

Uhde innovate 2024

Green Revamp Solutions

06.06.2024 | Günter Völker and Alexander Poppe
thyssenkrupp Uhde

engineering.tomorrow.together.

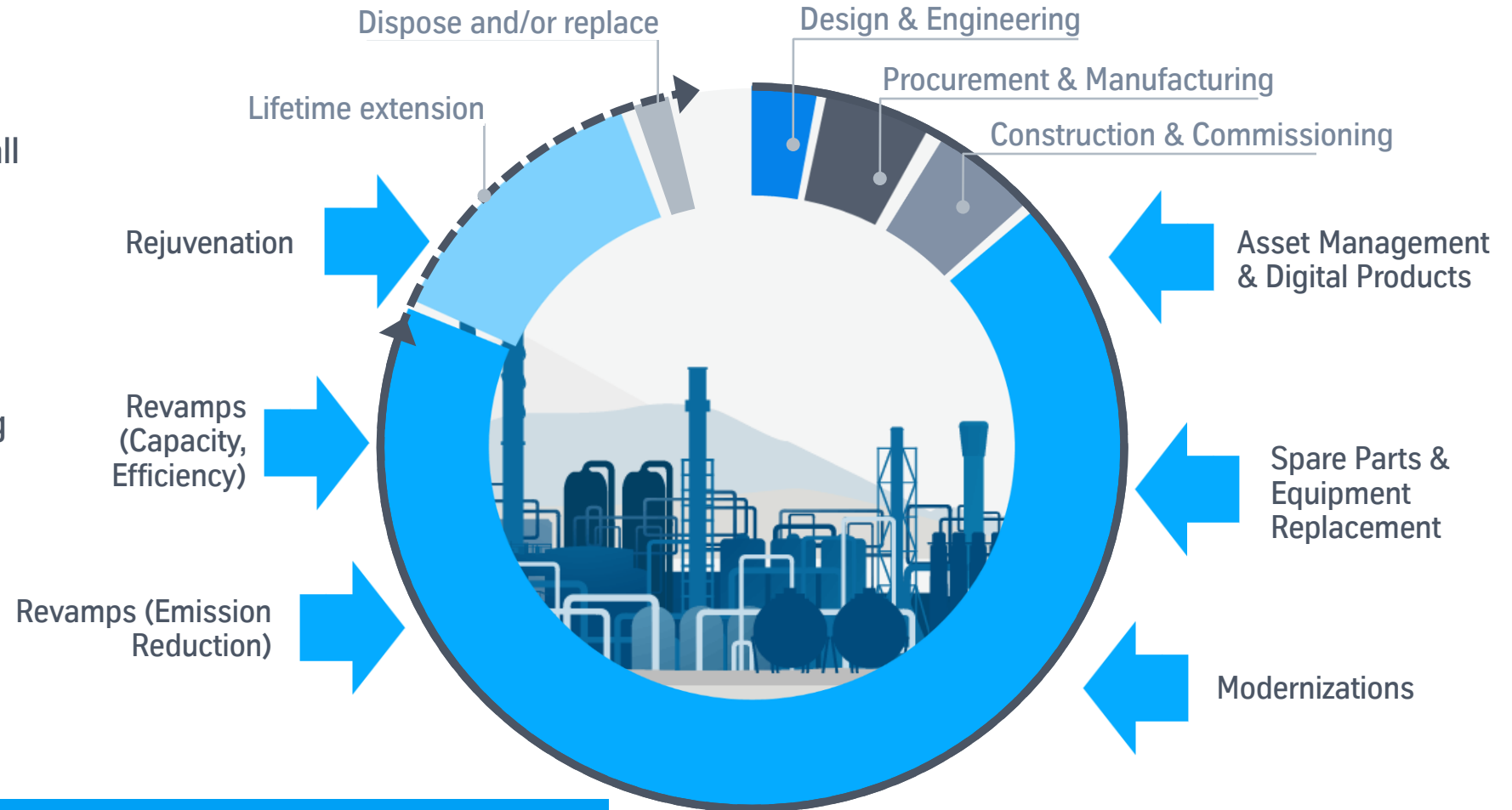


thyssenkrupp

Uhde Services Portfolio Update

Lifecycle Services by Uhde's global Service Team for existing plants

- Our Service teams deliver technical solutions over the complete plant lifecycle to improve our customers' competitiveness - that's what we call 360° Service.
- Worldwide more than 300 experts are dedicated to Service
- Our focus is on optimizing our customer's profit and risk – creating a win-win situation and trustful partnership

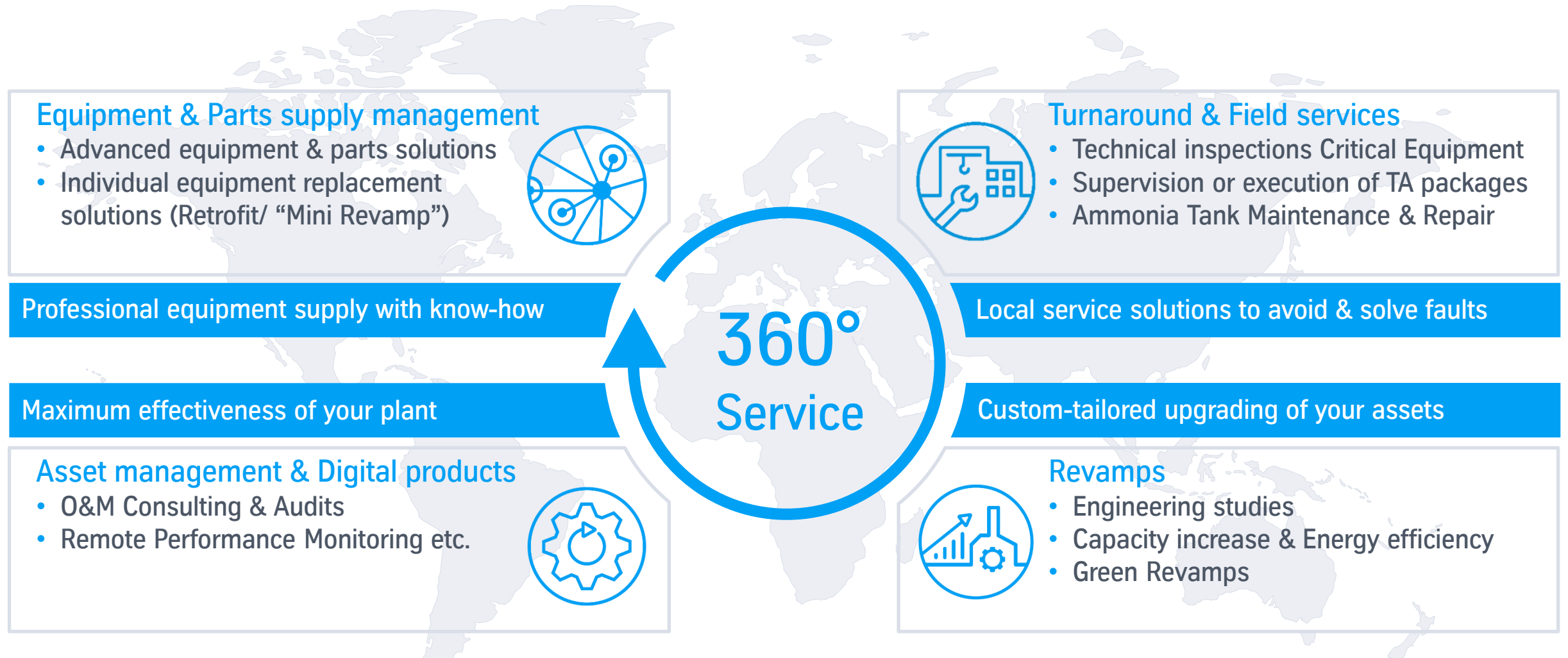


Maintaining trusted customer relationships over the complete plant lifecycle



Service solutions along the entire plant lifecycle to enhance our customers' competitiveness

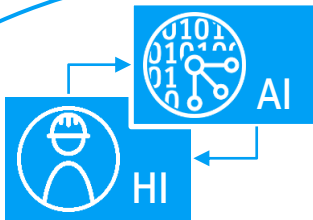
That's what we call 360° Service



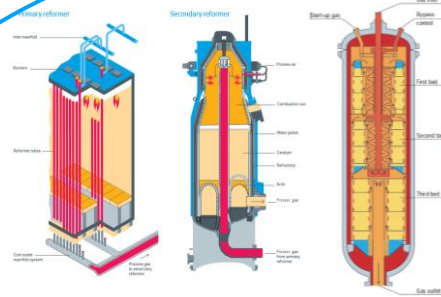
Transition from conventional (gray) to sustainable (blue and green) chemicals

Different revamp options for existing plants to reduce GHG/CO₂ emissions

Optimization of operation of current plant/complex by digitalization



Improvement of existing complex to increase efficiency (Energy Revamp)



Adding new technologies to remove emissions GHG/CO₂/N₂O ("blue" products)

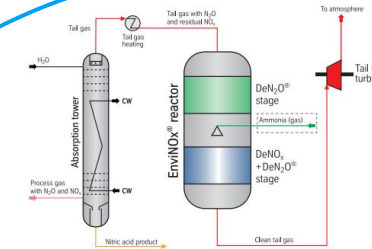
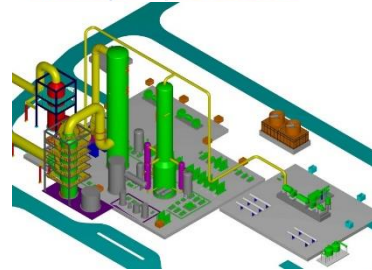
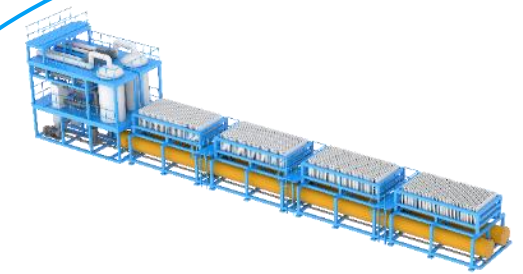


Fig. 3: Envinox® process variant 1: catalytic decomposition of N₂O and catalytic NO_x reduction with ammonia over zeolite catalysts



Usage of Green Hydrogen from electrolysis instead of fossil energy ("green" products)

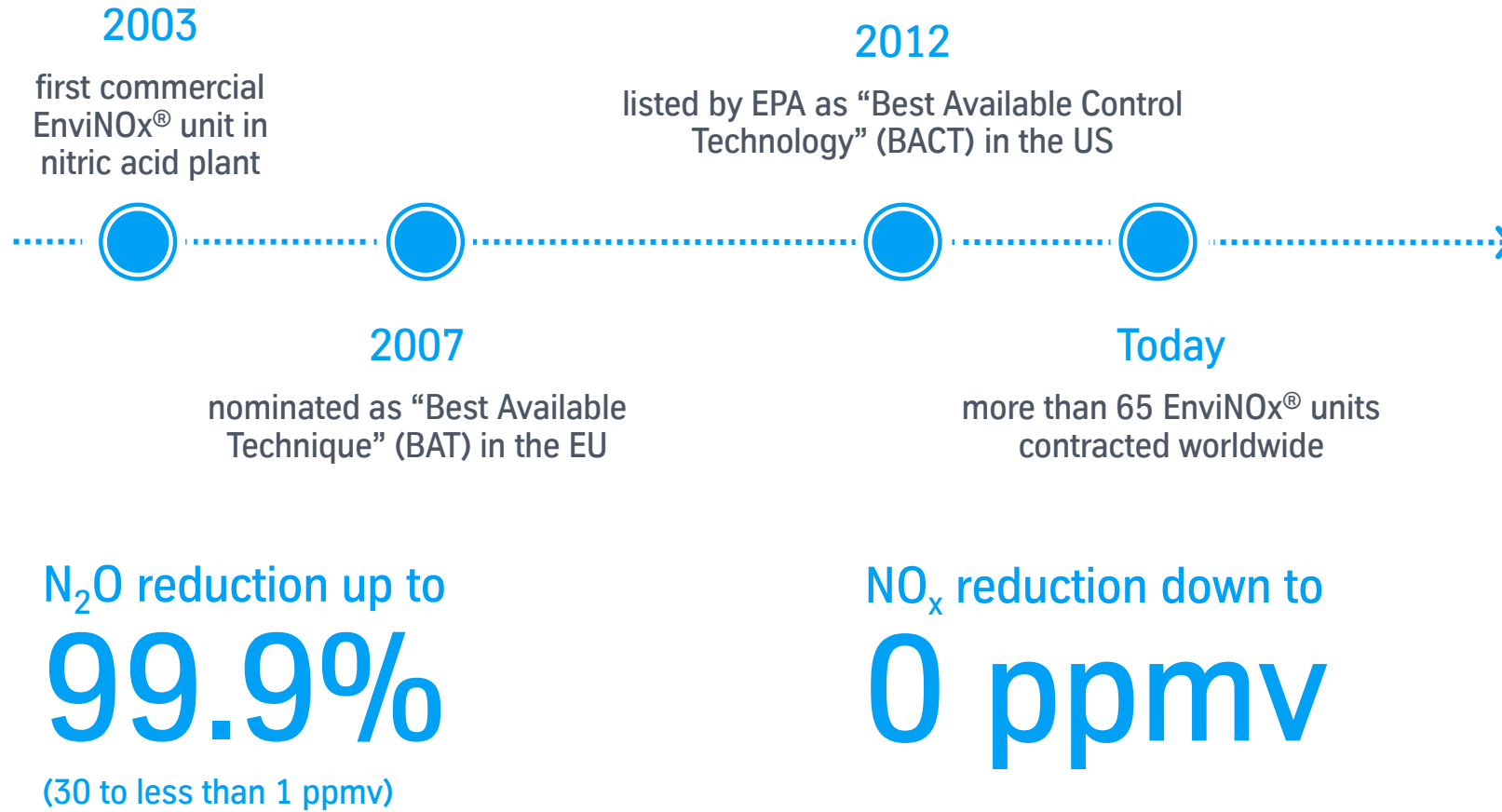


GHG / CO₂ reduction



Uhde EnviNOx[®] technology for N₂O and/or NO_x reduction

Status

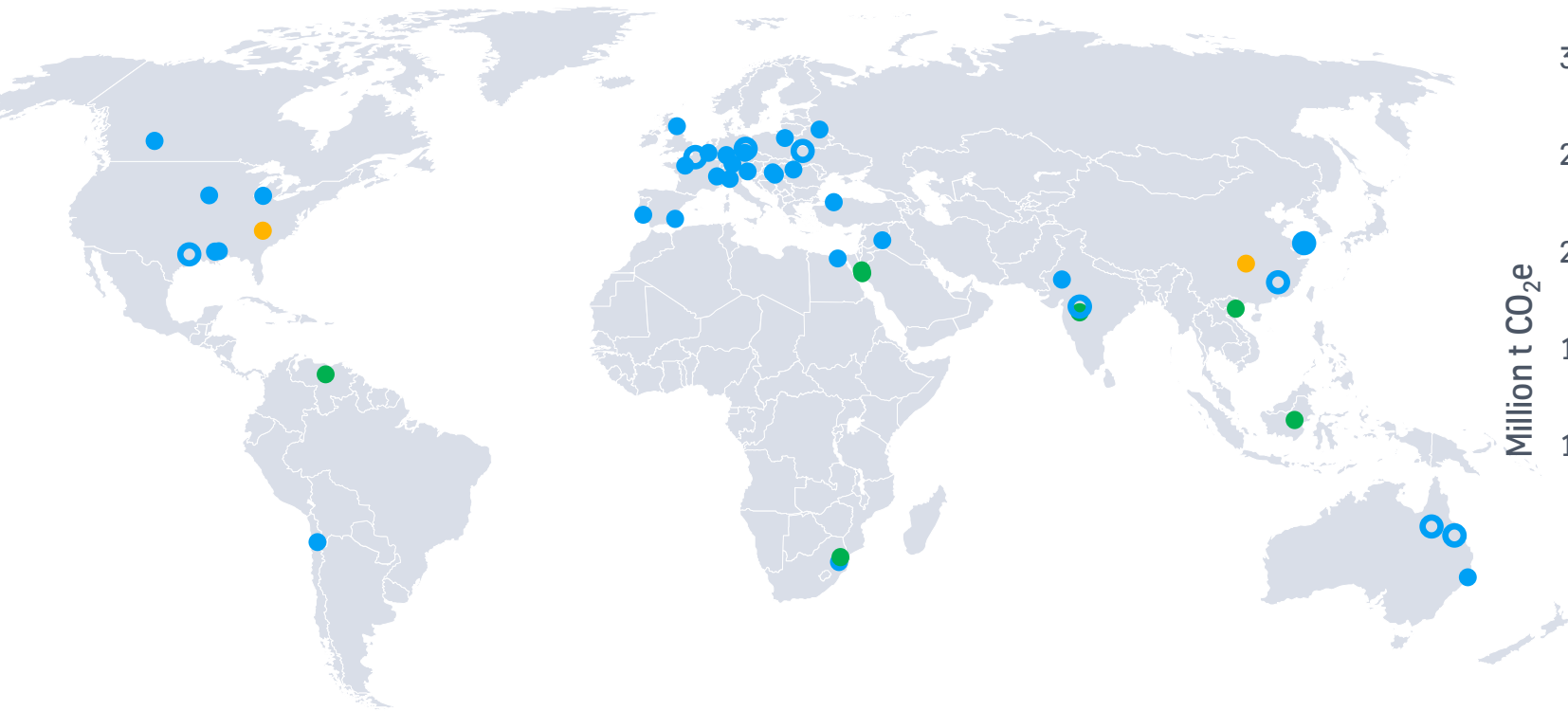


EnviNOx[®] reliably meets all present and future emission requirements

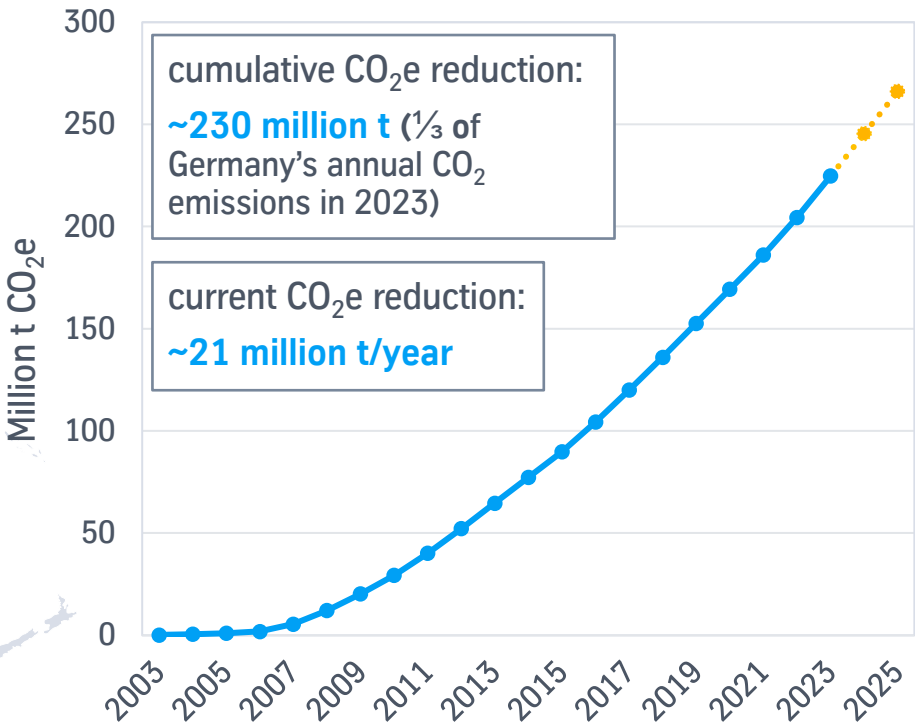


Uhde EnviNOx[®] technology for N₂O and/or NO_x reduction

Overview – Worldwide EnviNOx[®] & DeN2O[®] installations



Total cumulative CO₂ equivalent reductions from EnviNOx[®] plants



More than 65 customized EnviNOx[®] units (will) contribute to global climate and environmental protection

- EnviNOx[®]
- DeN₂O[®]
- DeNO_x
- in operation
- to be commissioned



Uhde EnviNOx[®] technology for N₂O and/or NO_x reduction

Current and future applications of Uhde EnviNOx[®] technology

For off-gas cleaning in chemical plants:

- Nitric acid plants
- Niacin plants
- Caprolactam plants
- Adipic acid plants
- Other chemical plants having N₂O & NO_x emissions
- ...



For off-gas cleaning from ammonia burning:

- Direct heating
 - e.g. ammonia cracking plants
- Energy production
 - ammonia gas turbines
 - ammonia driven engines e.g. for ships
 - ...



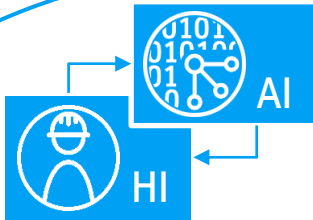
Any tail gas having N₂O & NO_x emissions can be investigated for application of Uhde EnviNOx[®] technology



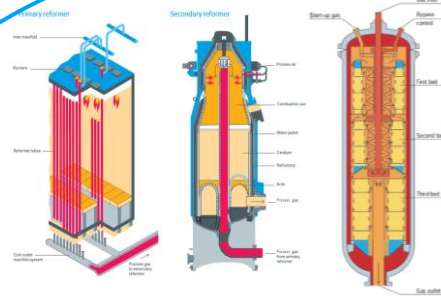
Transition from conventional (gray) to sustainable (blue and green) chemicals

Different revamp options for existing plants to reduce GHG/CO₂ emissions

Optimization of operation of current plant/complex by digitalization



Improvement of existing complex to increase efficiency (Energy Revamp)



Adding new technologies to remove emissions GHG/CO₂/N₂O (“blue” products)

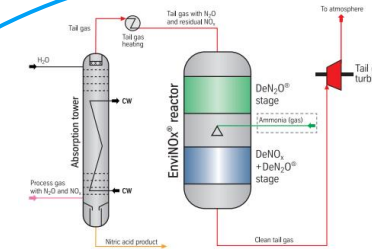
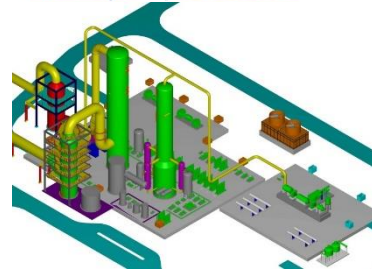
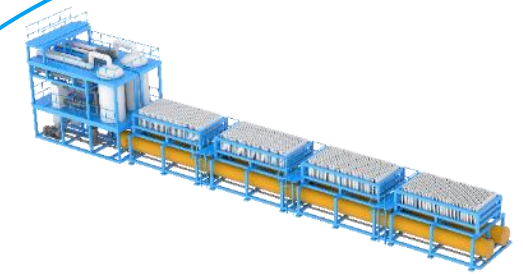


Fig. 3: Envinox® process variant 1: catalytic decomposition of N₂O and catalytic N₂O reduction with ammonia over zeolite catalysts



Usage of Green Hydrogen from electrolysis instead of fossil energy (“green” products)



GHG / CO₂ reduction

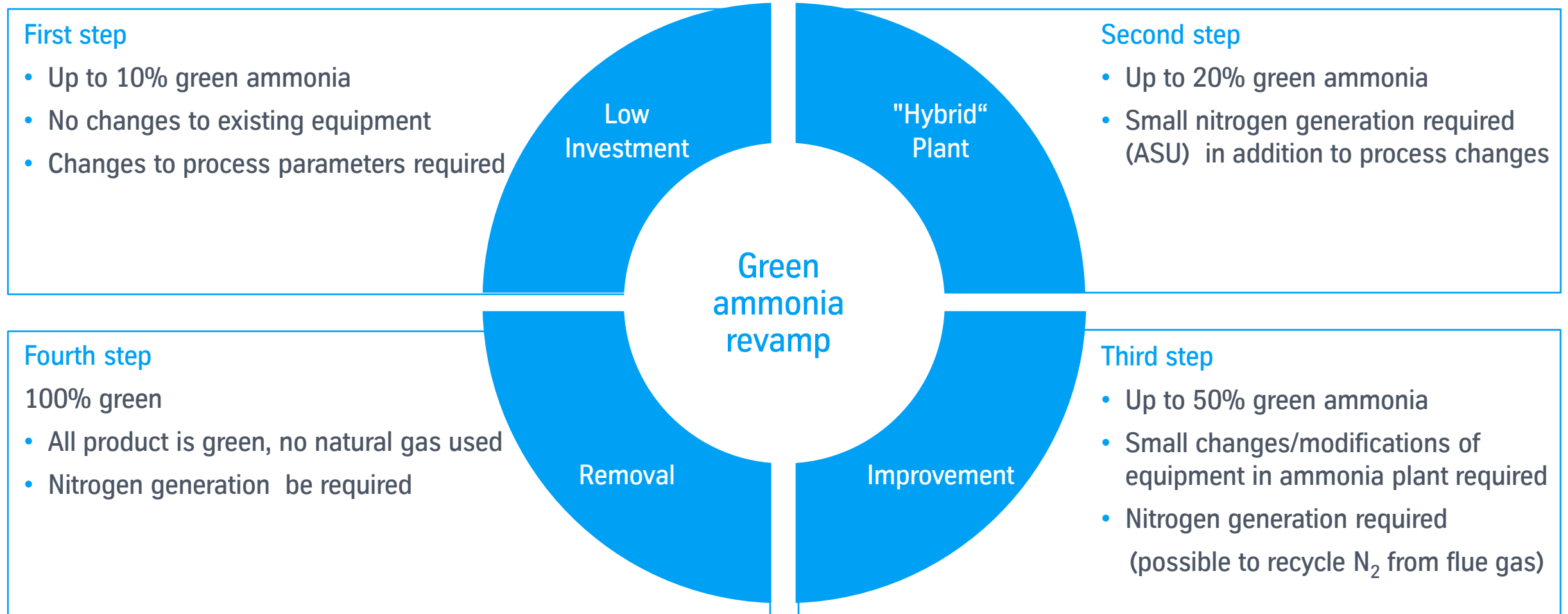


Natural Gas
Replacement



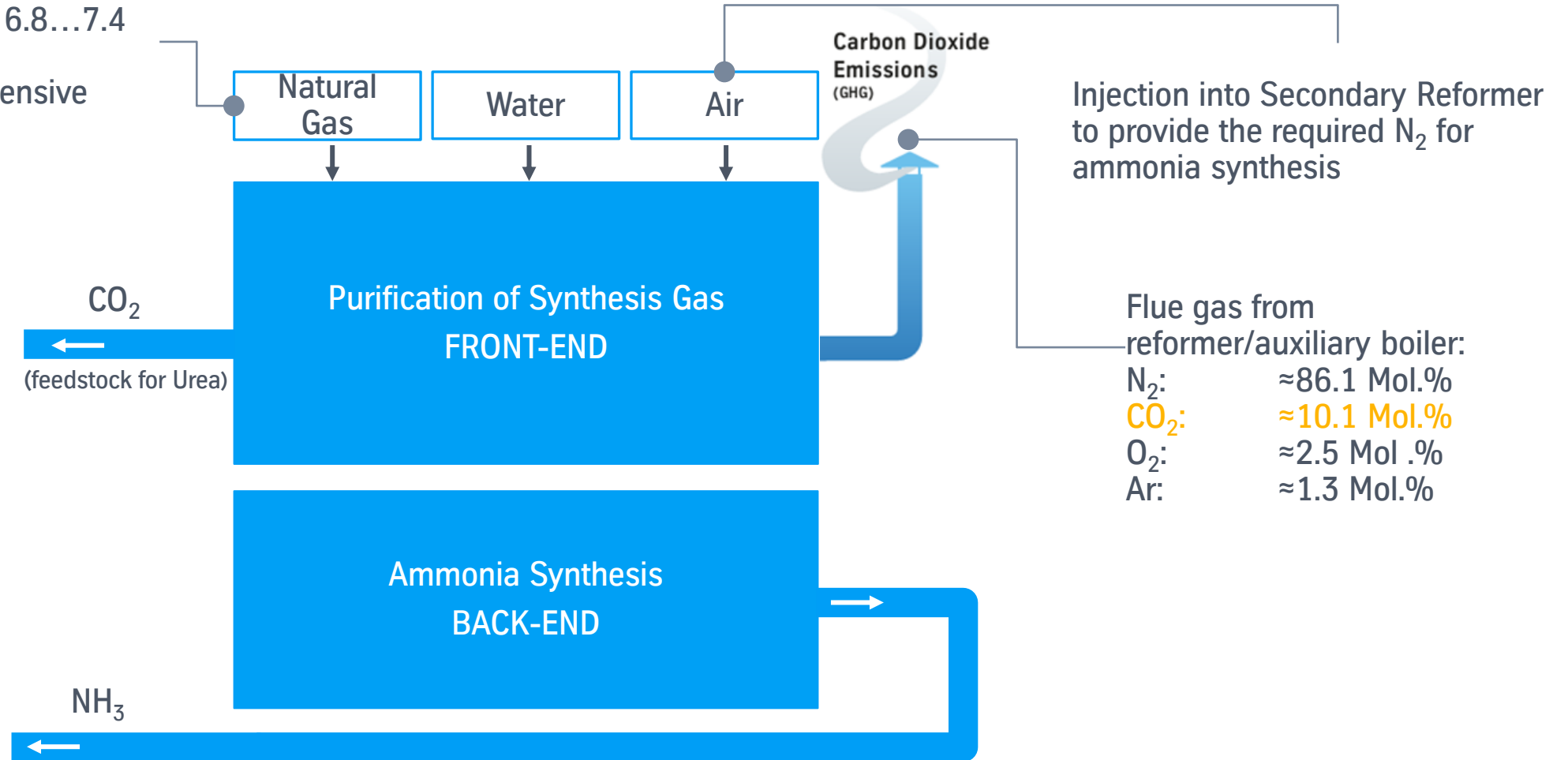
Capacity
Increase

Different options for a green ammonia revamp – replacement of natural gas

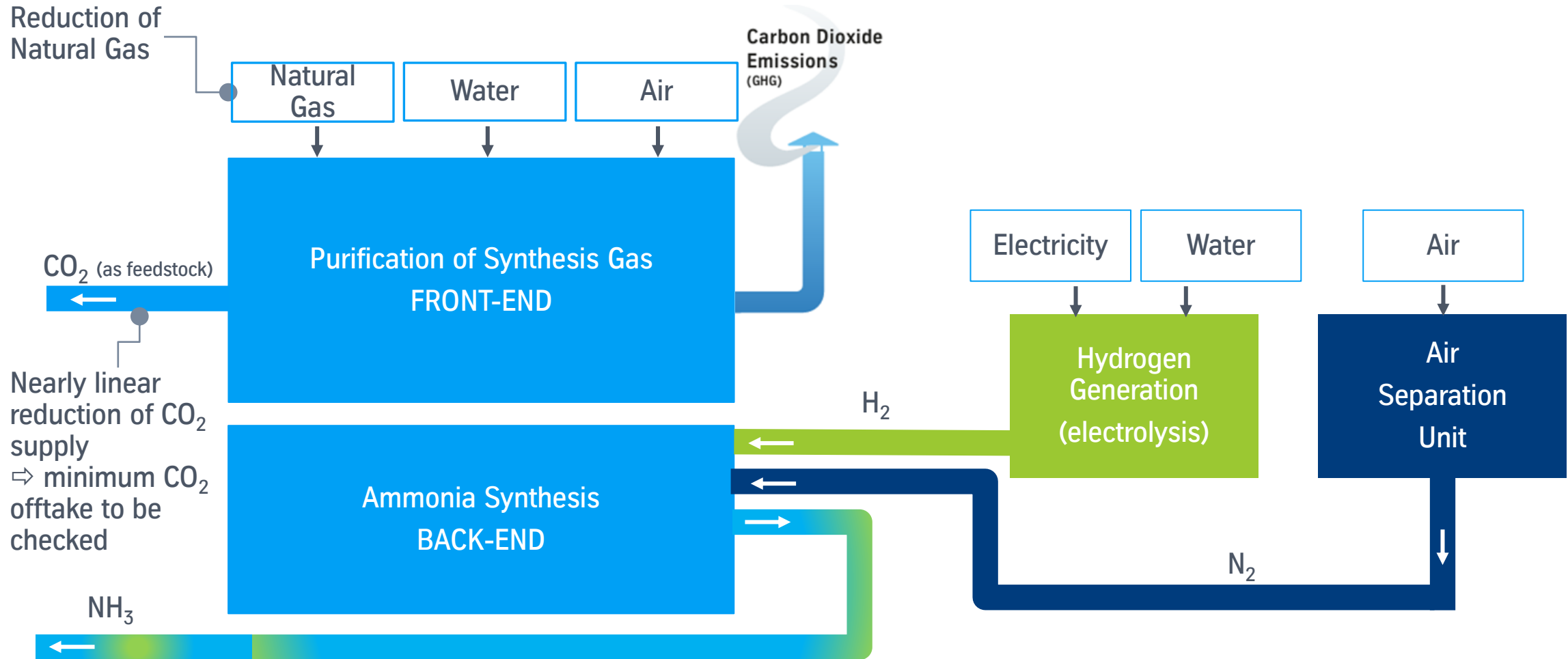


Green Revamp – Conventional ammonia plant

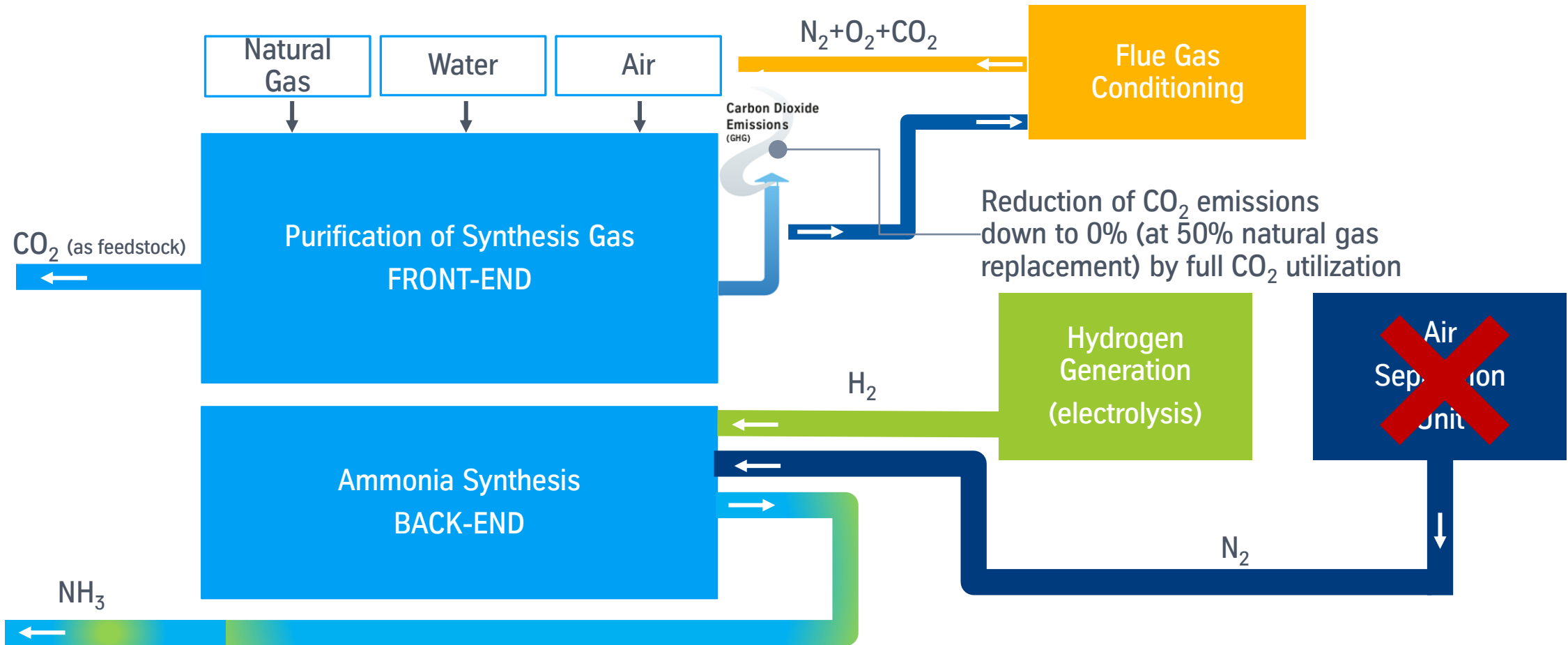
Energy consumption of 6.8...7.4
Gcal / t NH_3
→ extremely energy intensive



Decarbonization – Replacement of 20% - 50% Natural Gas



Decarbonization – Replacement of 20% - 50% Natural Gas (*ALTERNATIVE*)



Actual green ammonia revamp projects

Unigel, Brazil	CFI, USA	Not disclosed	Fertiglobe	Fertiberia Spain
• Basic Engineering (completed) for injection of green hydrogen (60 MW electrolysis) • Production of additional +150 mtpd of green NH₃	• Engineering & Construction (completed) for injection of green hydrogen (20 MW electrolysis) • Decarbonization of ≈50 mtpd NH₃	• Basic Engineering (completed) for Ammonia & Urea revamp - EPC Phase to begin soon • Removal of CO₂ from reformer flue gas for additional Urea production and injection of green H₂ for capacity increase	• Feasibility Study for injection of green hydrogen into existing NH₃ plant • Completed study to produce additional +25% of green NH₃ by application of Uhde® dual pressure system	• Feasibility Study (ongoing) for injection of green hydrogen to replace 40% natural gas



Blue and Green Revamps

to reduce CO₂ footprint of existing VCM & PVC plants



Uhde / Westlake Vinnolit

Leading-edge technology in VCM/PVC production

50 years of experience
in design, erection
& operation

Licenses for more than

14 Mio

tons of EDC

Licenses for more than

6.5 Mio

tons of VCM

Special know-how in energy efficiency technologies

CNC Direct
chlorination



Oxy-
chlorination



Cracking /
EDC Evaporator



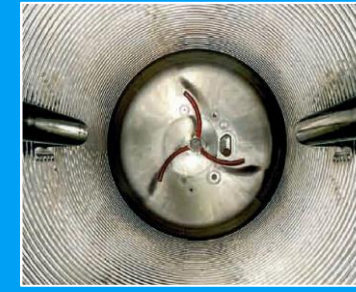
Recycle EDC
Chlorination



VCM Dryer



PVC Inner
Cooler Reactor



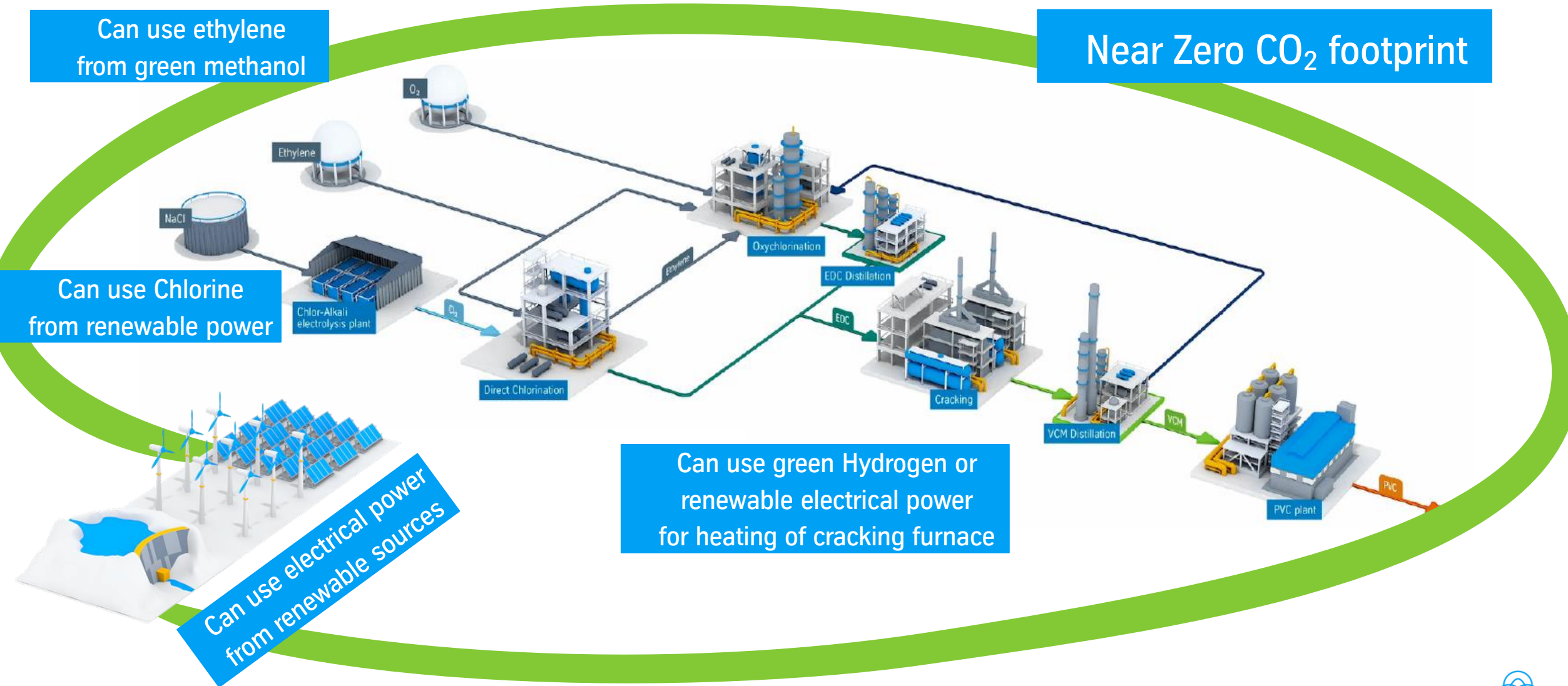
PVC Reaction
Water Recovery



¹ Uhde is the exclusive partner of Vinnolit



Numerous combinations of heat recovery and energy-saving measures of the Uhde/Westlake Vinnolit EDC/VCM/PVC process lead to a near-zero carbon footprint





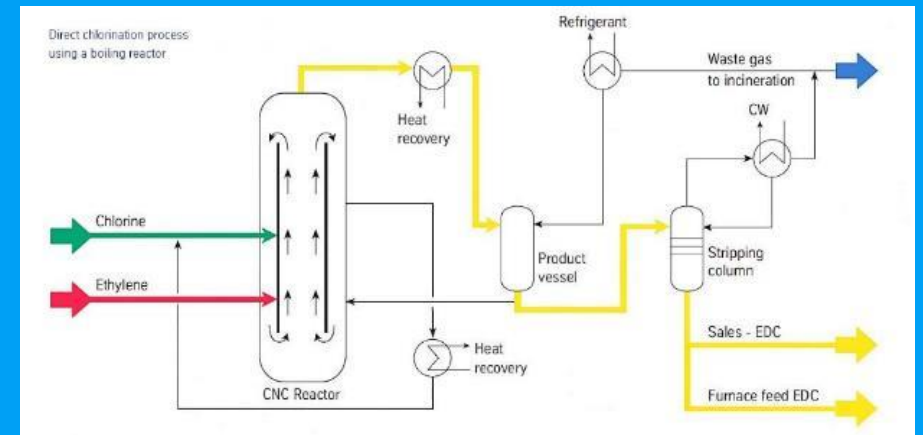
Reduction in Direct Chlorination

Reduction of approx. 50.000 t CO₂/year
(based on a 500 KTA VCM plant).

Revamp done in Europe and in operation. In
total 4 reactors in operation, 17 planned or
under implementation.

High reaction temperatures create several
heat recovery options like drying of PVC or
EDC distillation.

Production of furnace feed quality EDC
without further distillation, only stripping.





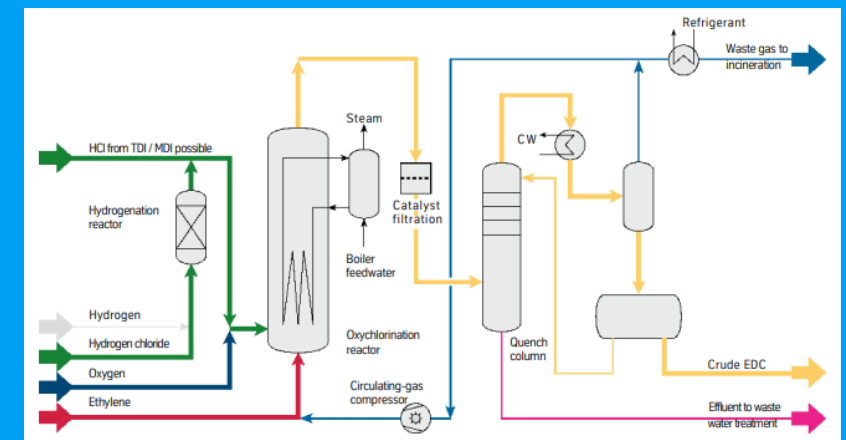
Reduction in Oxychlorination Technology

Reduction of approx. 35.000 t CO₂/year (based on a 500 KTA VCM plant).

Revamp done in Europe and in operation. More than 40 references worldwide for the Oxychlorination technology.

Medium pressure steam production is standard in the industry but for capacity increase pressure level is lost. Keeping pressure level with Uhde/Vinnolit oxychlorination solution.

The steam produced covers a major part of the medium pressure steam consumption of the entire EDC/VCM plant.





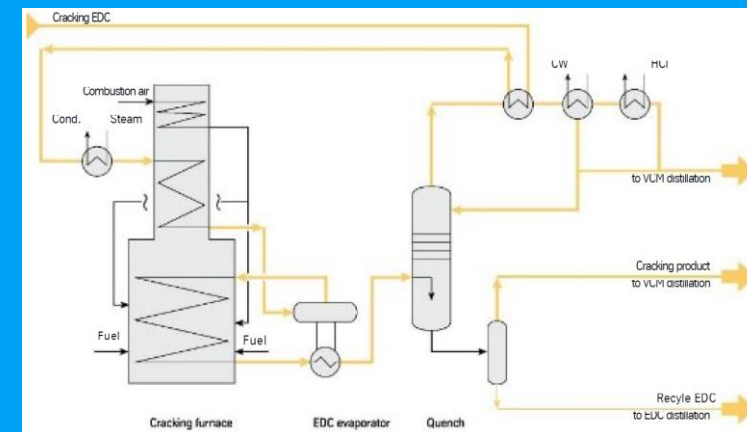
Reduction in EDC Cracking

Reduction of approx. 30.000 t CO₂/year
(based on a 500 KTA VCM plant).

5 revamps done in many regions and in
operation. More than 40 references worldwide
for the EDC Cracking technology.

The unique EDC evaporator system recovers
the sensible heat of the reaction mixture
leaving the cracking furnace by evaporating
the feed EDC.

Additional features in the EDC Cracking Unit
result in a significant energy saving.





Reduction by Recirculation of process streams

With the Uhde/Vinnolit recycle EDC chlorination system a dry lights distillation unit is no longer necessary and this saves further energy.

Steam can be generated in the by-product recovery, which also contributes to supplying the plant with steam from internal sources.

Furthermore, a HCl recovery section of the by-product recovery generates gaseous HCl which is fed back to the oxychlorination unit. This results in chlorine savings and thus energy savings.





The Uhde/Vinnolit S-PVC technology environment-friendly features:

Process water recycling back into the polymerization reactor

Utilization of heat from the centrifuges and the condensate for hot water charging back to the polymerization process.

Reduces water consumption



Dr. Günter Völker



Head of Service & Operation OU FER



guenter.voelker@thyssenkrupp.com

Alexander Poppe



Head of Service OU PP



alexander.poppe@thyssenkrupp.com

