




Delivering clean hydrogen fuel from ammonia using metal membranes

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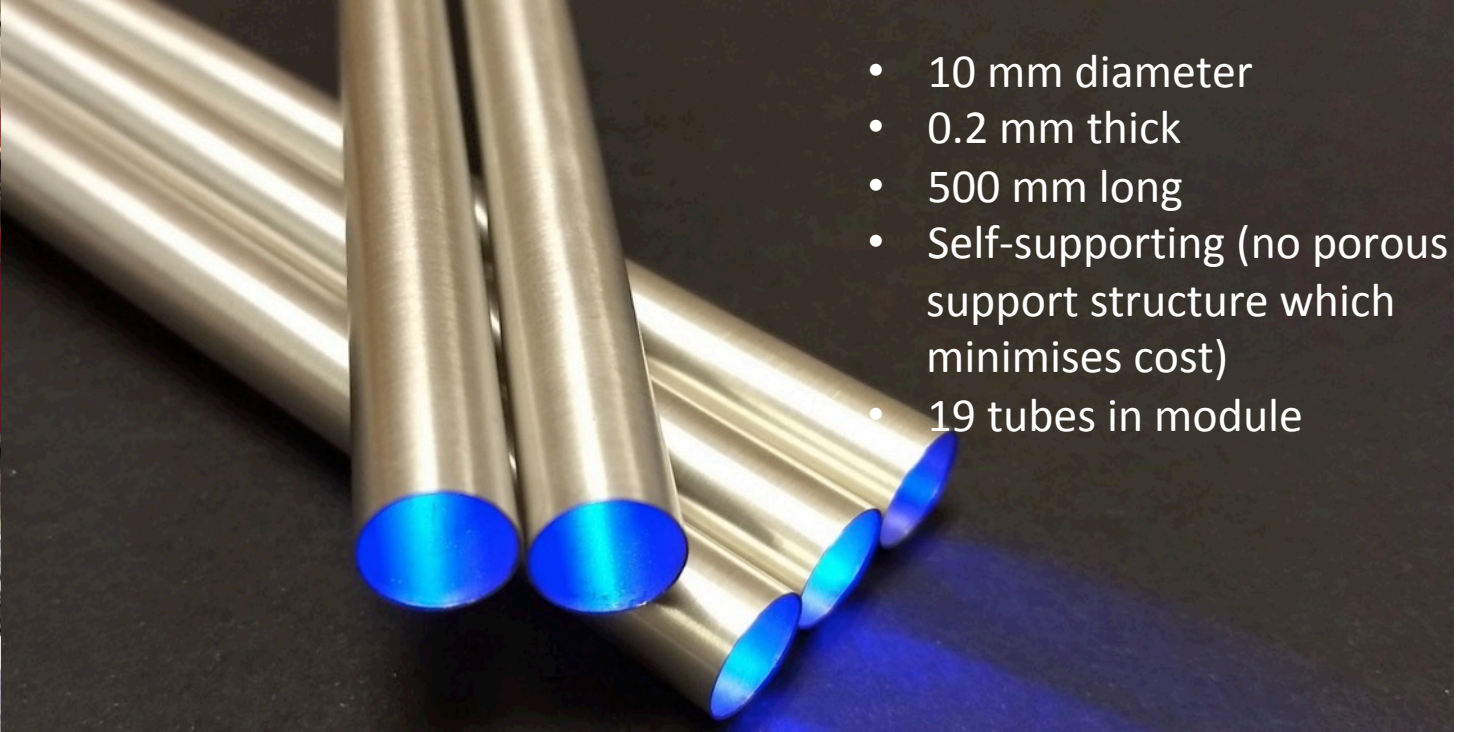
ENERGY
www.csiro.au

SCIENCE AND
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ENDOWMENT
FUND
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 **BOC**
Member of The Linde Group



CSIRO's membrane technology



- 10 mm diameter
- 0.2 mm thick
- 500 mm long
- Self-supporting (no porous support structure which minimises cost)
- 19 tubes in module

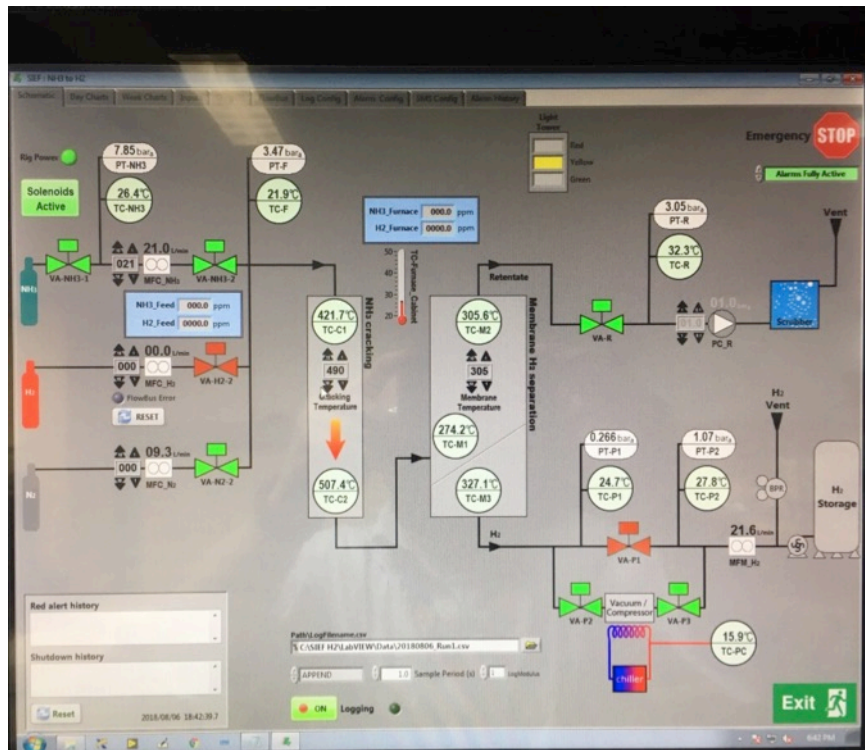
Pilot Plant Hardware



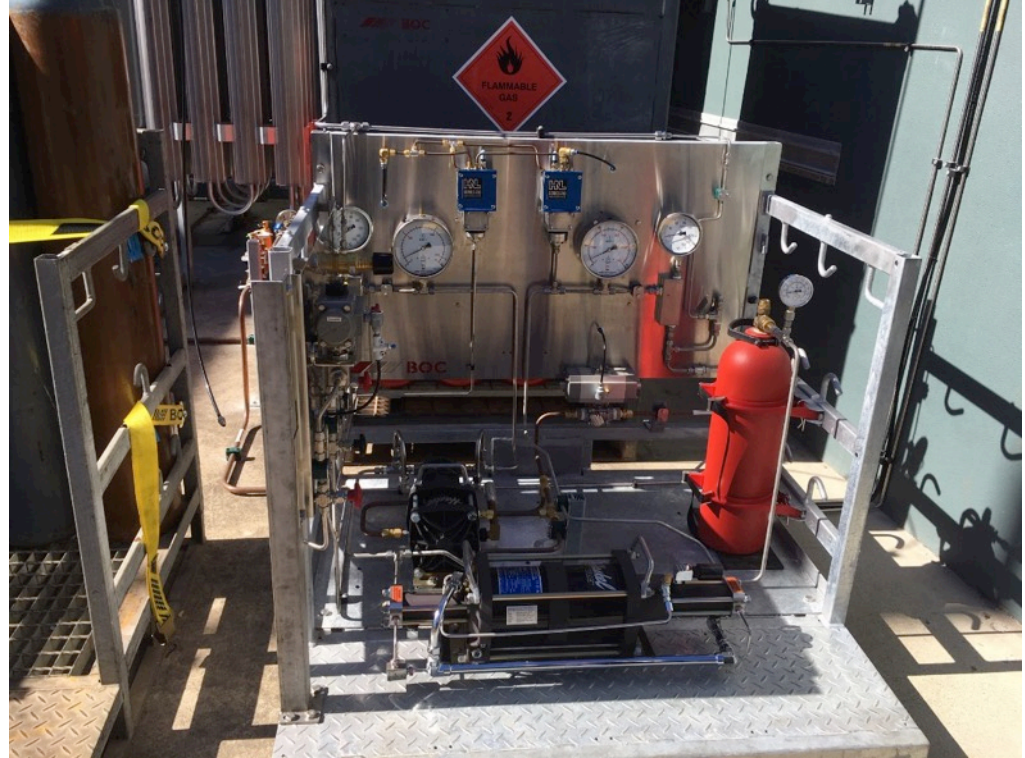
The CSIRO process



The CSIRO process

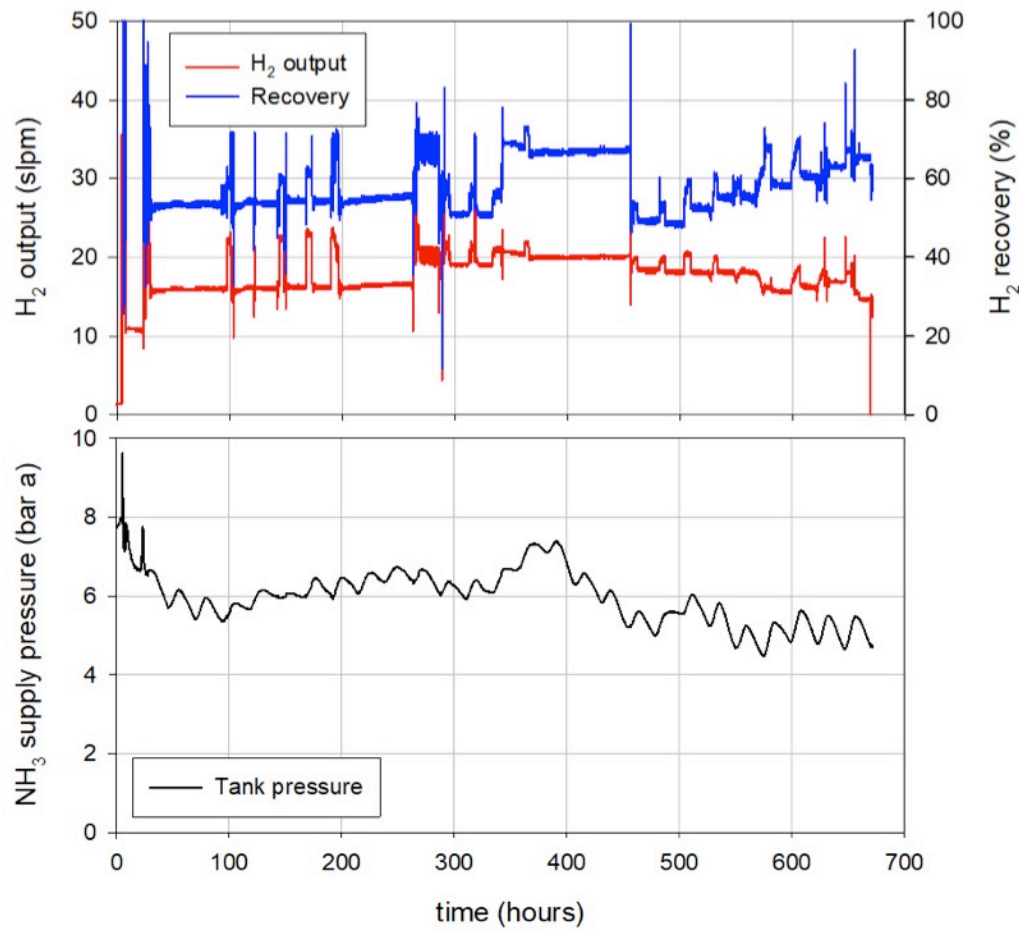


The CSIRO process



Pilot Plant Performance





Actual NH_3 cracking rate much lower than anticipated

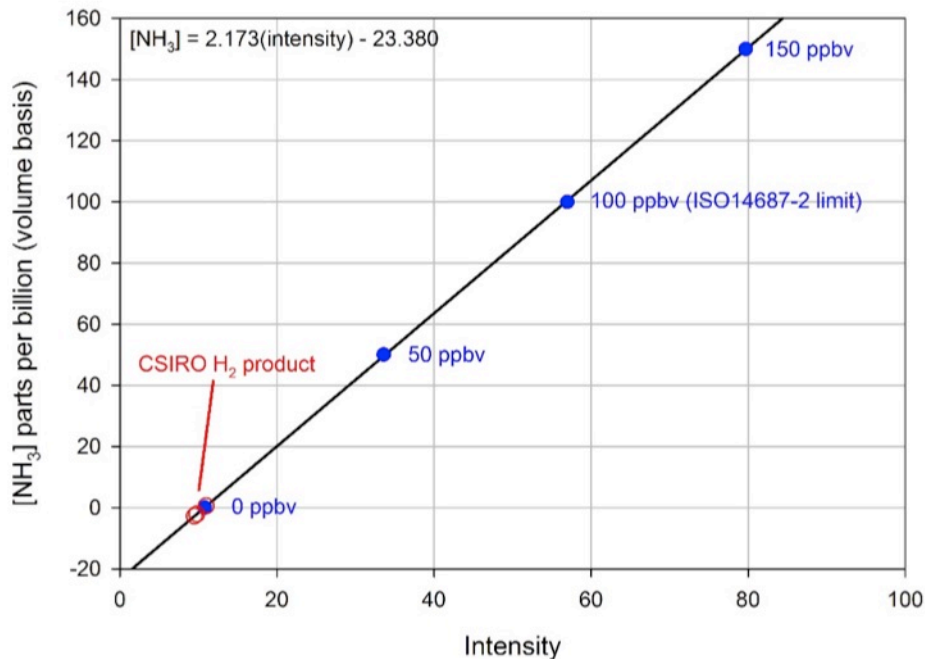
- Failed heating elements
- Poor heat transfer

Unseasonably cold Brisbane winter limited NH_3 supply pressure

- Poor recovery through membranes

H2 purity analysis

Trailer-mounted SYFT Voice 200 Secondary Ion Flow Tube Mass Spectrometer



- Calibrated against 4.7ppmv certified NH₃-in-H₂ mixture supplied by BOC, diluted on-demand with UHP-H₂
- Detection limit << 10 ppbv
- SIFT-MS not suitable for field applications: FTIR is best option for online monitoring







What's next?



Towards commercialisation

- Strategic relationship with one of the world's largest resources companies
- 200 kg/day H₂ plant operating within 24 months
 - Membrane manufacturing pilot plant
 - 20 ft-containerised BOP
 - Integration with commercial fueling infrastructure
- Demonstration in conjunction with FCEV fueling

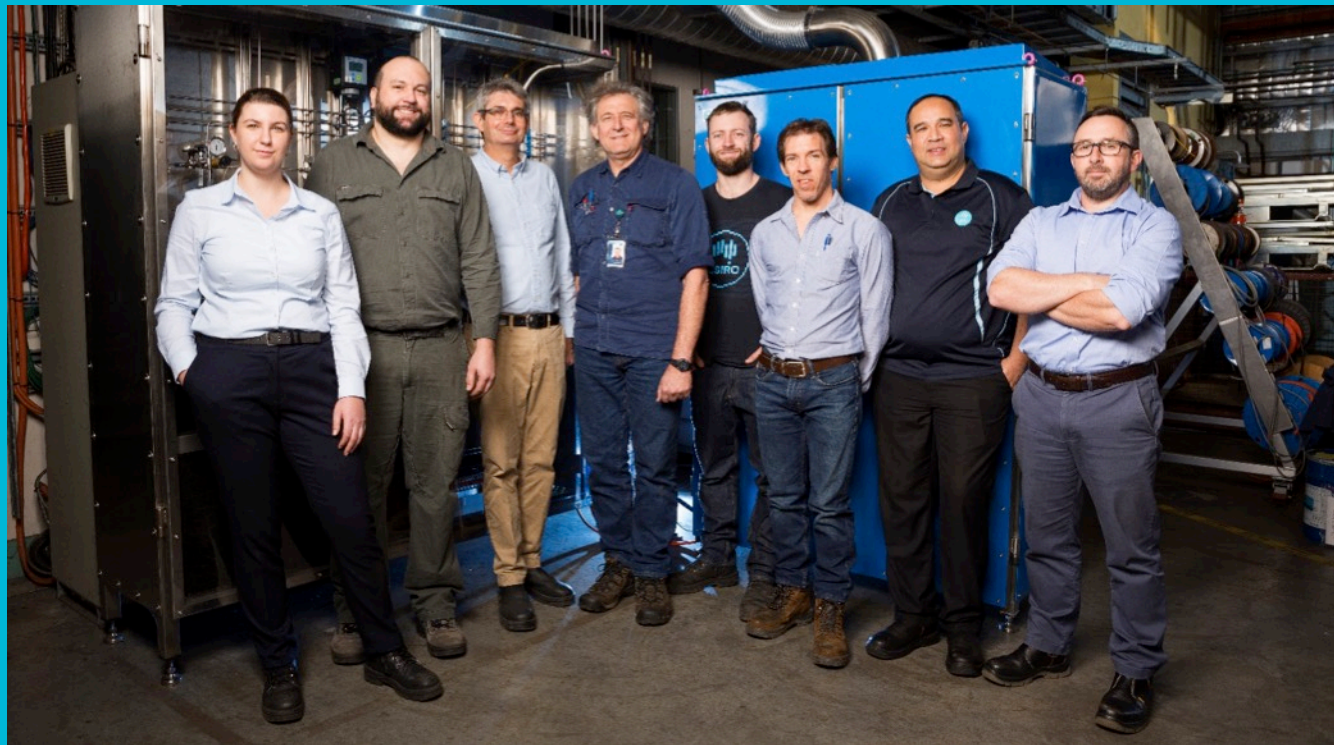
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