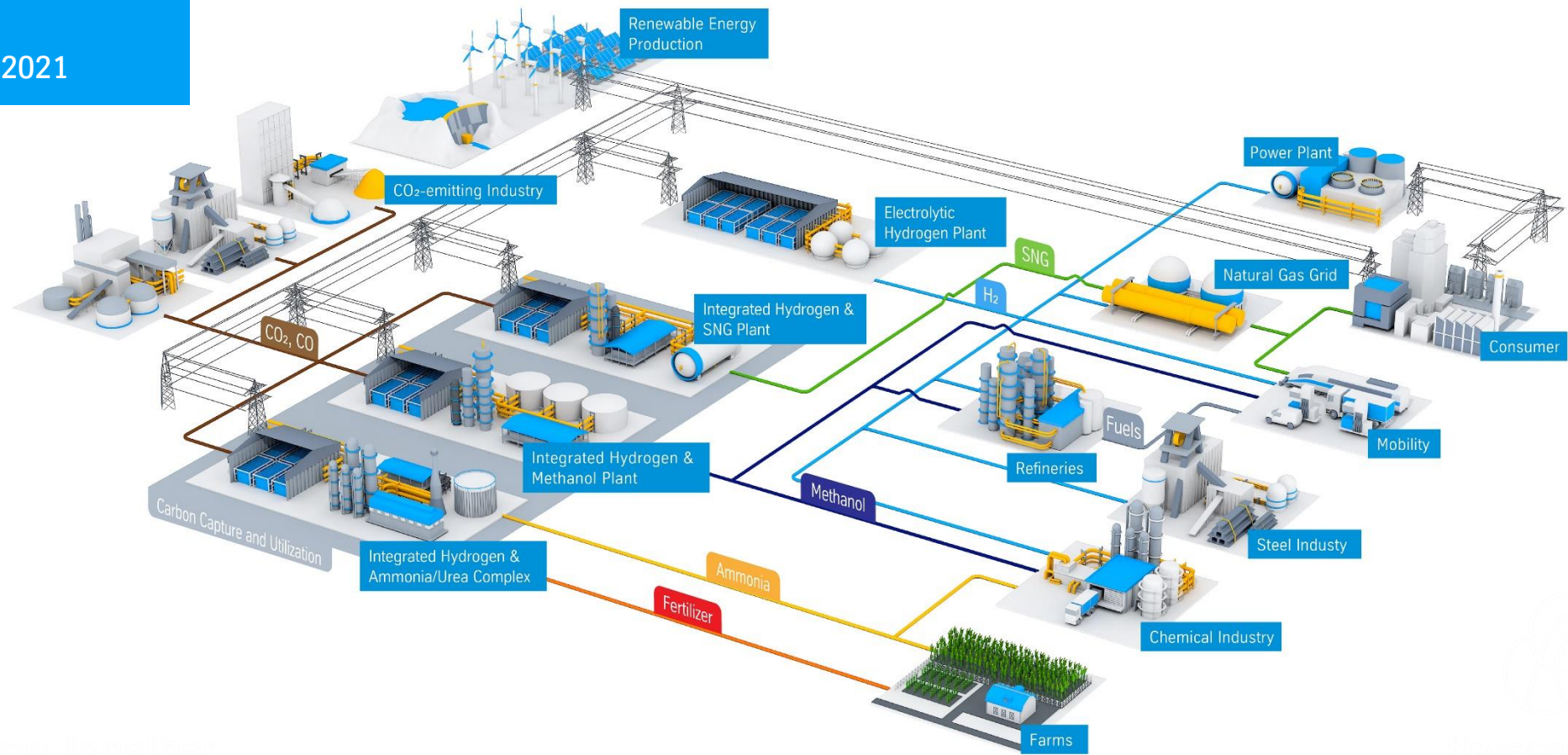


Flexible green ammonia synthesis and

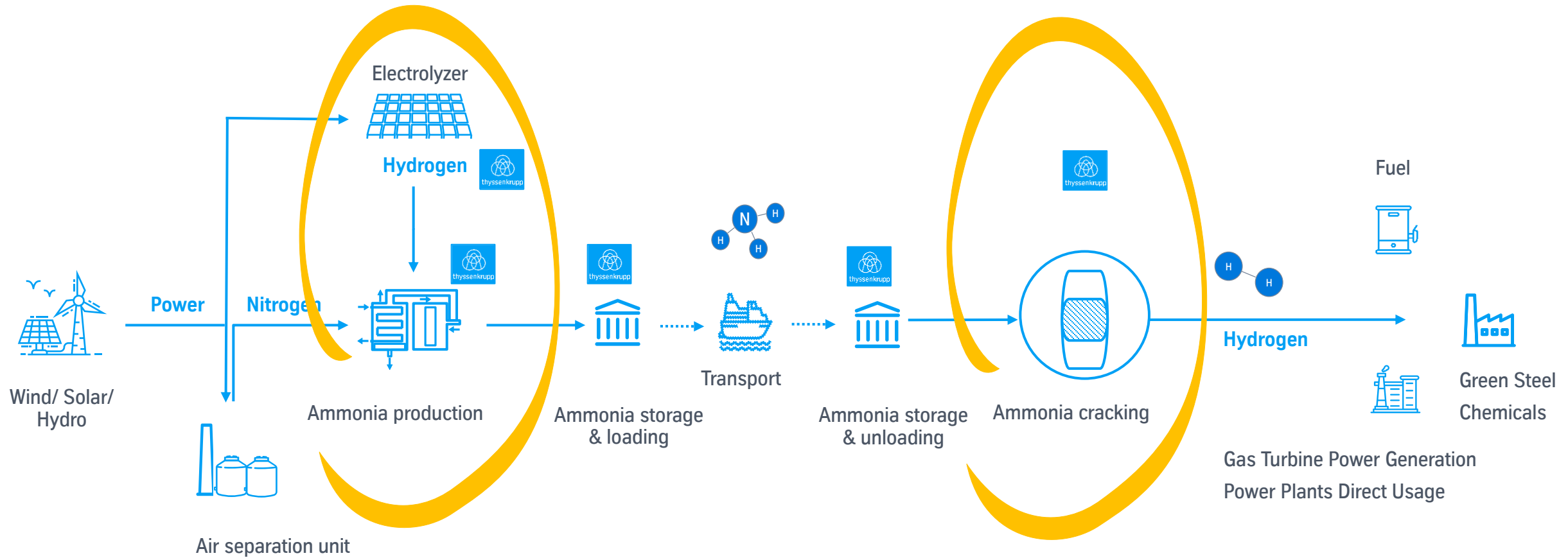
Large scale ammonia cracking technology by Uhde®

AEA Conference
thyssenkrupp Uhde
Karan Bagga | August 2021



Green Ammonia as Energy carrier – Set up along the whole energy supply chain

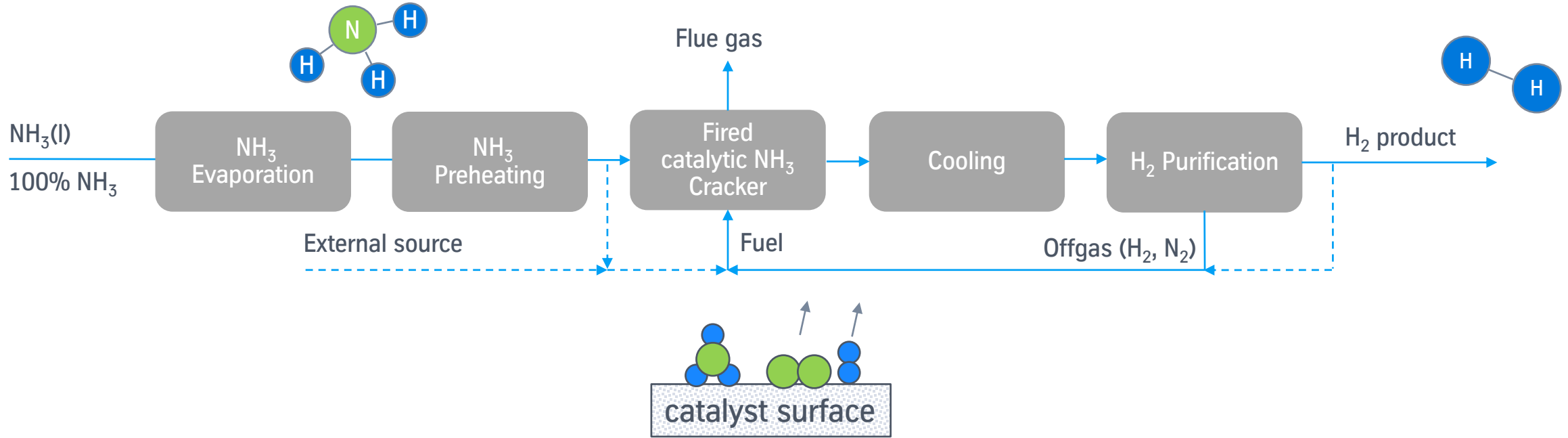
The complete solution from one source



Ammonia usage for energy transport, utilization as energy carrier or re-conversion to hydrogen



Ammonia cracking based on Uhde® proprietary equipment, high hydrogen yield and adaptable to user requirements



Suitable for large scale applications



Overall hydrogen recovery of ~78%,
after taking into account all fuel

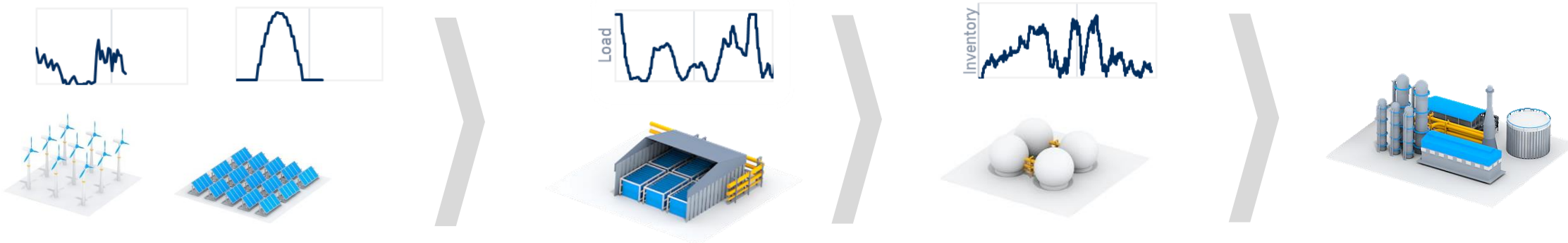
With 1 kg NH_3 0.13 kg H_2 as final product



Purities of 99.96% or higher are
possible

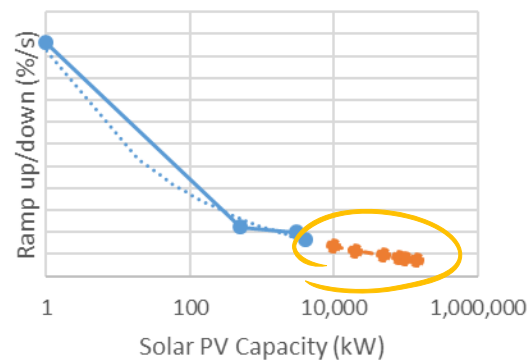
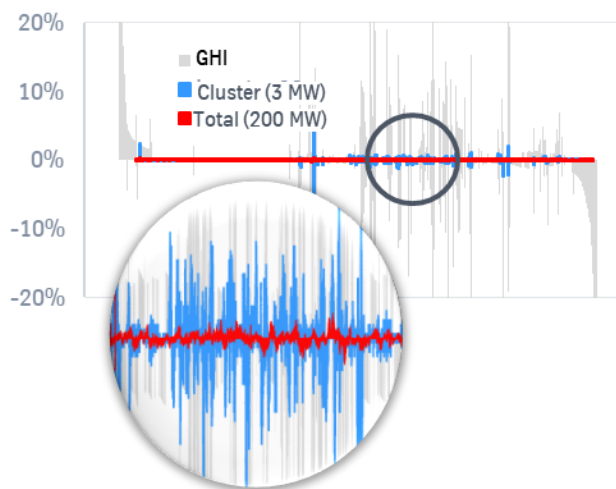


An techno-economically robust solution is a matter of minimising the entropy in the system

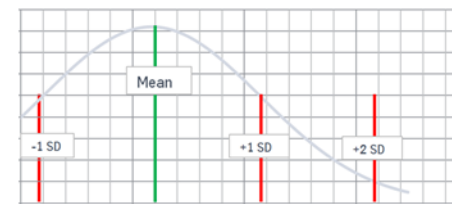


System: Right scale & energy mix, avoid over-compensation

Technology: Flexible, robust and efficient



Small scale
(W+S)

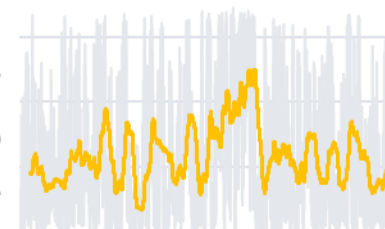


Large scale
(W+S)



Power generation

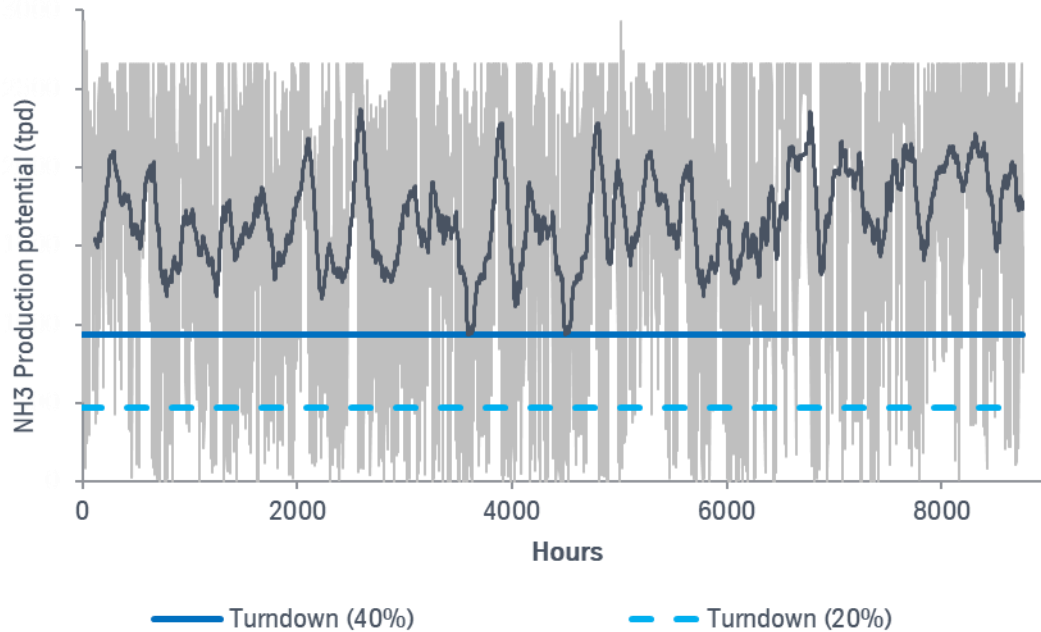
Hydrogen Input



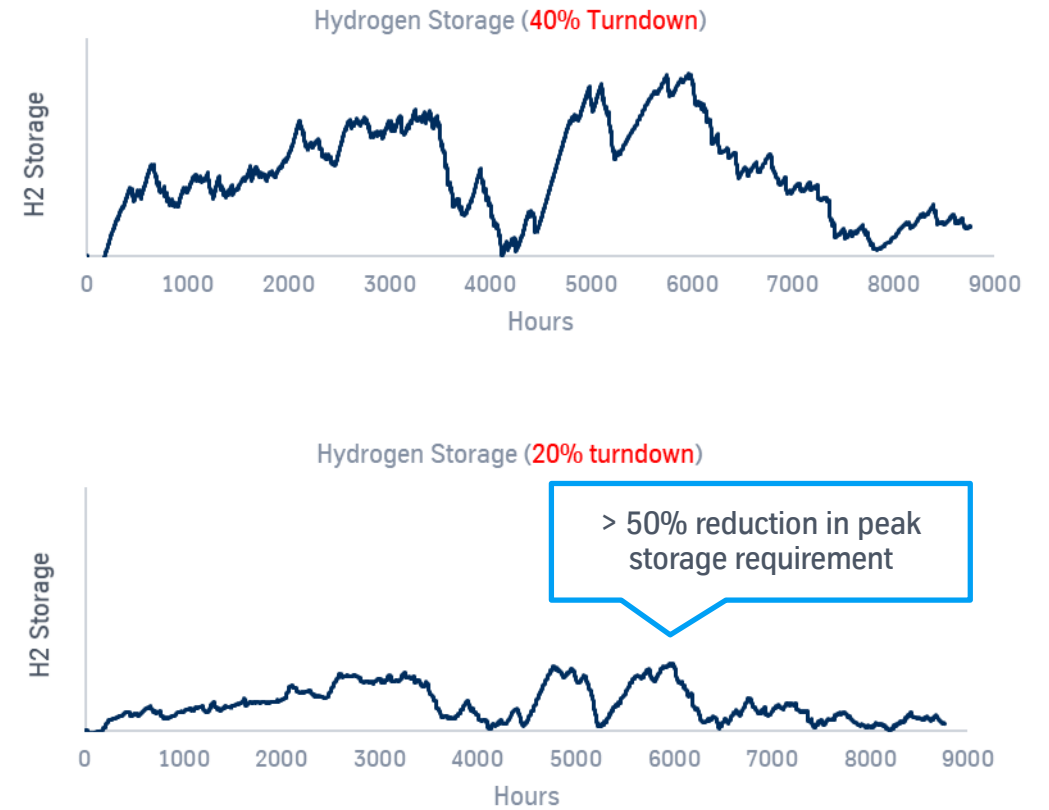
1. Deep turndown - key to minimising hydrogen storage

Synthesis Loop Turndown Performance

- Limited by machinery performance and reaction parameters



Hydrogen Storage Requirements

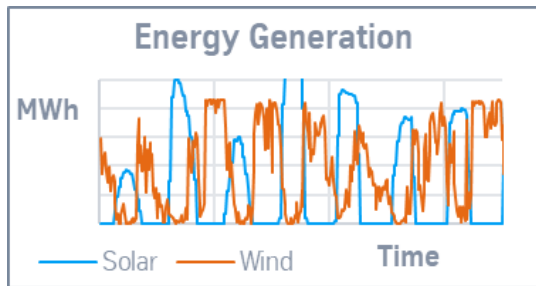
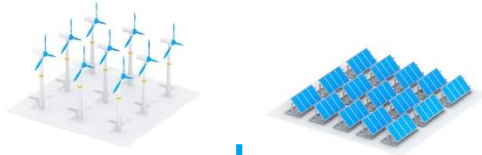


Deep turndown and dynamic response enables lower CAPEX, however ultimately it is a matter of Total Cost of Ownership (TCO)



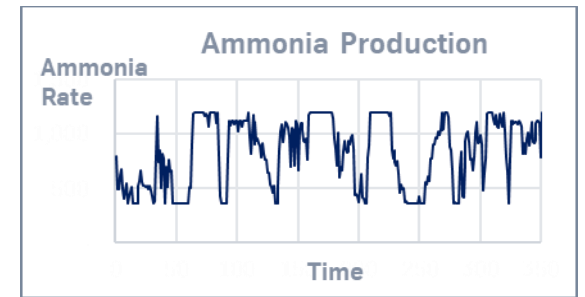
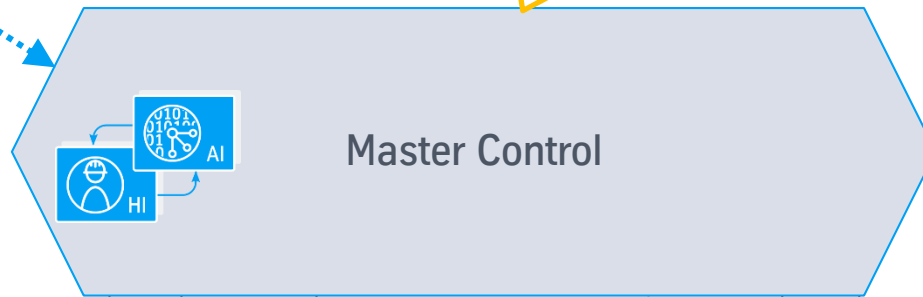
2. Dynamic performance - Uhde[®] high flexibility ammonia synthesis, based on advanced digital solutions, for large scale direct coupling with renewables

Fluctuation of renewable energy



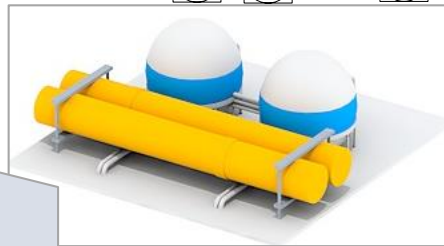
- Adjusts ammonia production to forecasted H₂ flow
- Ramps up- and down NH₃ plant
- Minimal hydrogen storage need
- Without pressure change!**

Dynamic Operation of ammonia plant

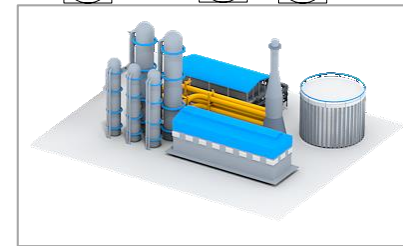


Electrolysis

H₂



Compression and Storage



Ammonia Synthesis



engineering.
tomorrow.
together.

Karan Bagga
Chief Engineer
thyssenkrupp Green Hydrogen and Chemicals Technology

Karan.Bagga@thyssenkrupp.com



thyssenkrupp