MariNH3

Clean, green ammonia
engines for maritime

Ammonia Fuelling Strategies in a Split Cycle Engine

Sponsored by:
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Power | Drives | Propulsion

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1. What we do (Energy & Transport)

2. NH3 Landscape (Infrastructure & CO2)

3. Motivation (Alterative NH3 Fuelling)

4. Context (Advanced Powertrain)

5. Methodology (System Level Solution)

6. Novel (Reformed Cryo NH3)

7. Results (NOx, CO2)

8. Significance (IMO Targets)

9. Conclusion (BSFC)

10. Impact (More Solutions)

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STEP Lab

Sustainable Technology and Engineering Projects

University of Brighton

Advanced Engineering Centre

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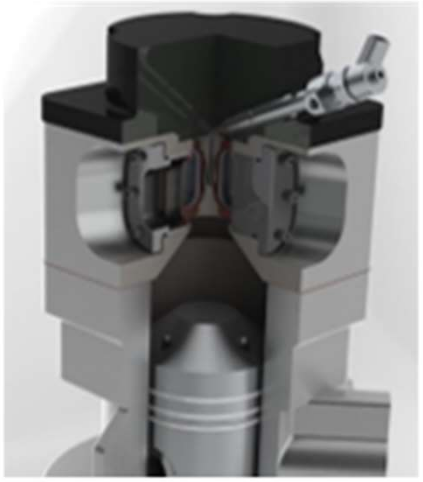
We do Energy Conversion, Storage, Recovery. We do Power, Propulsion, Fuels.



Rapid Compression Machine

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NH3 landscape: Cost-effective infrastructure with lower CO2 production routes looks promising and is very necessary

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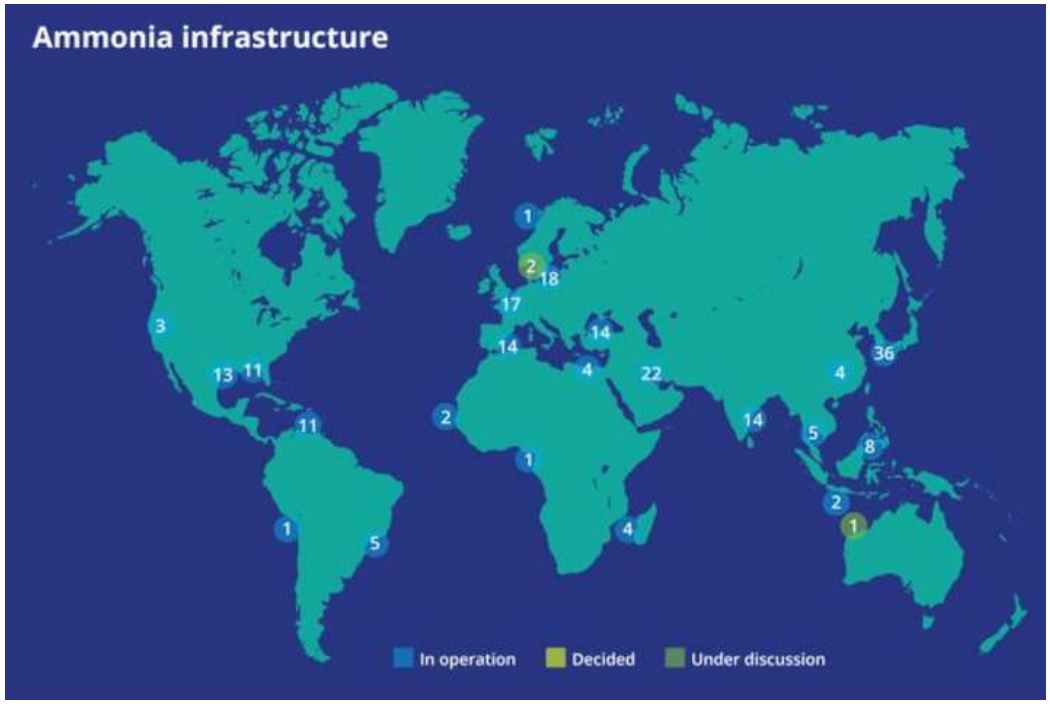

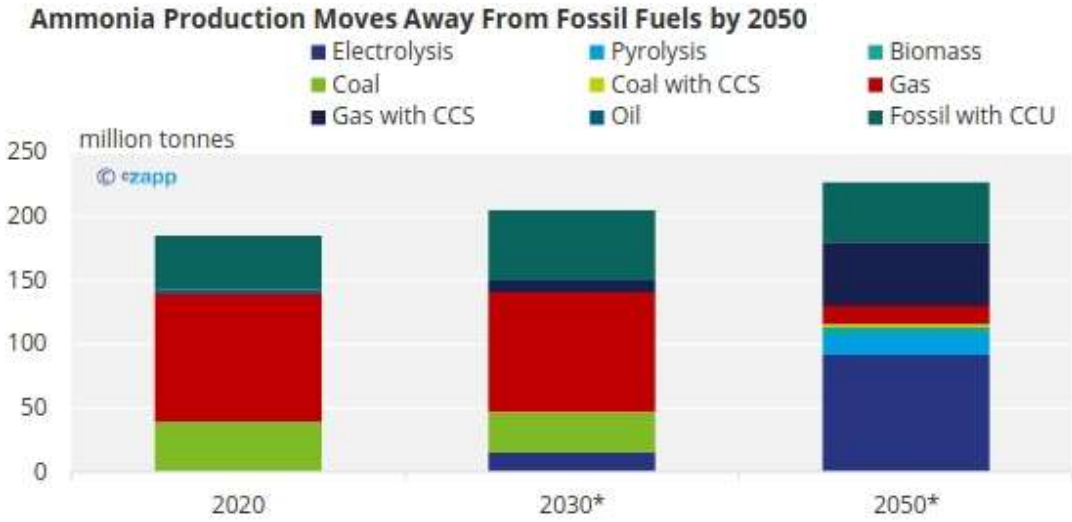

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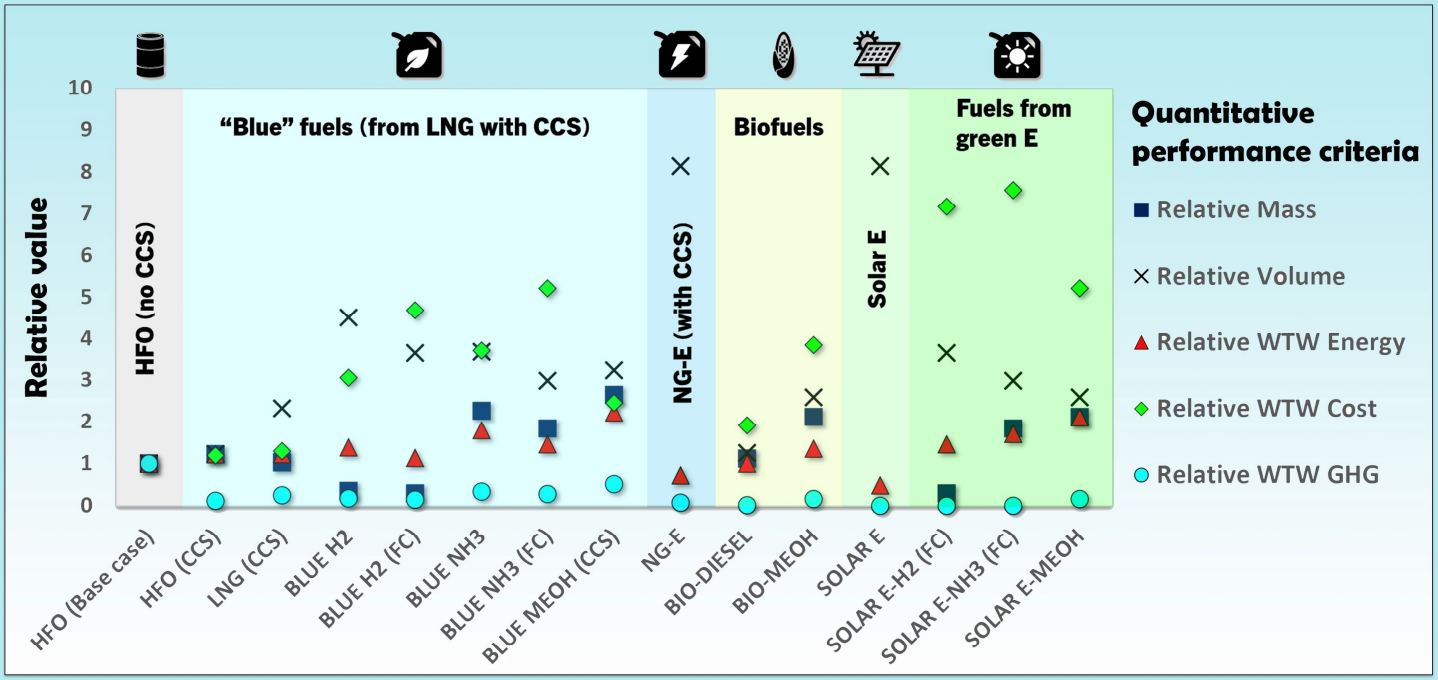

*Values shown relative to HFO (no CCS)
*Abbreviation: E = electricity, CCS = carbon capture

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One step back: Rethinking conventional engine cycle
Split cycle gets its advantage by decoupling the compresses & combustion processes

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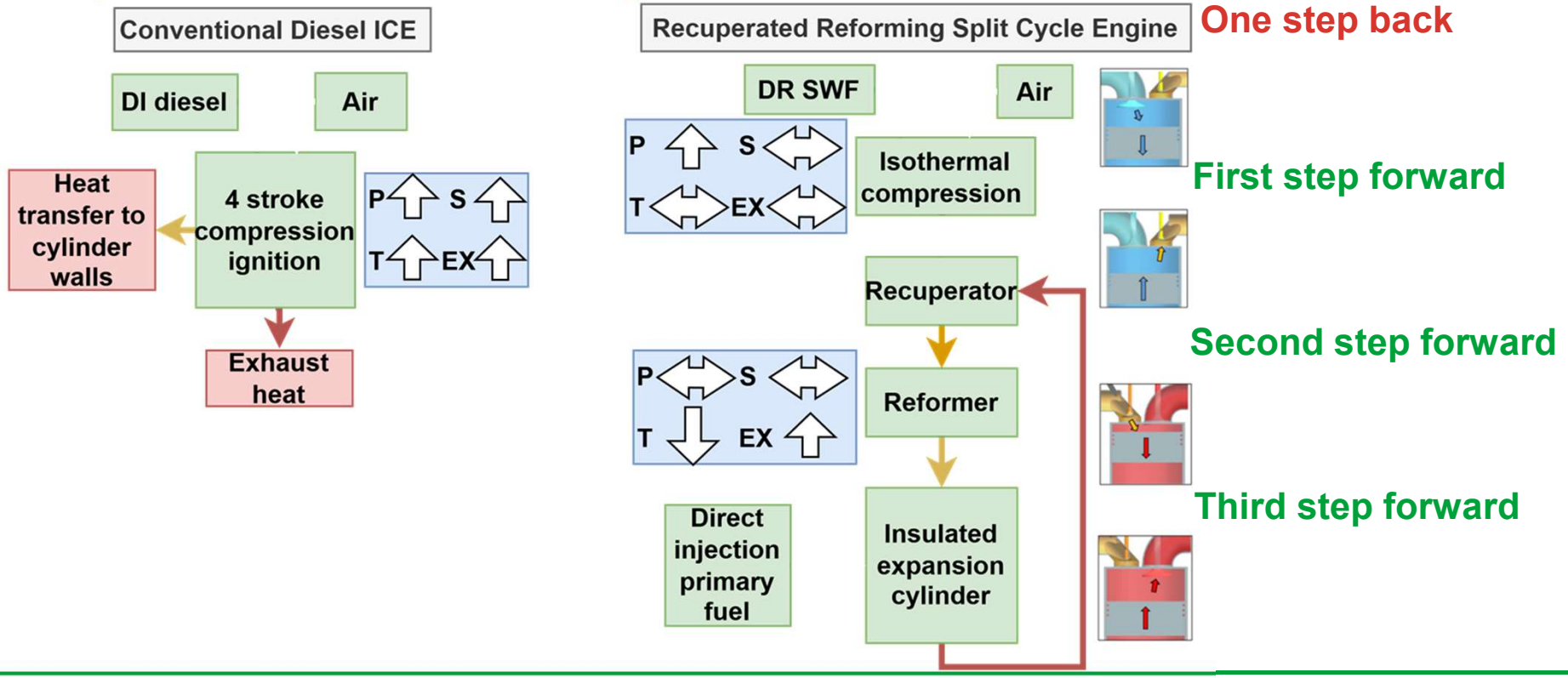

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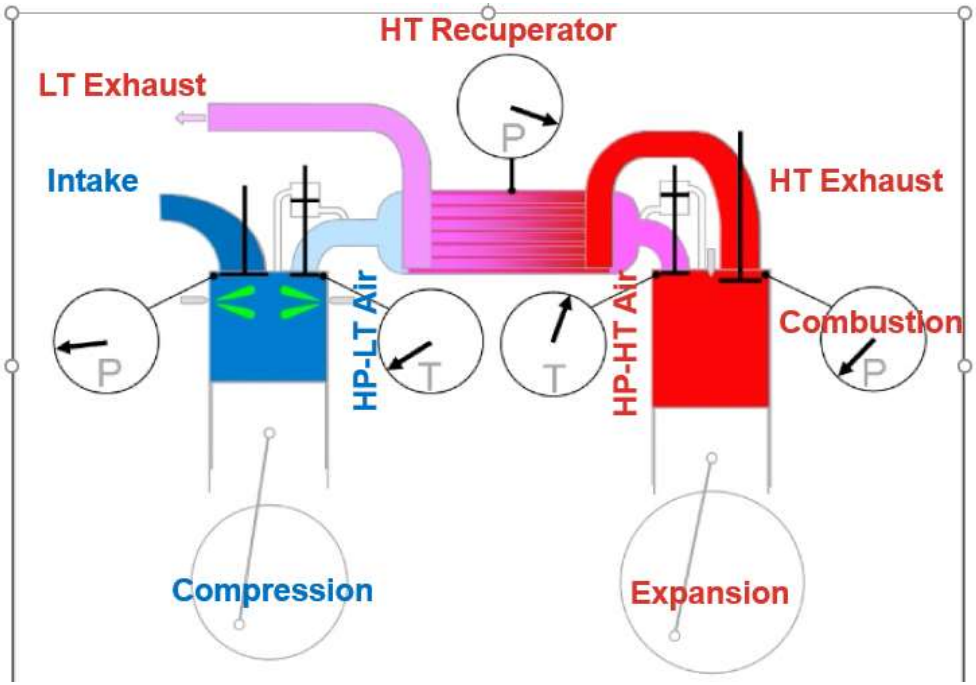

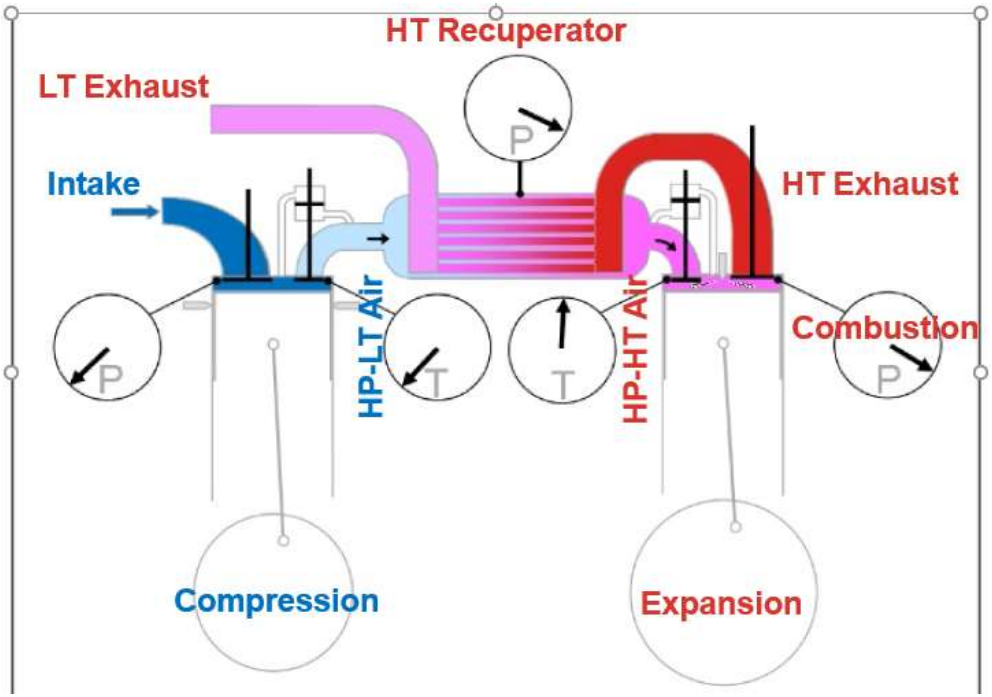

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Architecture of Split Cycle: Useful insights form testing of compression, expansion, recuperation, H2 fuelling

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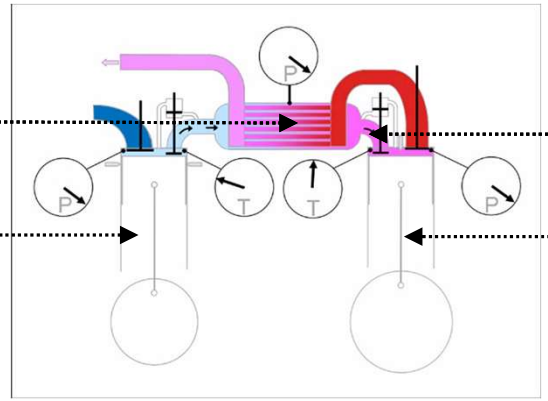

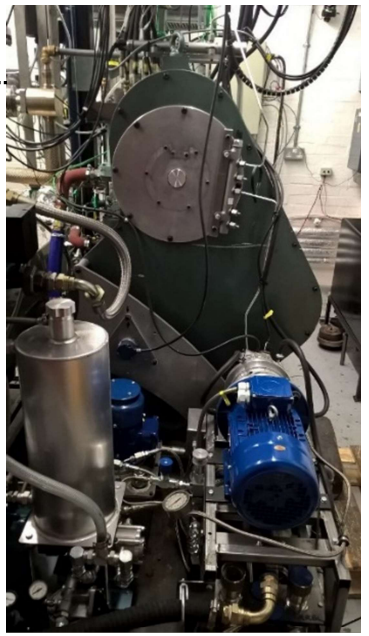

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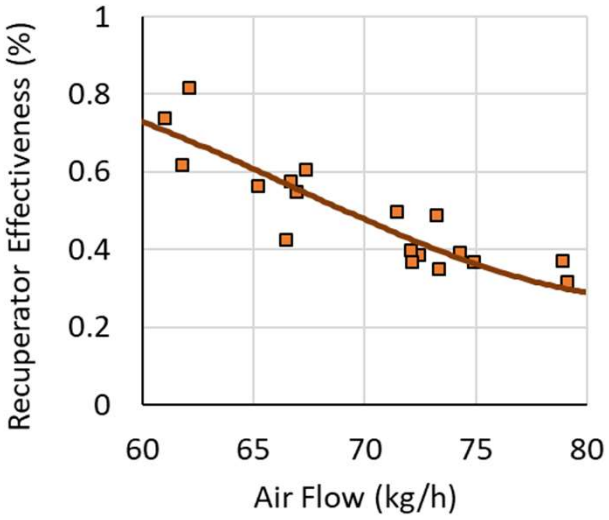

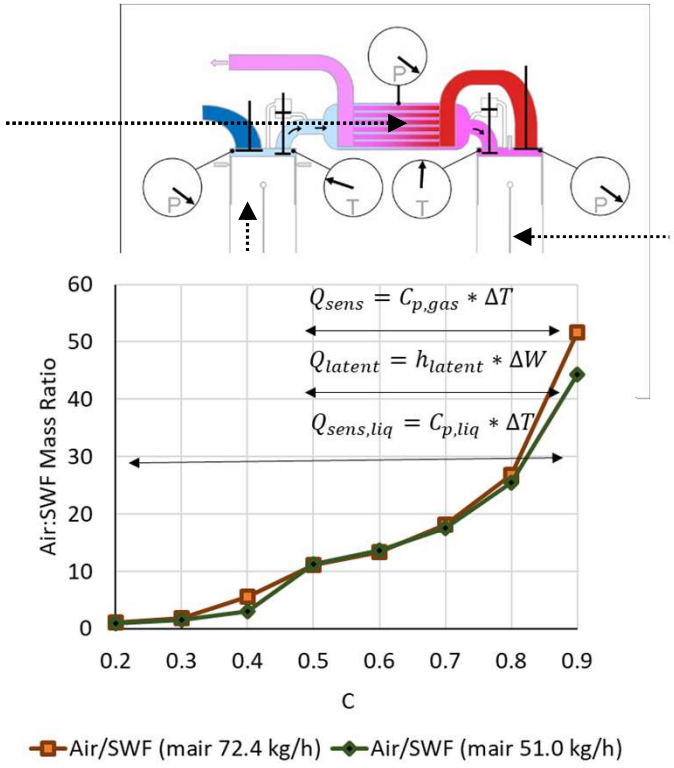

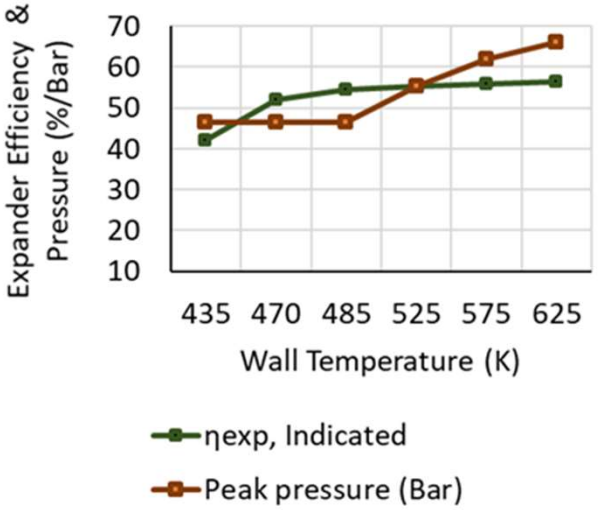

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First step forward: Rethinking compression process Quasi-isothermal compression in split cycle reduced losses, improves overall fuel conversion efficiency

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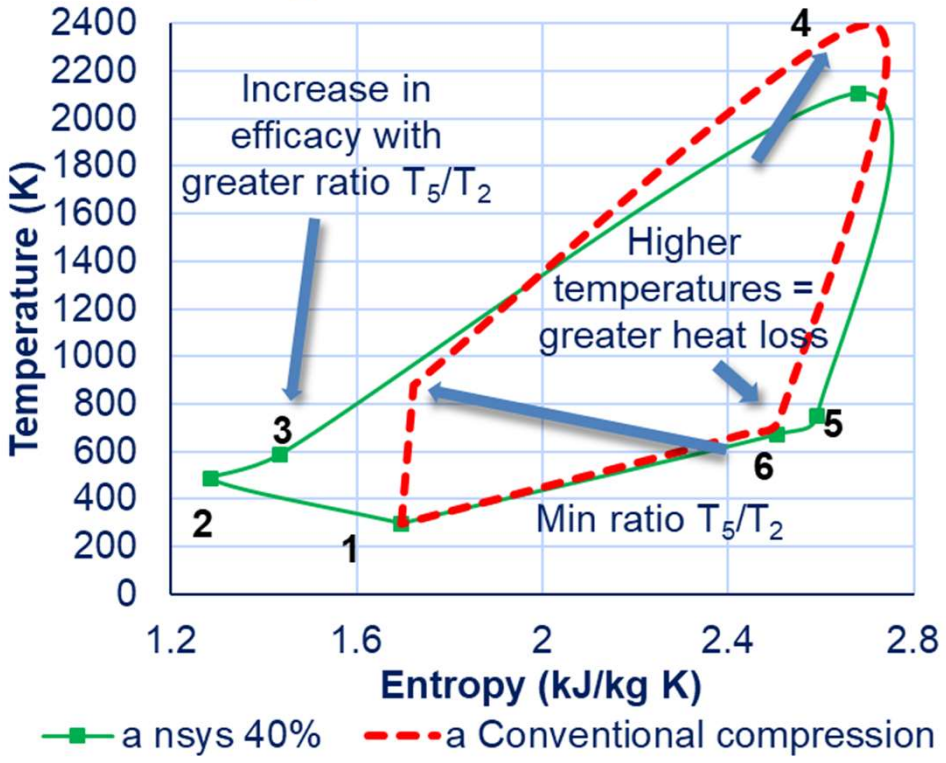

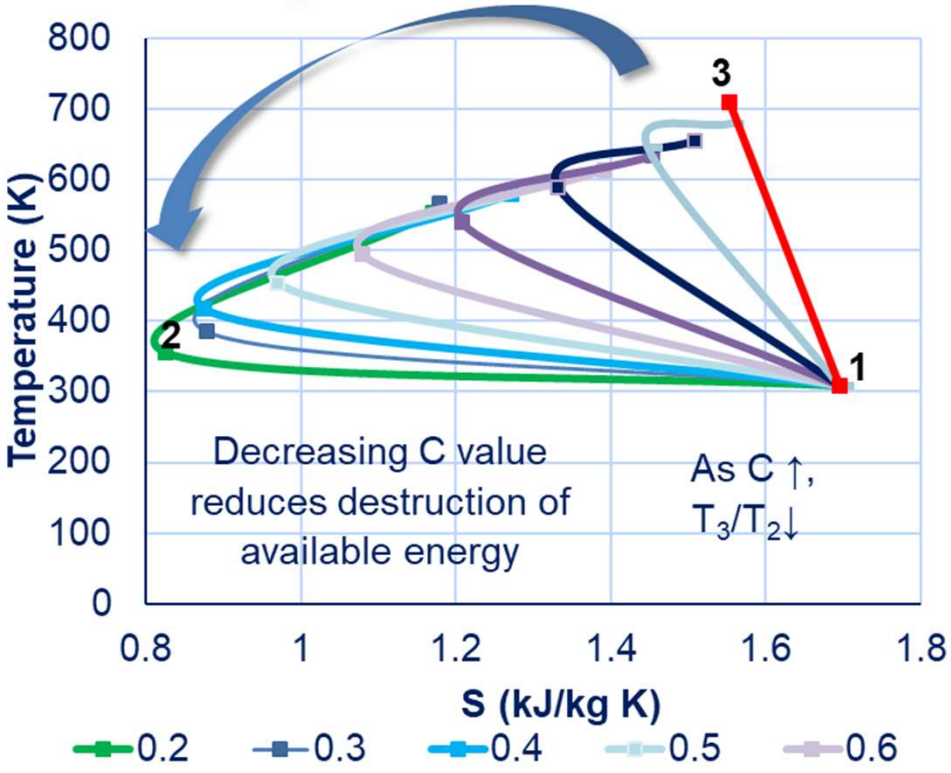

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First step forward: 35% compression work saving by dual role of cryogenic NH3 due to boiling point, LFL & latent heat of evaporation

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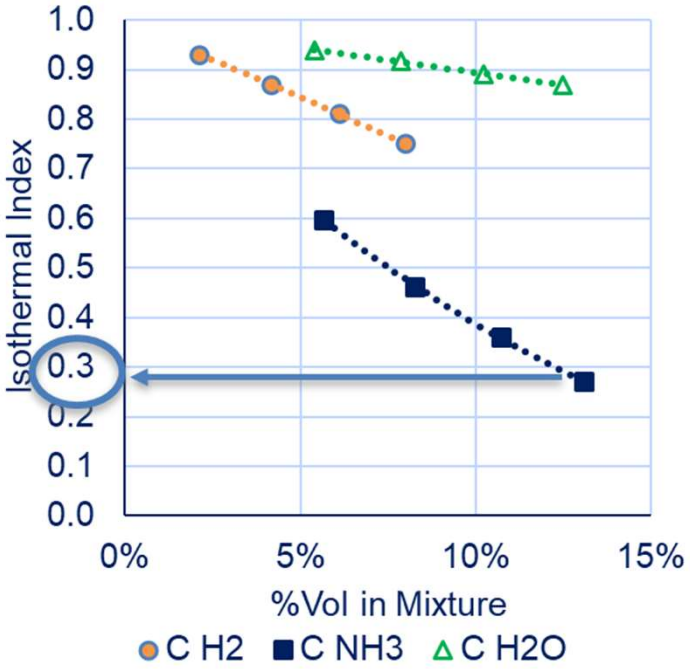

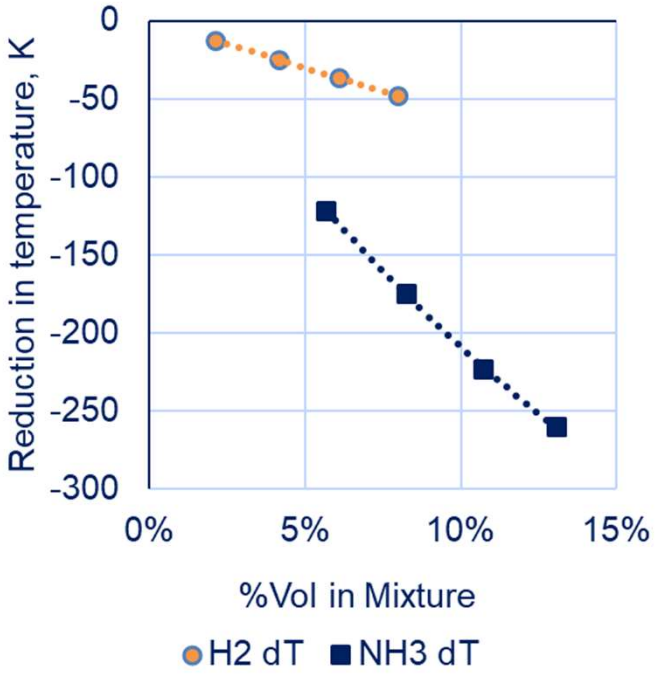

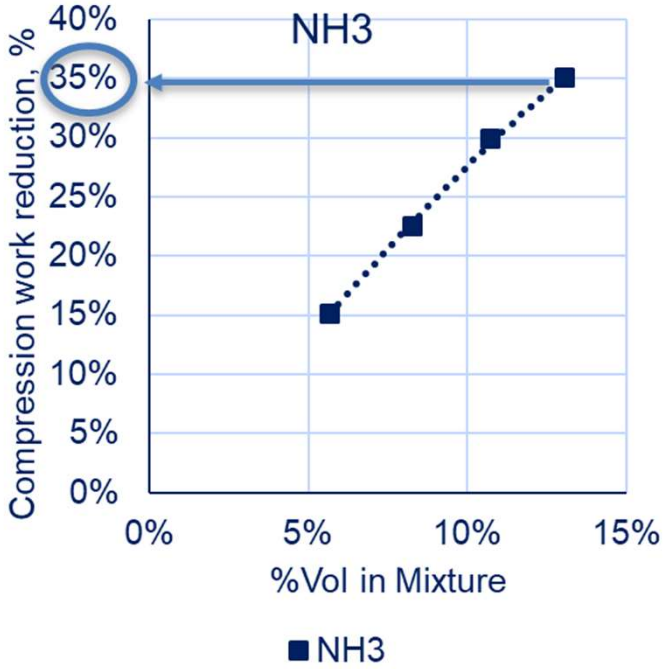

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Second step forward: Rethinking intracycle processes Recuperated-reformed that transfers waste heat into fuel chemical energy and lowers exergy destruction

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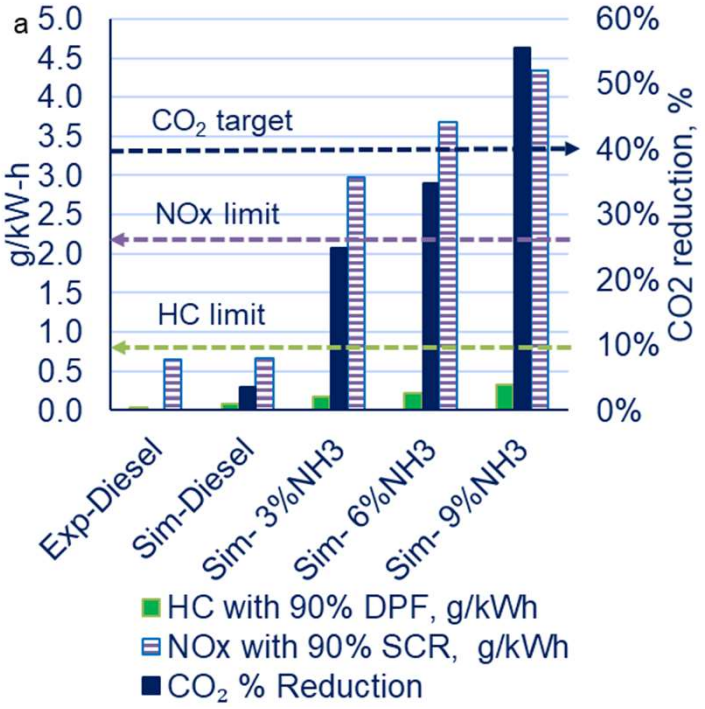

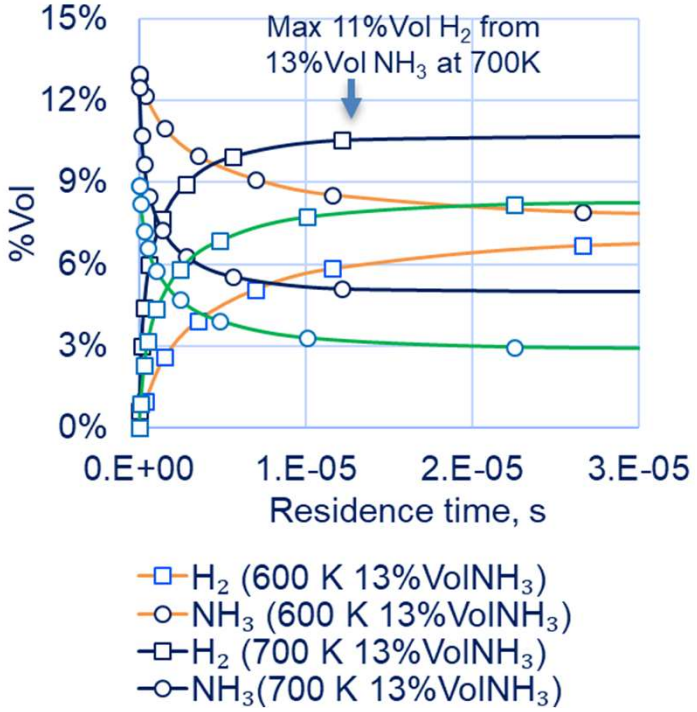

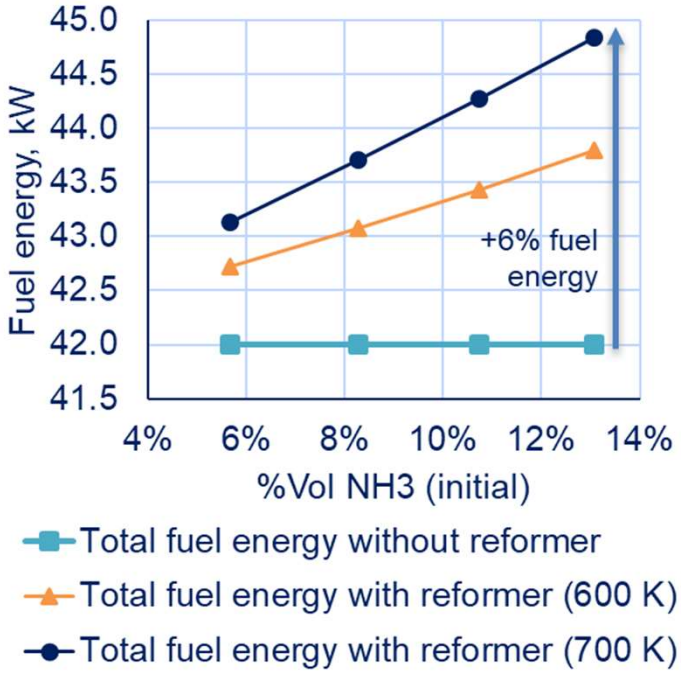

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Third step forward: Rethinking combustion
Small step to big result as partial NH3 reforming gives substantial fuel benefits and exceeds 40% CO2 target

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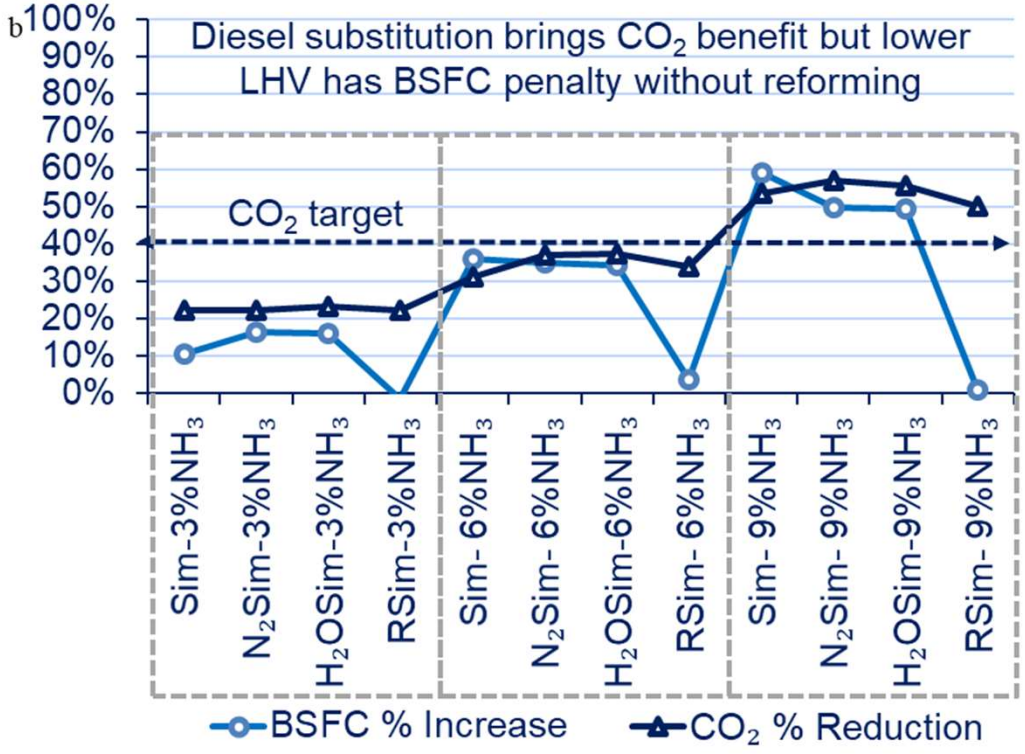

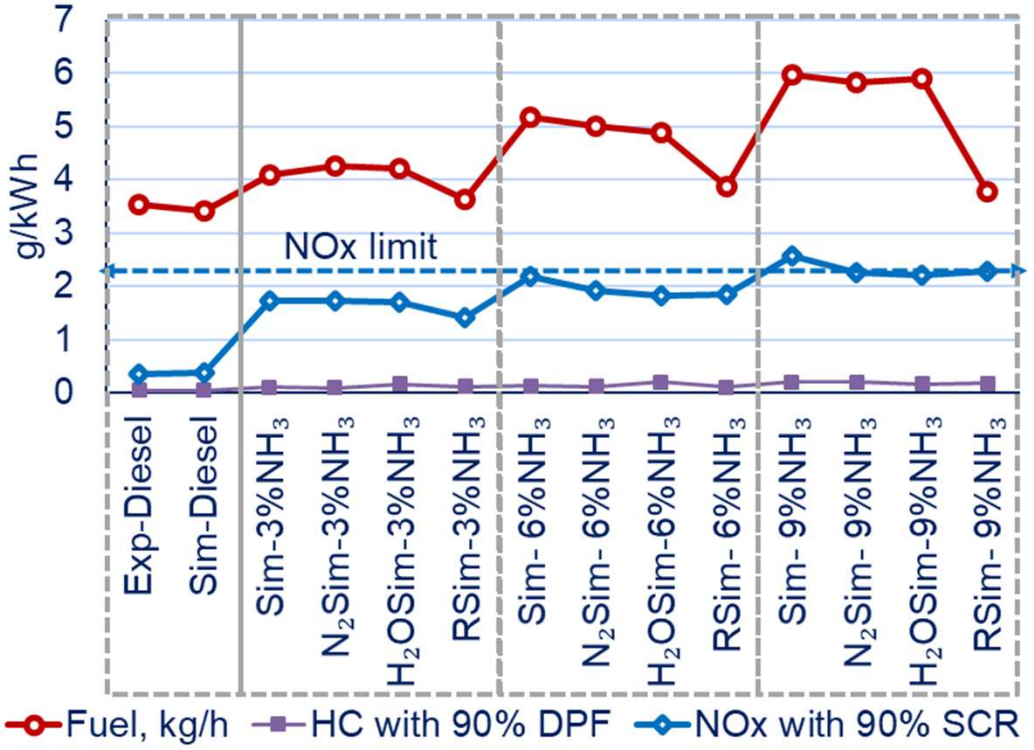

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Result of Three Steps Forward: A Novel Engine *Indirect-Direct Cryogenic Injection with Recuperated-Reformed NH3/H2 Split Cycle*

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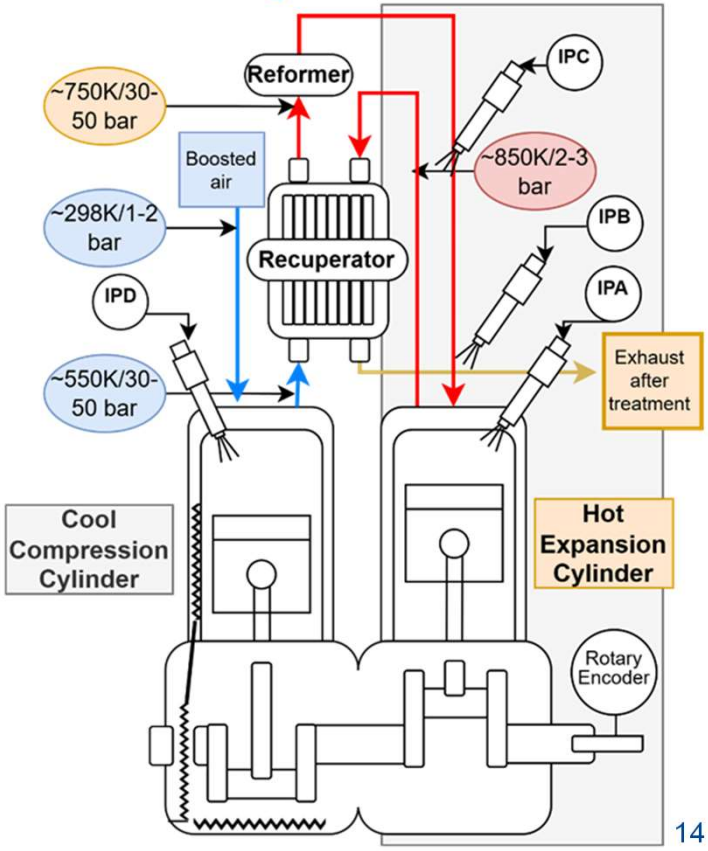
Shown this time CR²SCE

- *Flexible fuel injection strategies, simplify onboard fuel storage*
- *Cryogenic NH3 in dual role, offers compression work savings*
- *Intracycle recuperator-reformer, NH3/H2 blend*
- *Lowers fuel-bound & thermal NOx, improves combustion properties*

Watch this space

- *Cooler combustion, ruthenium catalyst reforming, coupled to spark ignition, higher NH_3 conversion, even lower NOx*

Special thanks to Elisa Wylie (PhD Candidate) for supporting split cycle works & championing the presented idea



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