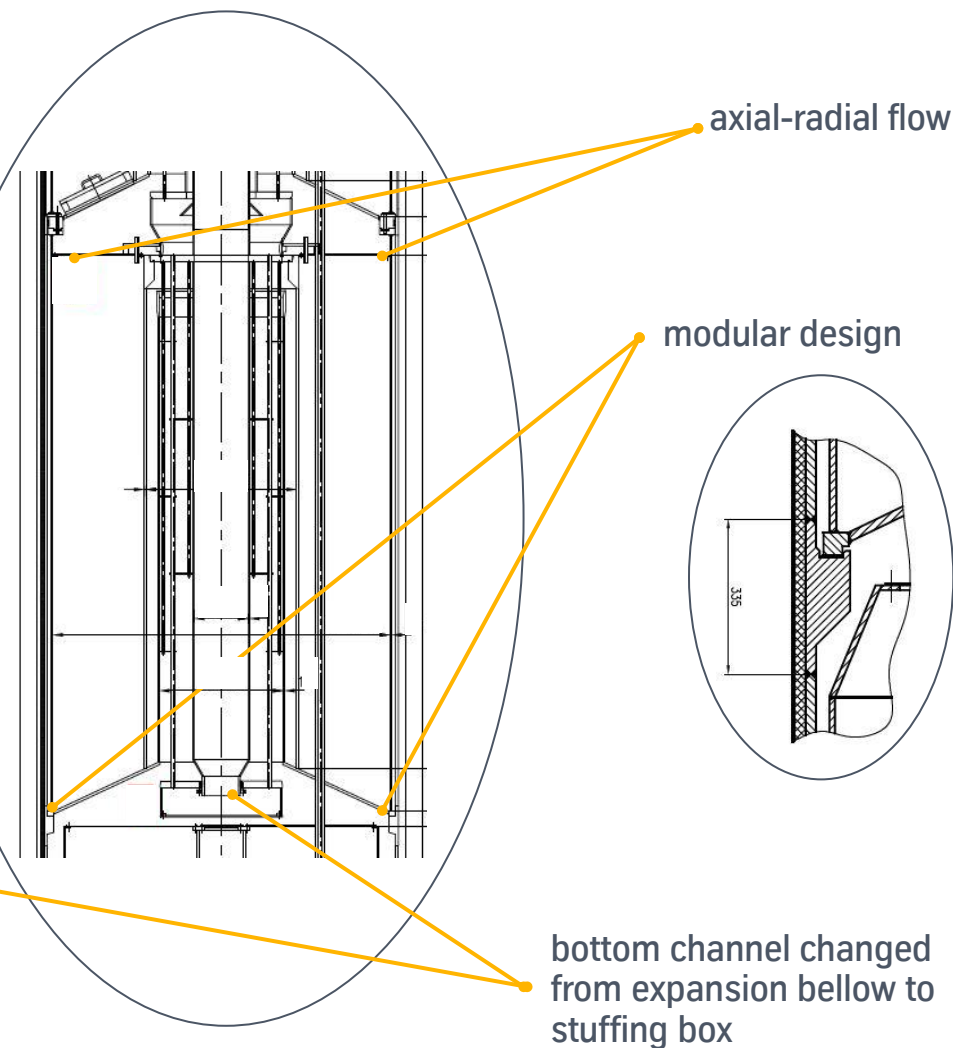


Design Improvements – Second catalyst bed

Conventional Design



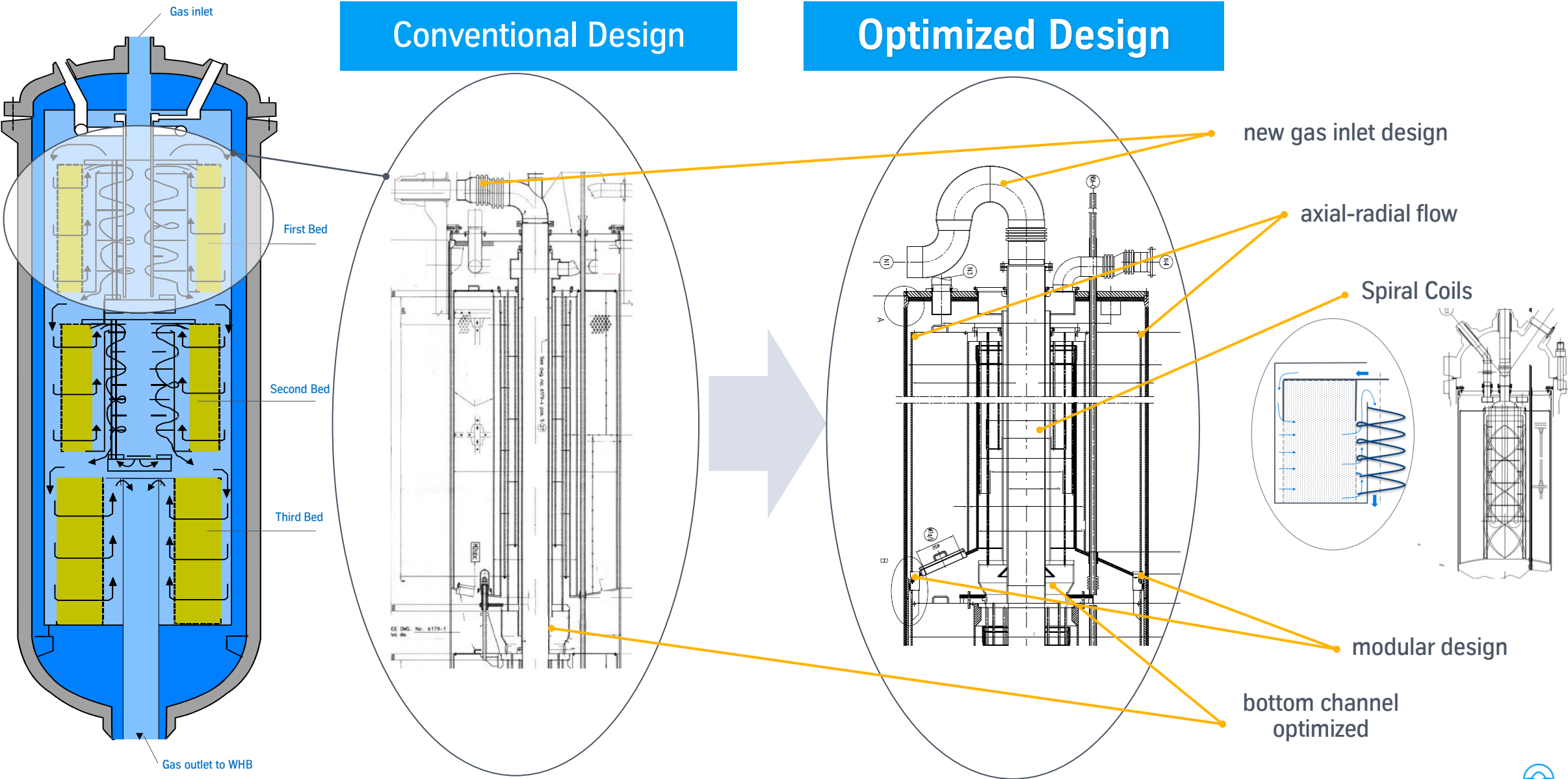
Optimized Design



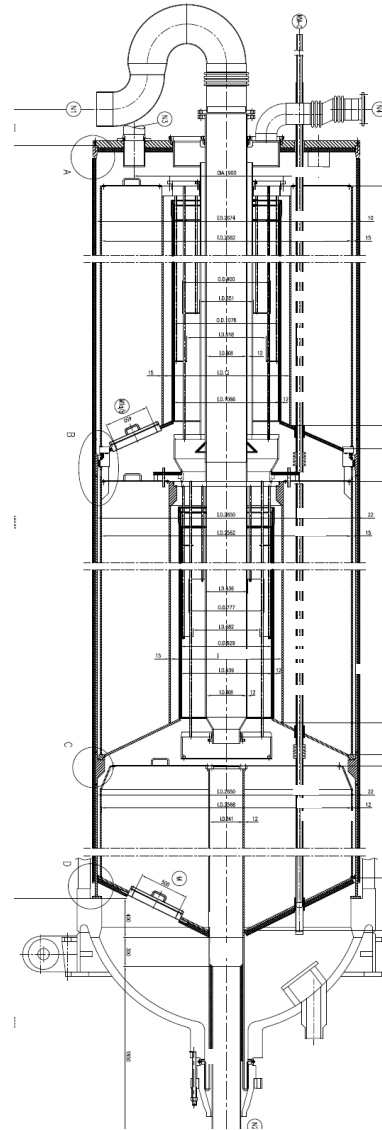
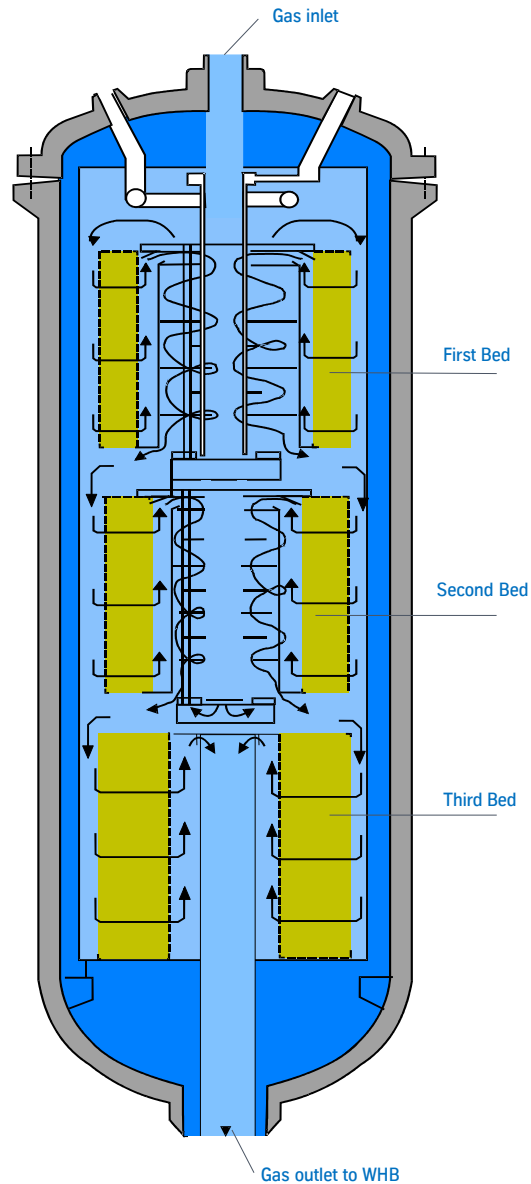
Design Improvements – First catalyst bed

Conventional Design

Optimized Design

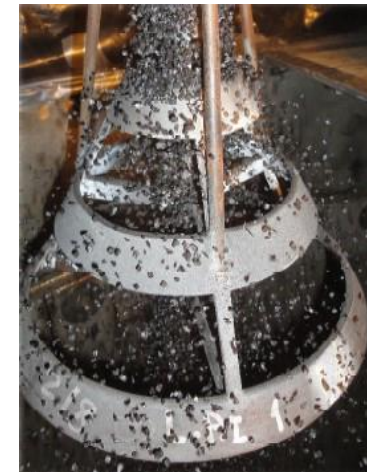


Design Improvements – Further Optimizations



Optimized Design

- Reduction of wall thickness (e.g. Cartridge cover) by FEM-calculation
- Thickness of heat exchanger tubes reduced
- General avoidance of dead spaces
- Catalyst filling by Dense loading:
 - ✓ 3-4 times faster conventional method (with vibration)
 - ✓ >15t/h loading rate
 - ✓ High bulk density in one step (2.2 – 2.8 kg/l)



Evolution of the Uhde® Ammonia Converter Cartridge

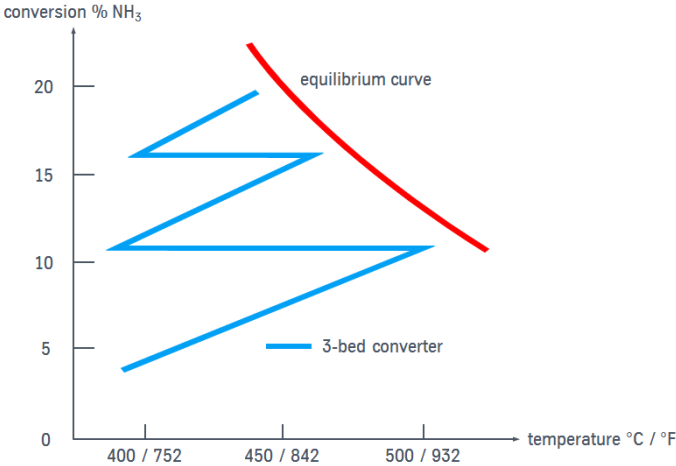
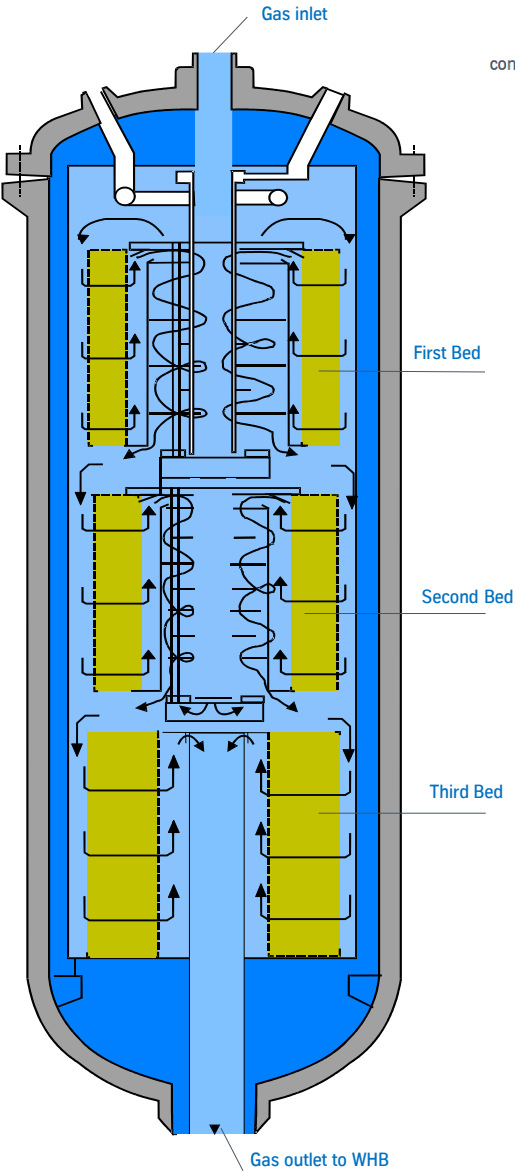
Agenda



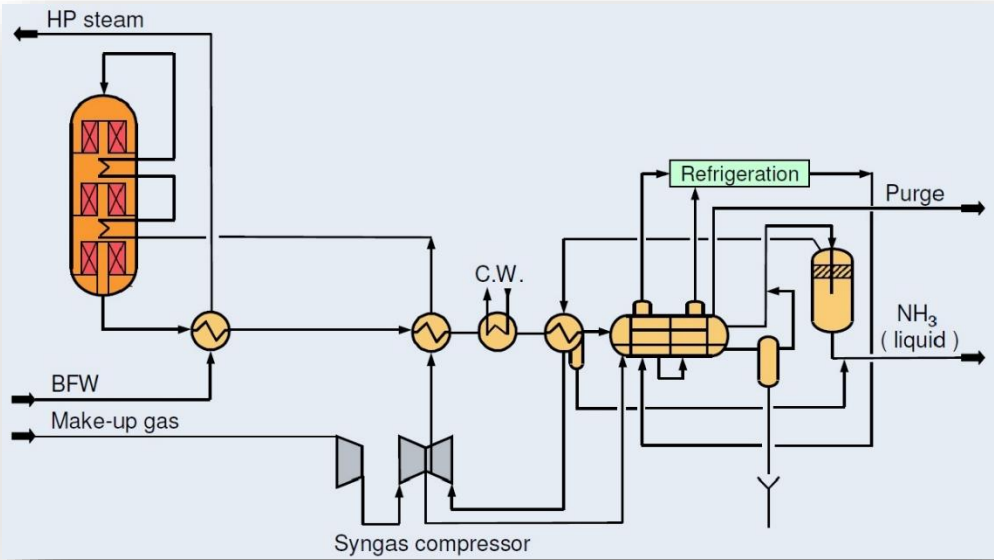
- 1 History
- 2 Basic Design
- 3 Design Improvements
- 4 Operational Benefits
- 5 Latest References - Converter Retrofits



Production increase with new optimized Uhde® Ammonia Converter Cartridge



	Case 1	Case 2	Case 3
Additional effective catalyst volume	+20%	+20%	+20%
Synthesis Catalyst	Conventional (KATALCO 35 series)	Conventional (KATALCO 35 series)	High activity (KATALCO 74-1)
Recycle gas flow	Constant	+6%	+8%
Capacity increase	+7.5%	+12.5%	+20%
Other synthesis equipment to be verified	- Heat exchangers - Refrigeration unit	- Heat exchangers - Refrigeration unit - Recycle stage - Equipment Δp	- Heat exchangers - Refrigeration unit - Syngas Compressor - Equipment Δp - Further modifications



Required synthesis gas to be provided from front-end or external sources (e.g. green H₂)



Evolution of the Uhde® Ammonia Converter Cartridge

Agenda



- 1 History
- 2 Basic Design
- 3 Design Improvements
- 4 Operational Benefits
- 5 Latest References - Converter Retrofits

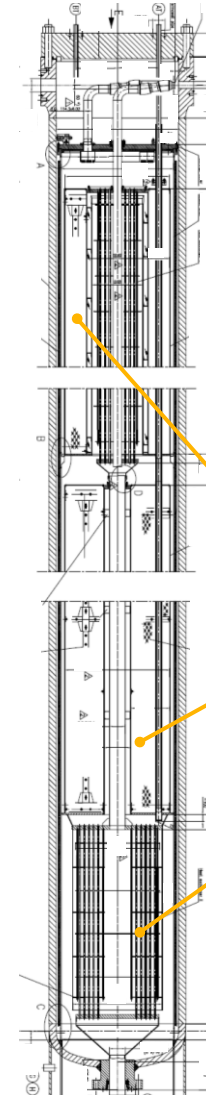
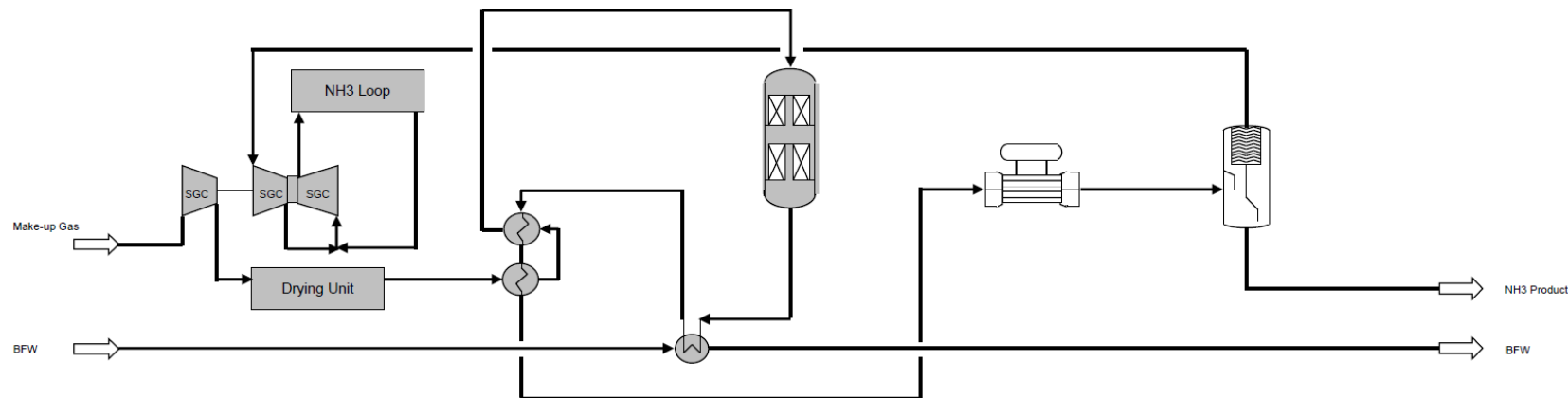


References – Koch Fertilizers (Fort Dodge / Iowa / USA)



Highlights

- ✓ Revamp of a vintage 3rd party-ammonia plant by application of well-referenced Uhde® dual-pressure process
- ✓ New Uhde® Ammonia Converter Cartridge in existing pressure shell
- ✓ High-performance synthesis catalyst KATALCO 74-1 by Johnson Matthey
- ✓ Additional capacity of 85,000 tons NH₃ per year
- ✓ Only 66 barg operation pressure
- ✓ Low construction risks as major installation work during running operation
- ✓ Start-up in 2022



Two axial-radial catalyst beds

additional bottom heat exchanger

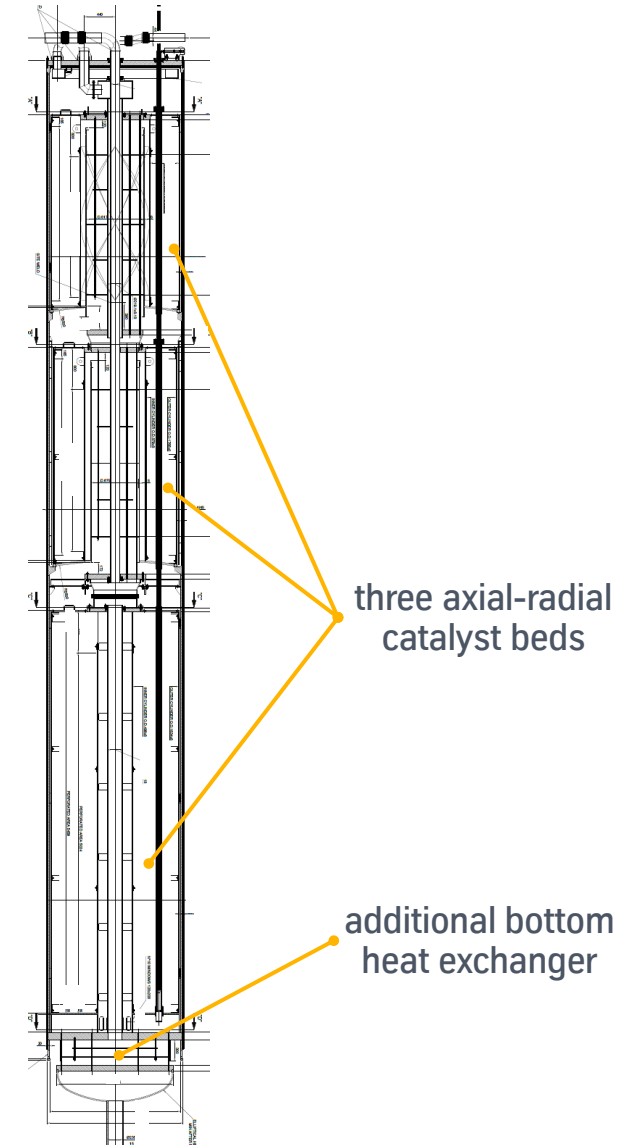
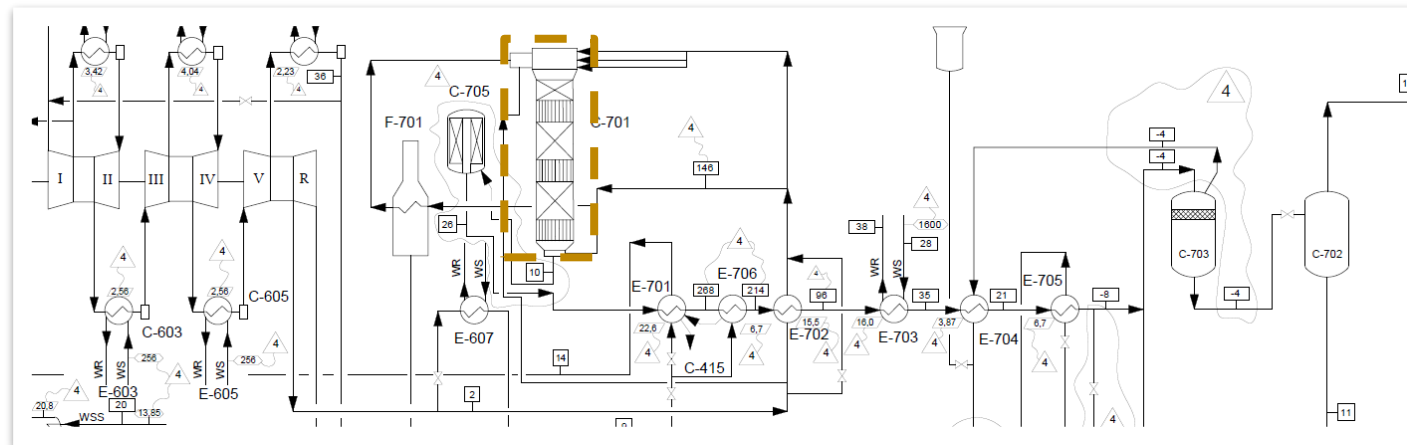


References – IGSAS İstanbul Gübre Sanayii A.Ş. (Kocaeli / Turkey)



Highlights

- ✓ Currently installed Cartridge by thyssenkrupp Uhde since 36 years in operation
- ✓ New Uhde® Ammonia Converter Cartridge in existing pressure shell
- ✓ Change from axial to axial-radial catalyst beds
- ✓ Pressure drop improvement over the Ammonia Converter by -50%
- ✓ High-performance synthesis catalyst KATALCO 74-1 by Johnson Matthey
- ✓ Energy efficiency improvement
- ✓ Reduction of synthesis loop pressure by -12% while maintaining the production capacity
- ✓ Start-up in 2024 (currently under fabrication)

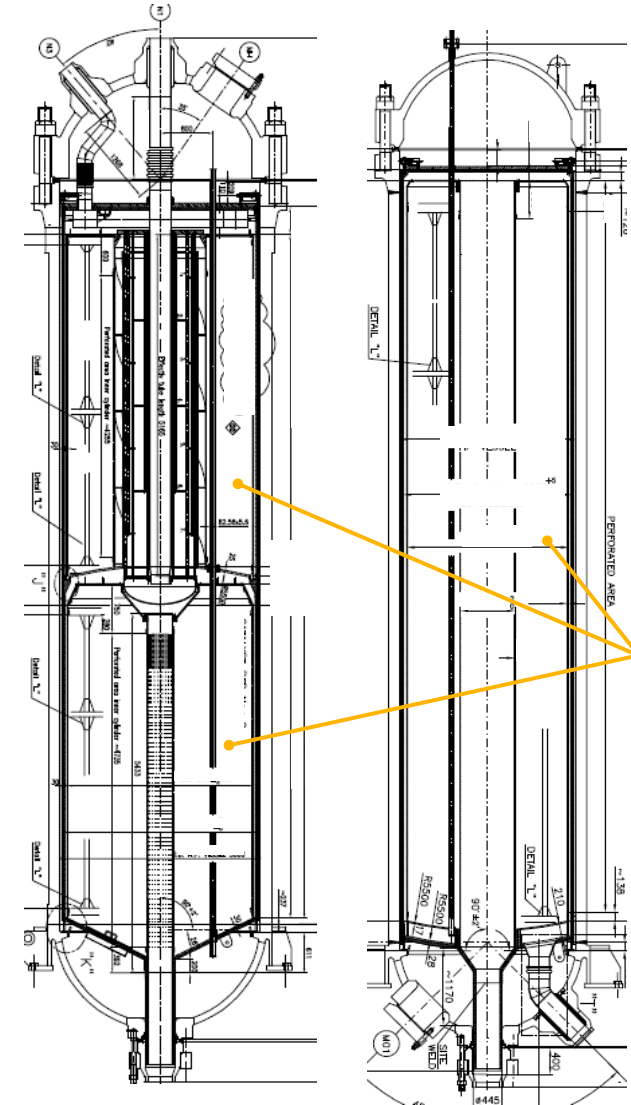
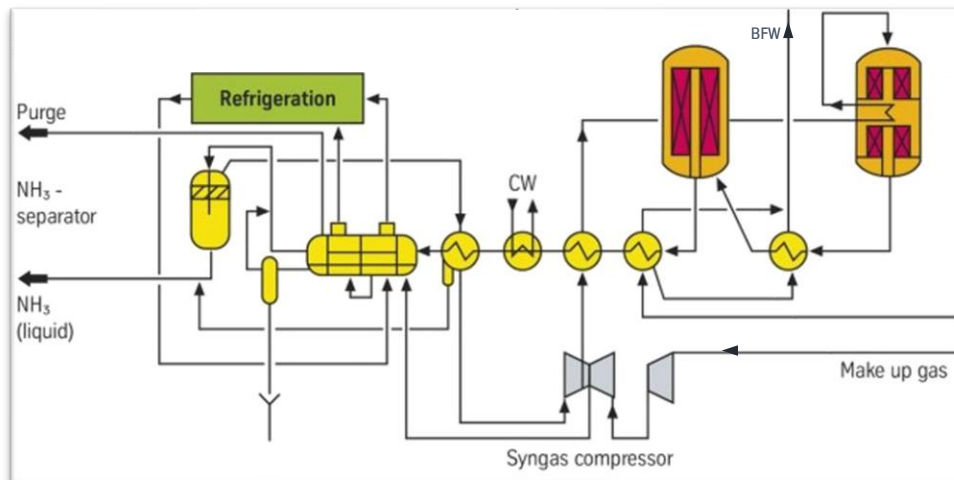


References – Yara Belle Plaine Inc. (Belle Plaine / Canada)



Highlights

- ✓ Currently installed Cartridges by thyssenkrupp Uhde since 31 years in operation
- ✓ New Uhde® Ammonia Converter Cartridges in existing pressure shells
- ✓ +10% more effective catalyst volume
- ✓ Energy efficiency improvement
- ✓ Reduction of synthesis loop pressure by -6% while maintaining the production capacity
- ✓ Start-up in 2026 (already delivered)



Ammonia Converter 1

Ammonia Converter 2

three axial-radial catalyst beds



Thank you for your attention



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Reducing CO2 footprint and increasing ammonia production

Uhde Ammonia Technology Users' Group Meeting

Munich, August 22nd 2023 | Fred Kessler | thyssenkrupp Uhde



engineering.tomorrow.together.



thyssenkrupp

Reduction and avoidance of CO₂ and other greenhouse gas (GHG) Emissions are not ideological decisions anymore.

Emission reduction will be an economic decision in the future!

Costs for CO₂ and GHG emissions will be higher than costs for reduction and avoidance

- ⊕ Importers will have to pay CO₂ taxes in case emissions are not billed in same equally (e.g. EU Green Deal)
- ⊕ Due to subsidies some revamps are already feasible
- ⊕ Revamps will consume time (Study, Engineering, Procurement, Construction & Commissioning)
- ➔ **The time to do the first step is NOW!**



Shifting Drivers for „Green Ammonia“ Plants since 80 years

Three main problems with new green ammonia plants:

- Hi costs (CAPEX & OPEX)
- Low availability of renewable energy
- No direct reduction of CO₂ (only avoidance)



Avoidance is good... reduction is better!



Transition from conventional (grey) to sustainable (blue and green) technologies

Different revamp options to reduce GHG/CO2 emissions

Usage of Green Hydrogen from electrolysis instead fossil energy (no GHG emissions)

Adding new technologies to remove (+ store) emissions (major GHG emission reduction)

Improvement of existing complex to increase efficiency (classical energy revamp)

Optimization of operation of current plant/complex

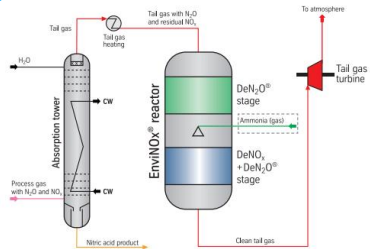
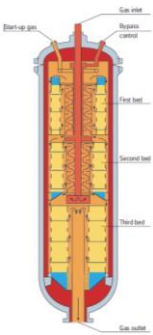
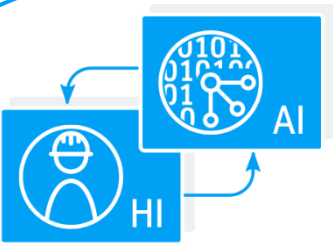
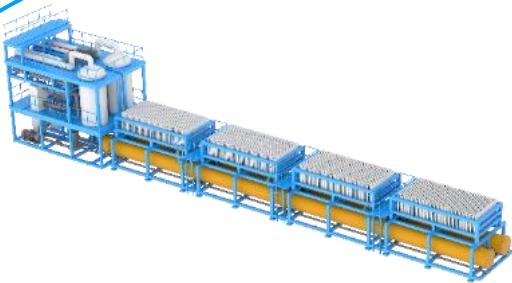


Fig. 3: Envinox® process variant 1: catalytic decomposition of H_2O and catalytic NO_x reduction with ammonia over zeolite catalysts



GHG / CO2 reduction

also combinations possible



Why blue / green ammonia revamp (usage of hydrogen produced with electrolysis)?



Utilizing of existing plant to reduce CAPEX



Revamp can be realized in shorter time than new-build plant



High fluctuation of renewable energy sources can be balanced with conventional produced hydrogen



Big potential of Green Ammonia not only as fertilizer but also as (maritime) fuel and energy carrier



Investments in “Green” technologies as the future market increase prestige and company value



Green revamp can be the “door opener” for this new technology

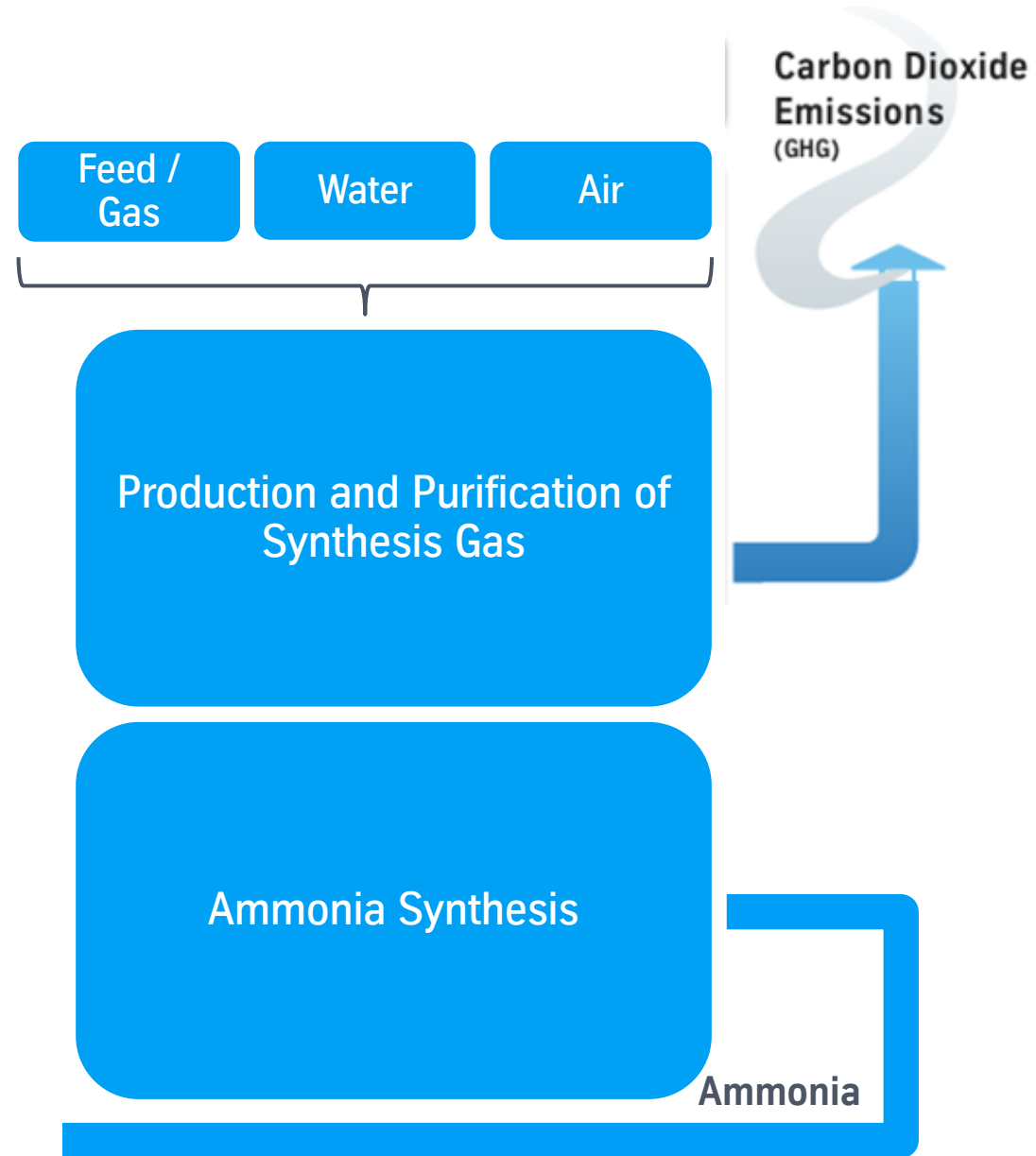


Stepwise ramp-up of Green Ammonia production possible (up to 100%)

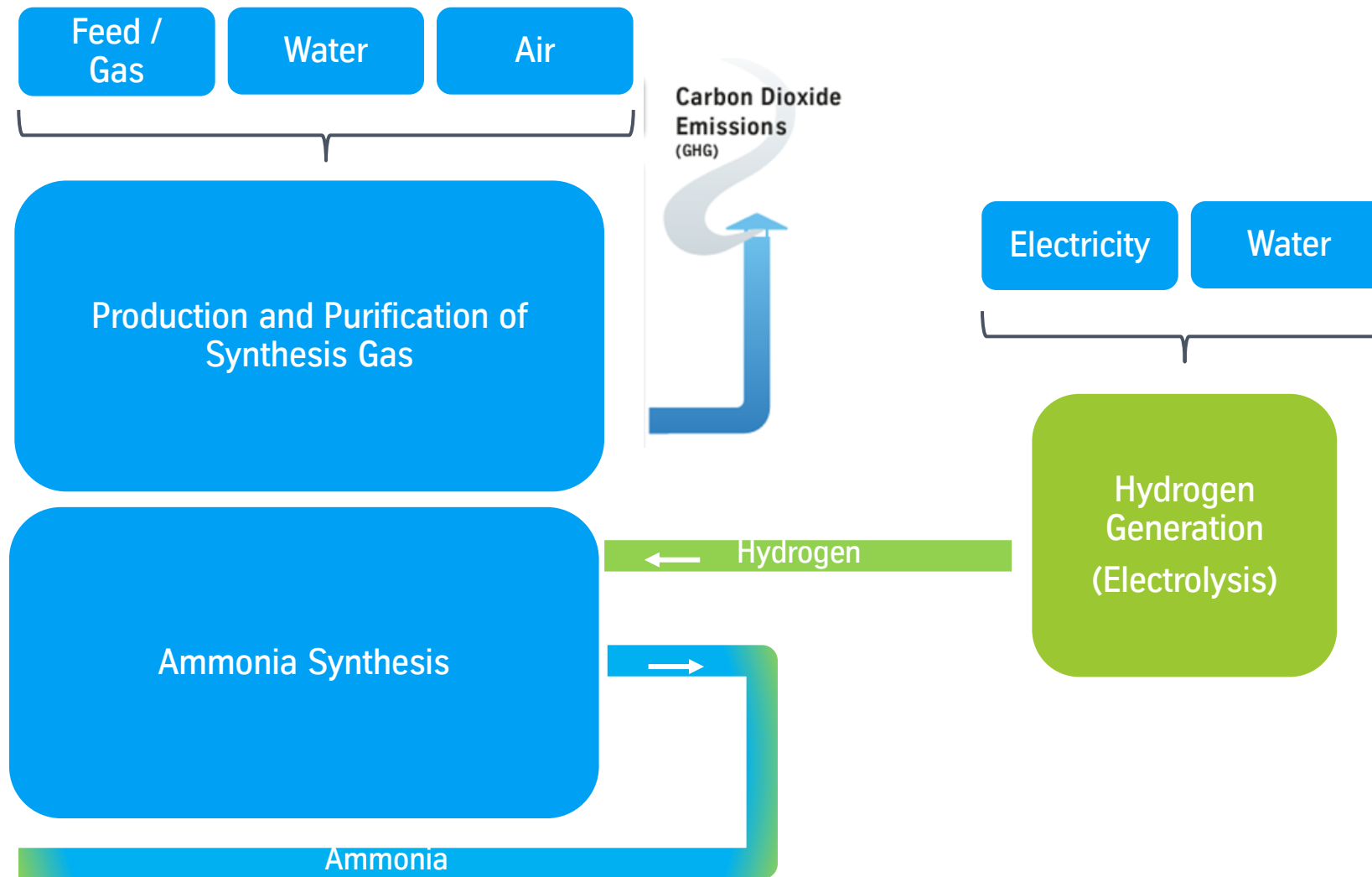
Uhde can offer a One-stop-shop for EPC execution, start-up and after sales services for such green revamps



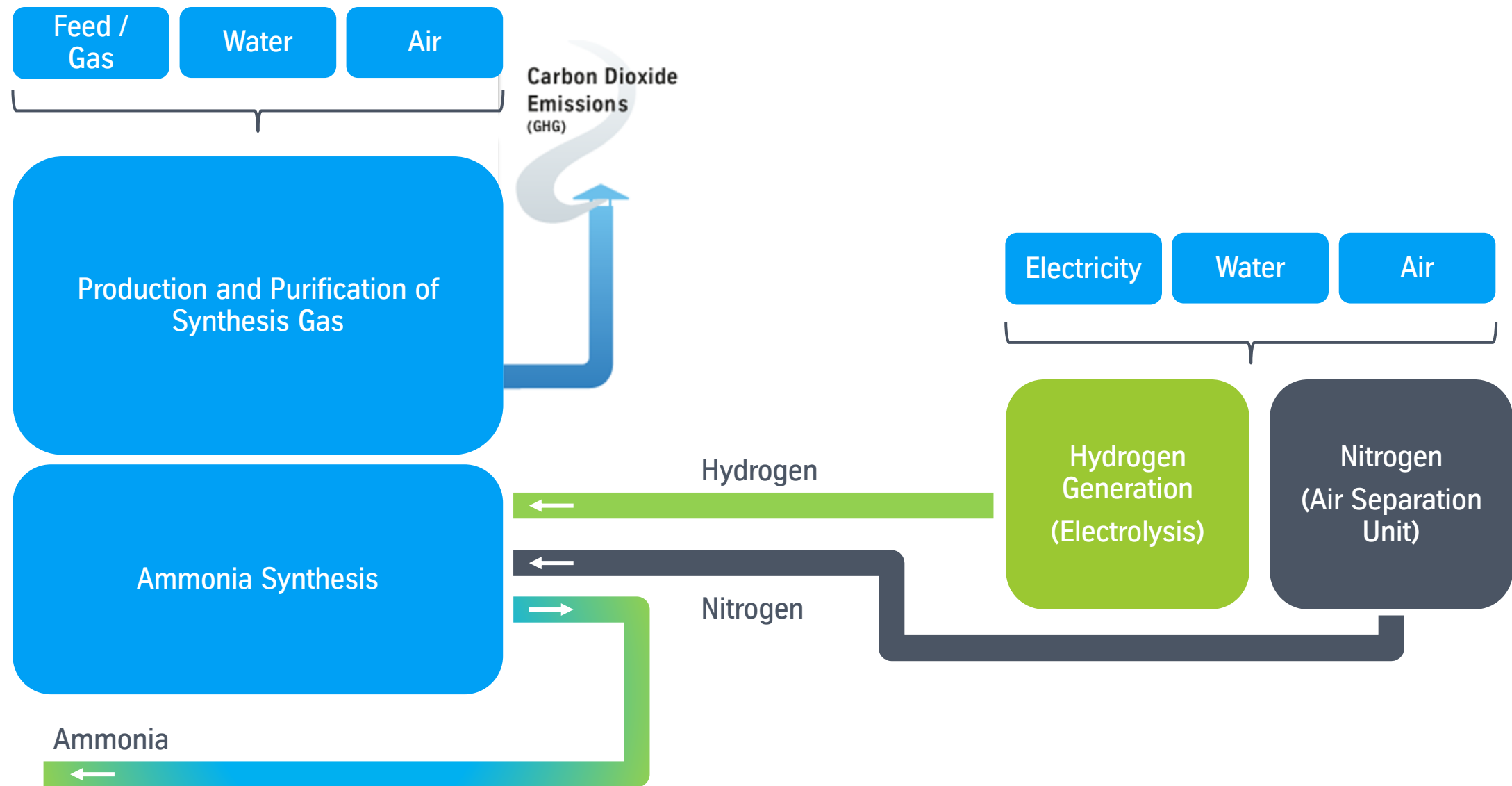
Conventional ammonia plant



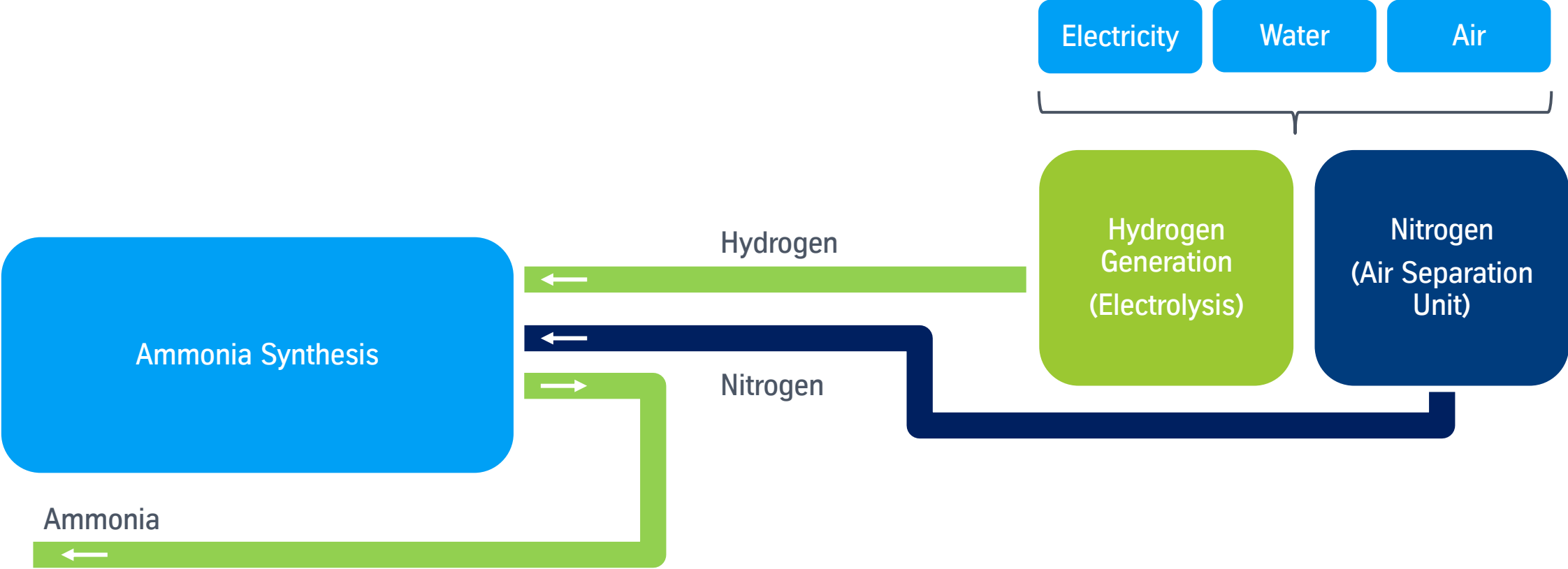
Conventional ammonia plant with 10% green Hydrogen



Conventional ammonia plant with 10-50% Green Hydrogen



100% Green Ammonia Plant



What about CO₂ for Urea Production

Green ammonia production has no CO₂ generated

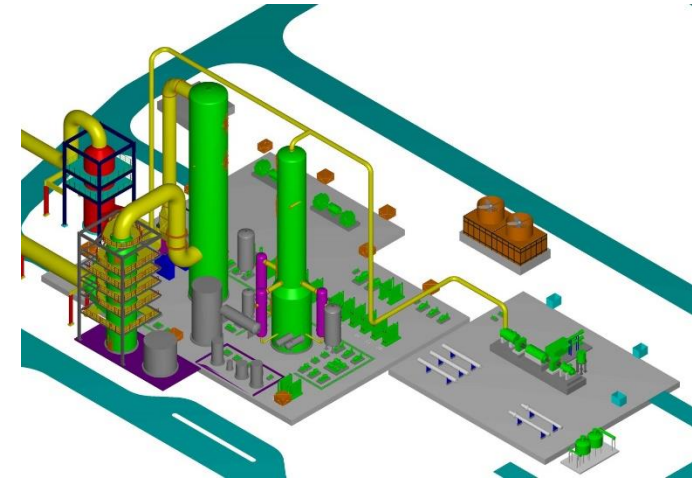
For Urea production, CO₂ is required

Solutions:

- CO₂ recovery from existing ammonia plant reformer flue gas
- CO₂ recovery from package boiler flue gas

Uhde has two different technologies available for CO₂ removal:

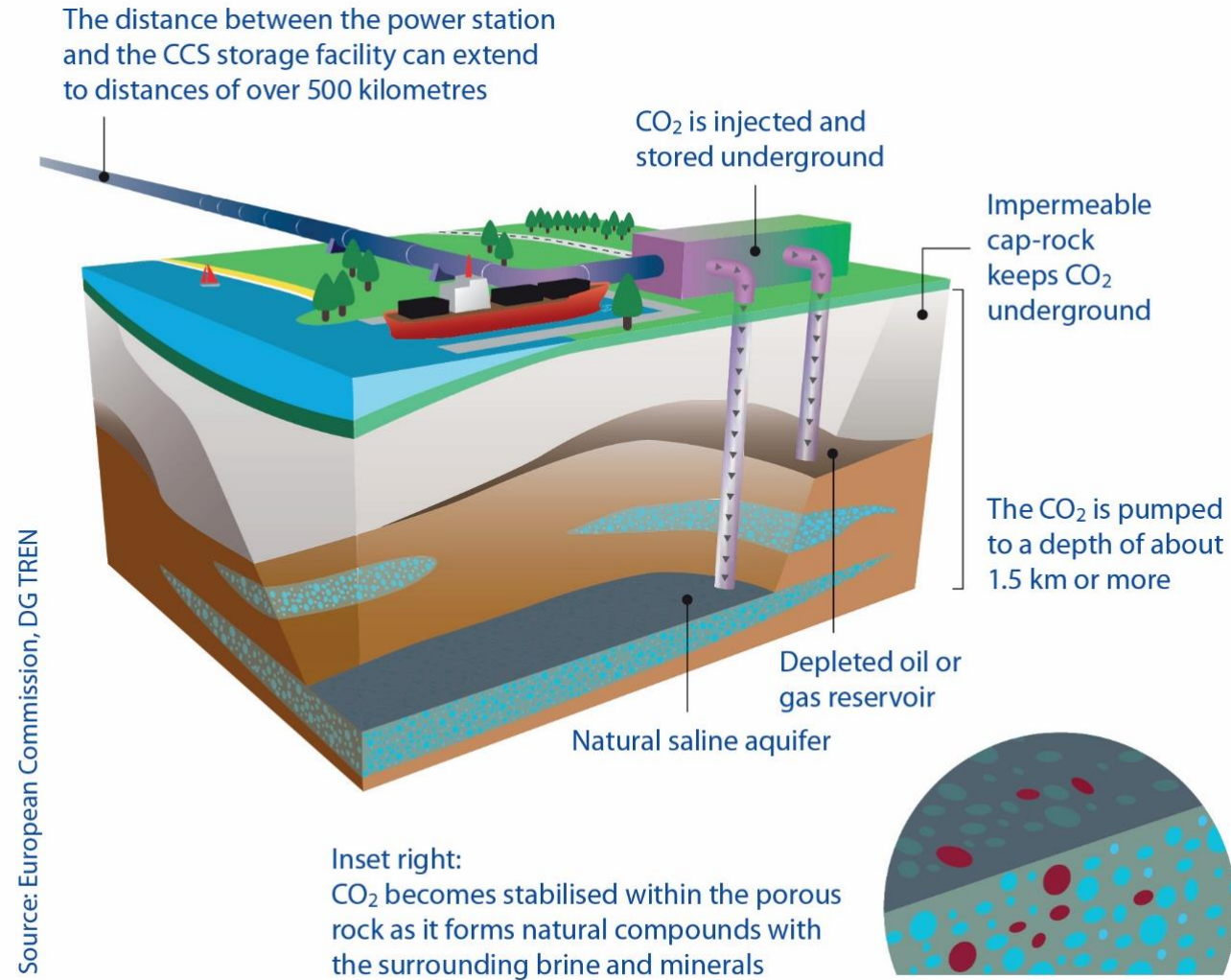
- Traditional Amine based solvent
- Ammonia/water-based solvent



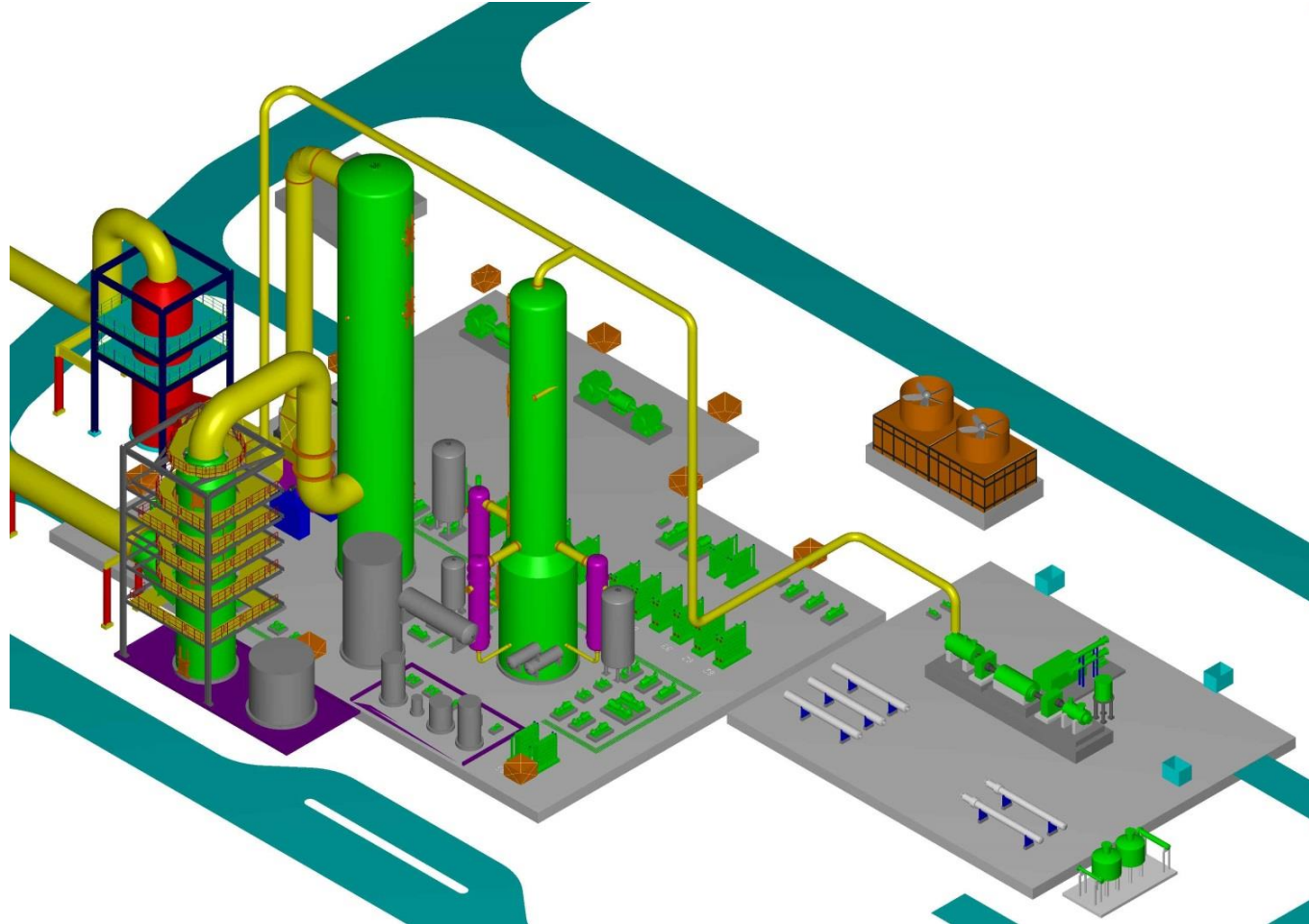
In future CO₂ recovery from flue gas is not an environmental but an economical decision!



CO₂ Recovery from flue gas – Carbon Capture and Storage (CCS) scheme



CO₂ Recovery from flue gas – layout example for a CO₂ Recovery Plant



CO₂ Recovery from flue gas – Further usage of Flue Gas Components

Case Study: Alternate source of Nitrogen in Ammonia Process
(for large capacity increase using Green H₂)

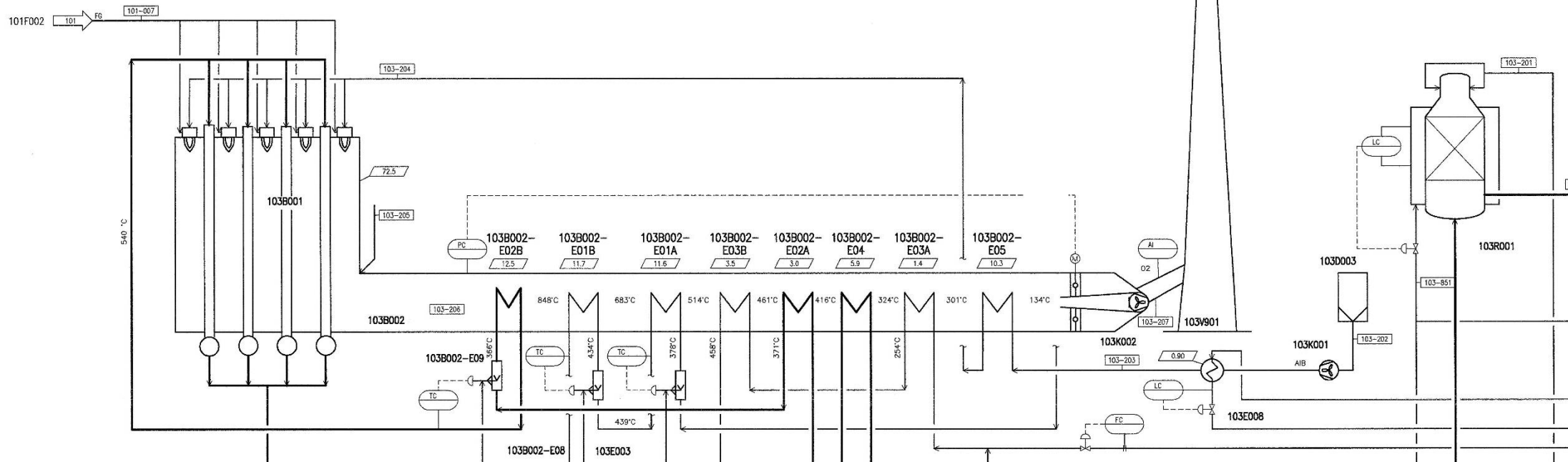
Usage of **Nitrogen in Flue Gas** in the ammonia process

Case Study: **Uhde Patent** for utilization of Nitrogen in Flue Gas for Green / Blue Ammonia Production



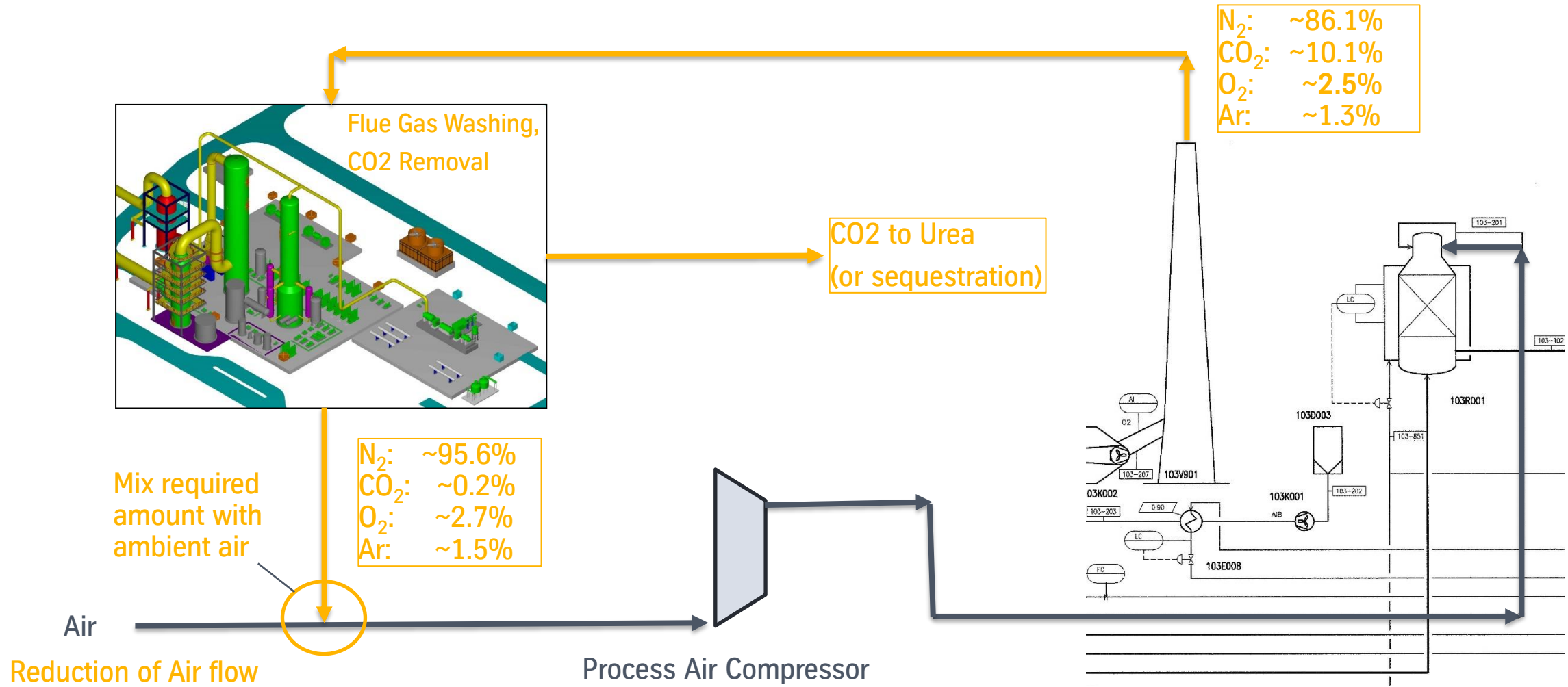
Case Study: Usage of Nitrogen in Ammonia Process

N ₂ :	~86.1%
CO ₂ :	~10.1%
O ₂ :	~2.5%
Ar:	~1.3%

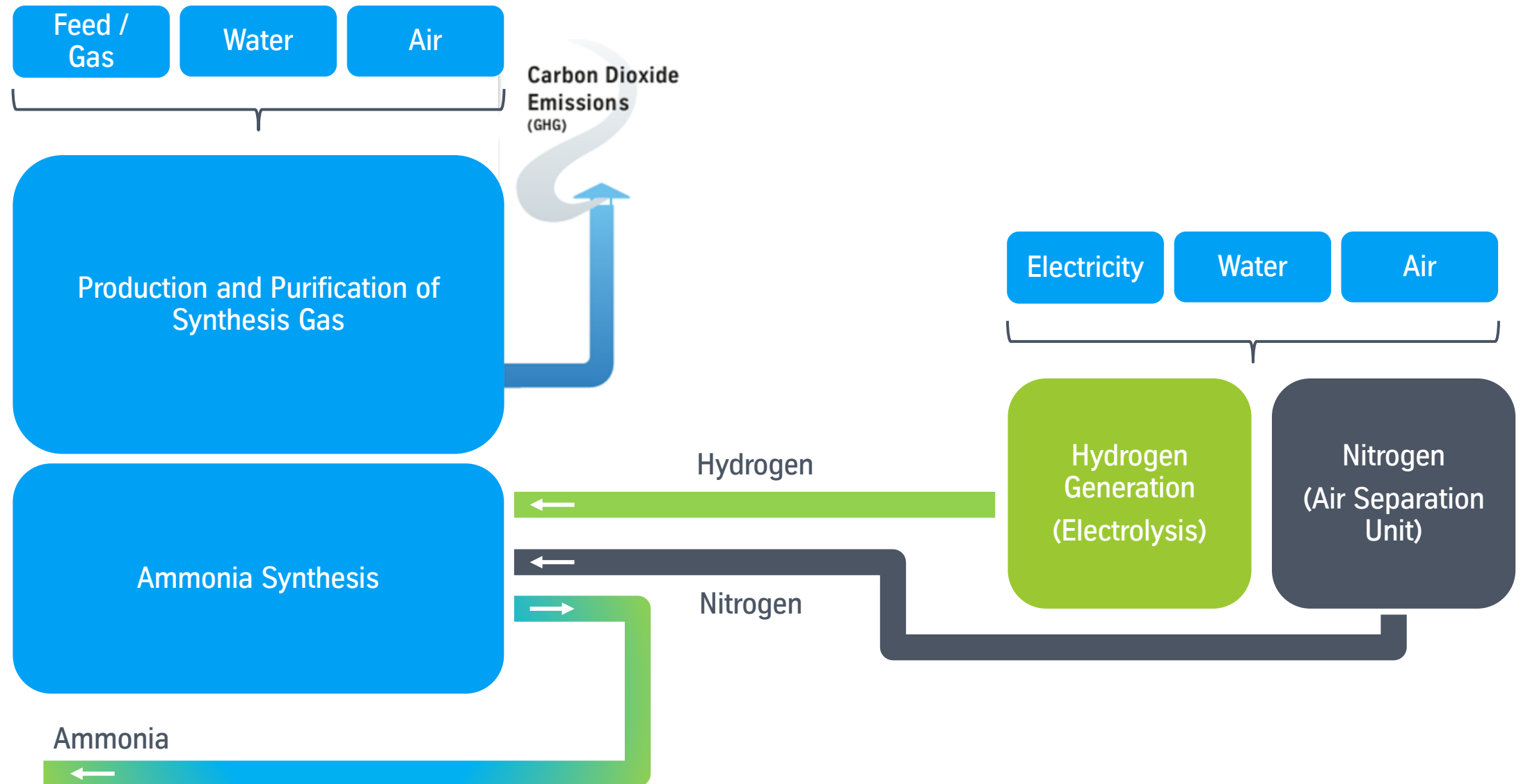


CO₂ Recovery from flue gas

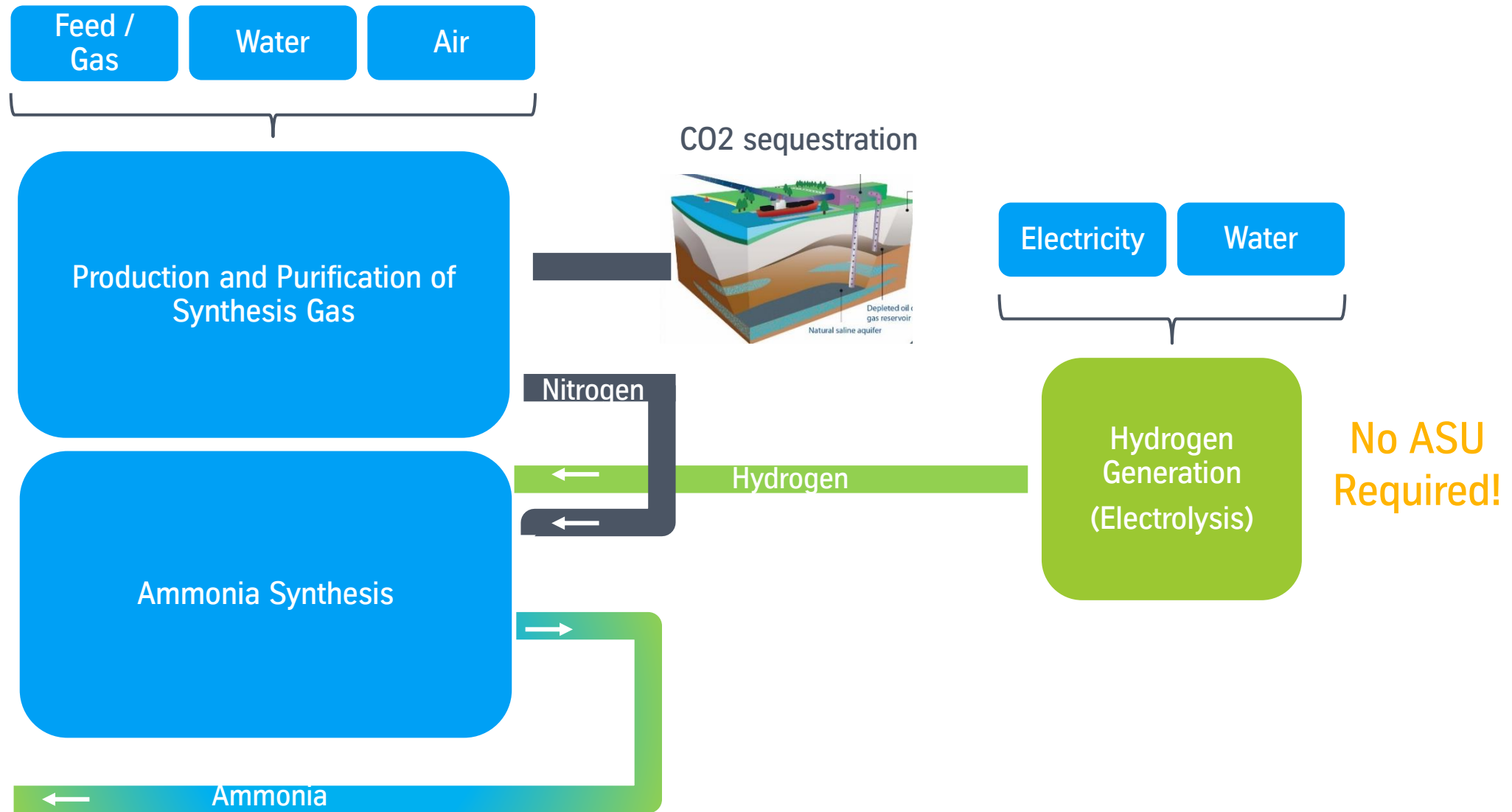
Usage of Nitrogen in Ammonia Process



Conventional ammonia plant with 10-50% Green Hydrogen



Conventional ammonia plant with 10-50% Green Hydrogen



Why is Uhde the ideal partner for green revamps?

-  Single organization takes responsibility for the whole process of design up to delivery to the plant site.
-  Full expediting & inspection services and monitoring of manufacturer during all stages of engineering/manufacturing by dedicated personnel whereby Uhde can lean on the cooperation between Uhde and manufacturer over many years.
-  Full supervision services before and during site works by dedicated Uhde personnel with experiences of similar complex projects.
-  Elaboration of a detailed, step by step guideline for the replacement work considering shut down time, constructability and site conditions.
-  Mechanical and performance guarantees by Uhde
-  Fixed price and time schedule for whole revamp
-  Optimum usage of existing space to implement revamp measures

Choosing Uhde as partner will reduce potential risks by minimizing interfaces and appointing one responsible party



thyssenkrupp delivers solutions for a sustainable future

Conclusion:

Uhde offers **many** different options and combinations to reduce carbon footprint of your existing fertilizer plants

- Ammonia: Green / Blue Ammonia / NOx abatement (Low Nox burners or SCR) / Energy Efficiency Revamp
- Nitric Acid: Envinox® / OxyBoost
- Urea: Zero emission stack / Acidic scrubbing with nitric acid or sulfuric acid / reduction of Formaldehyde emissions (UF Tank vent scrubbing or tkFT additive Add® without formaldehyde) / Increase of nitrogen efficiency (inhibitor Treatment Technology (ITT) of tkFT/BASF)



Thank you for your attention



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Round Tables

In the foyer you will find signs with the workshop topics on the tables.

At the tables you can ask questions about the topics ..

.. or just talk to our professional colleagues



We look forward to your questions!

