

Assessment of the Free Double Piston Composite Cycle Engine

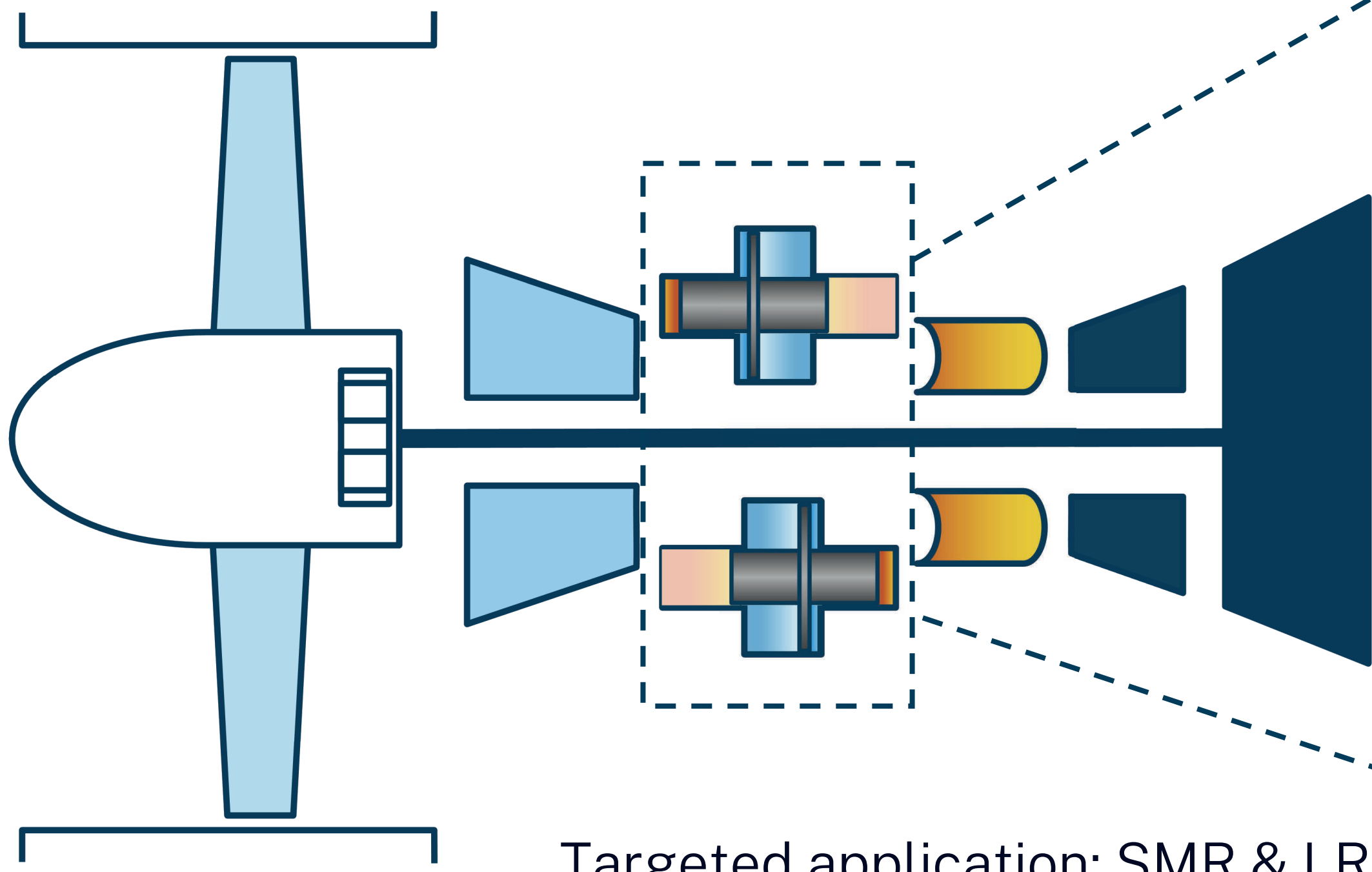


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1. Concept Description & Motivation

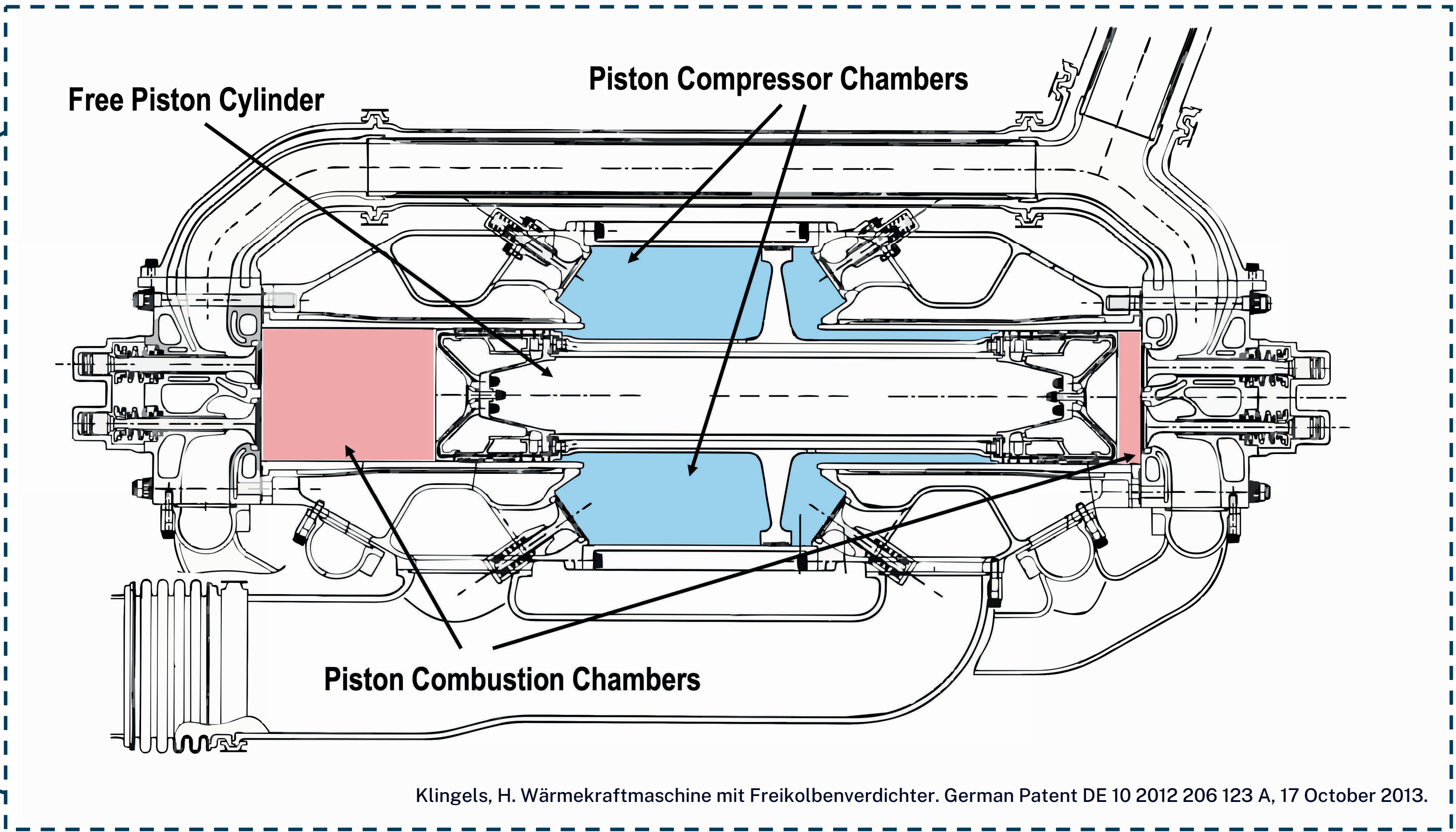
Composite Cycle Engine (CCE)

- Synergistic combination of Free-Double Piston (FDP) system and gas turbine
- Highly charged partial combustion in the FDP system
- Lower fuel burn by superior thermal efficiency



Targeted application: SMR & LR

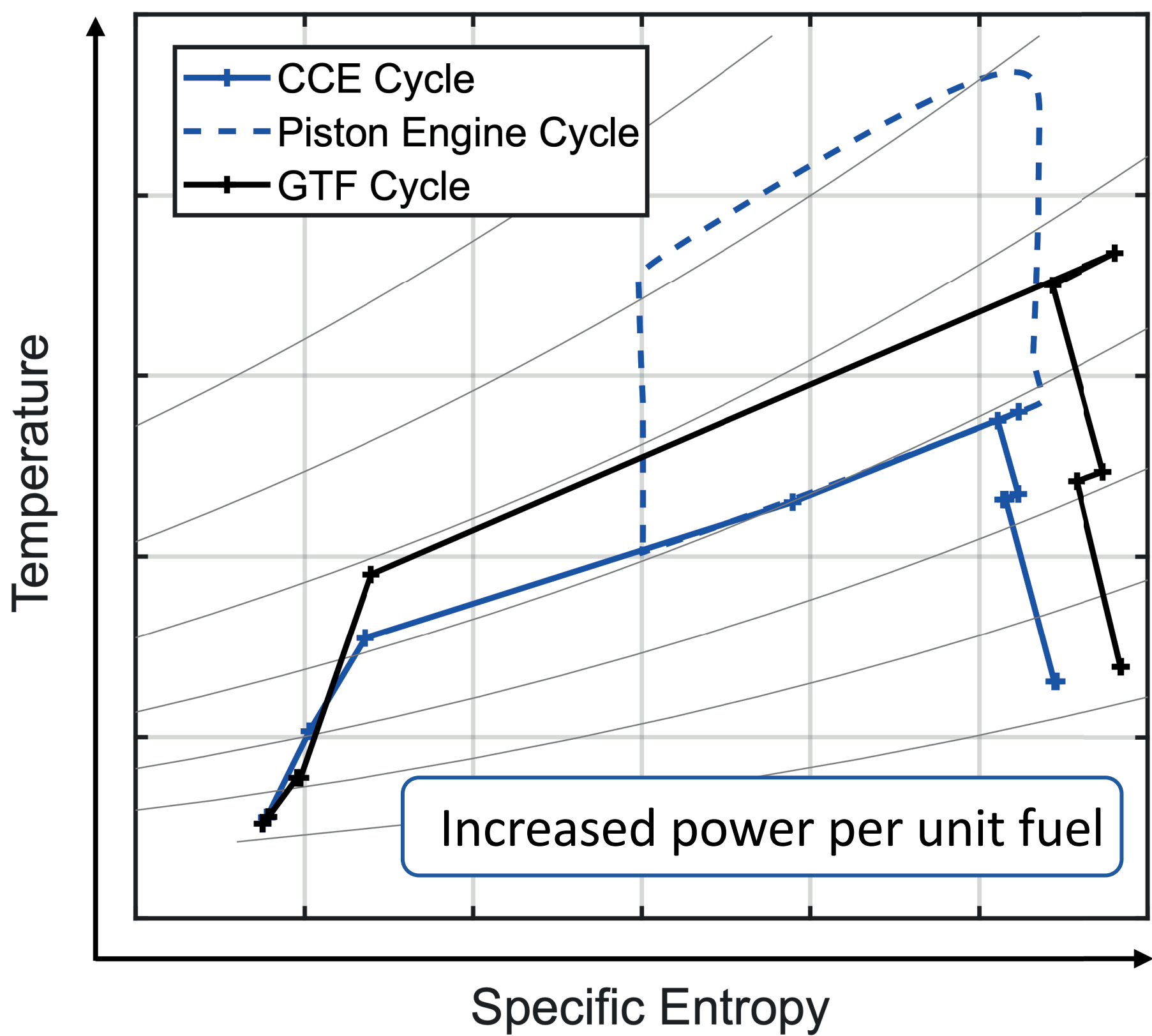
Free Double Piston (FDP) system: Self-sustained gas generator



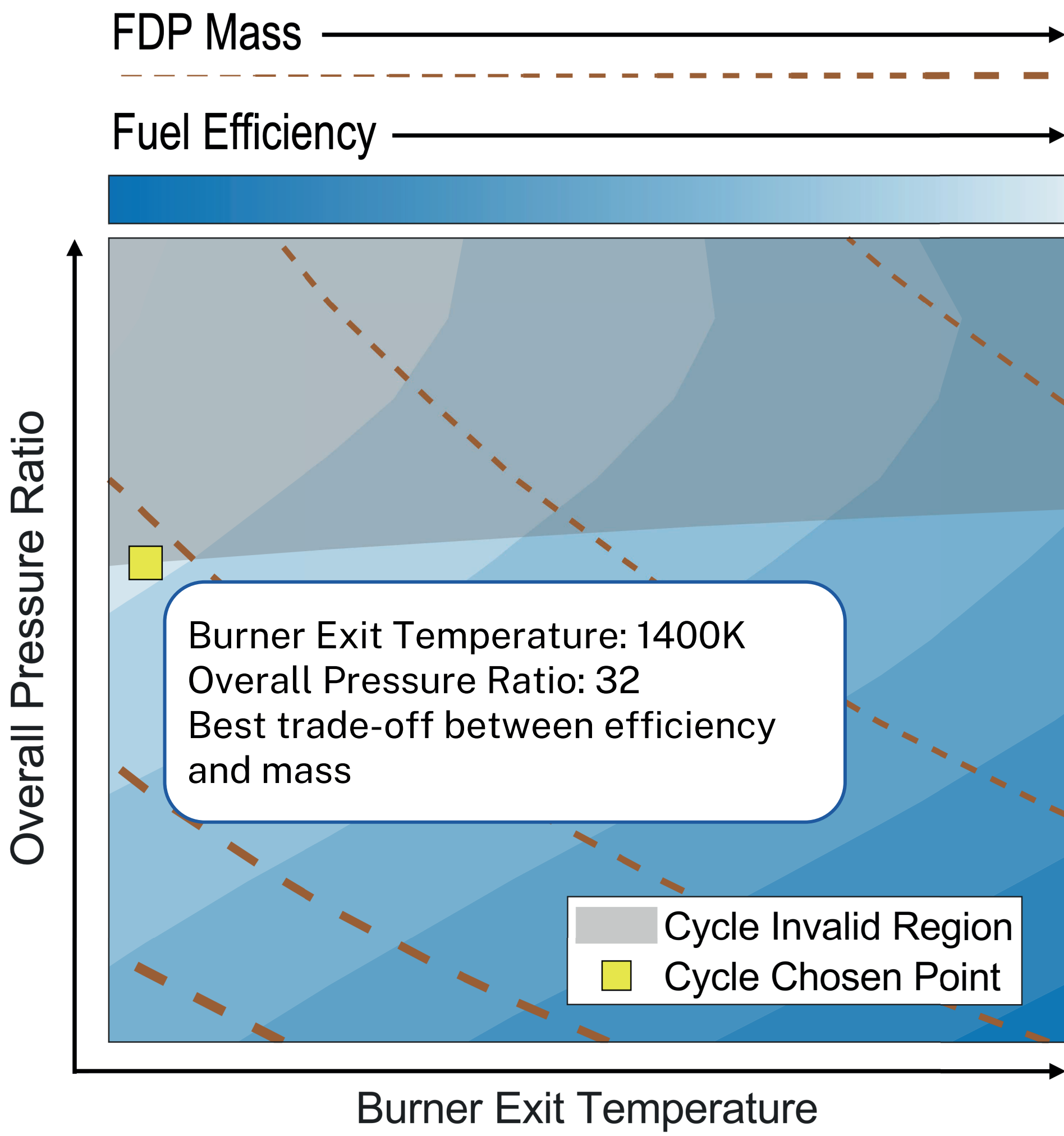
Klingels, H. Wärmekraftmaschine mit Freikolbenverdichter. German Patent DE 10 2012 206 123 A, 17 October 2013.

2. Engine Performance

Temperature-Entropy diagram of CCE and Geared Turbofan (GTF) at the design point

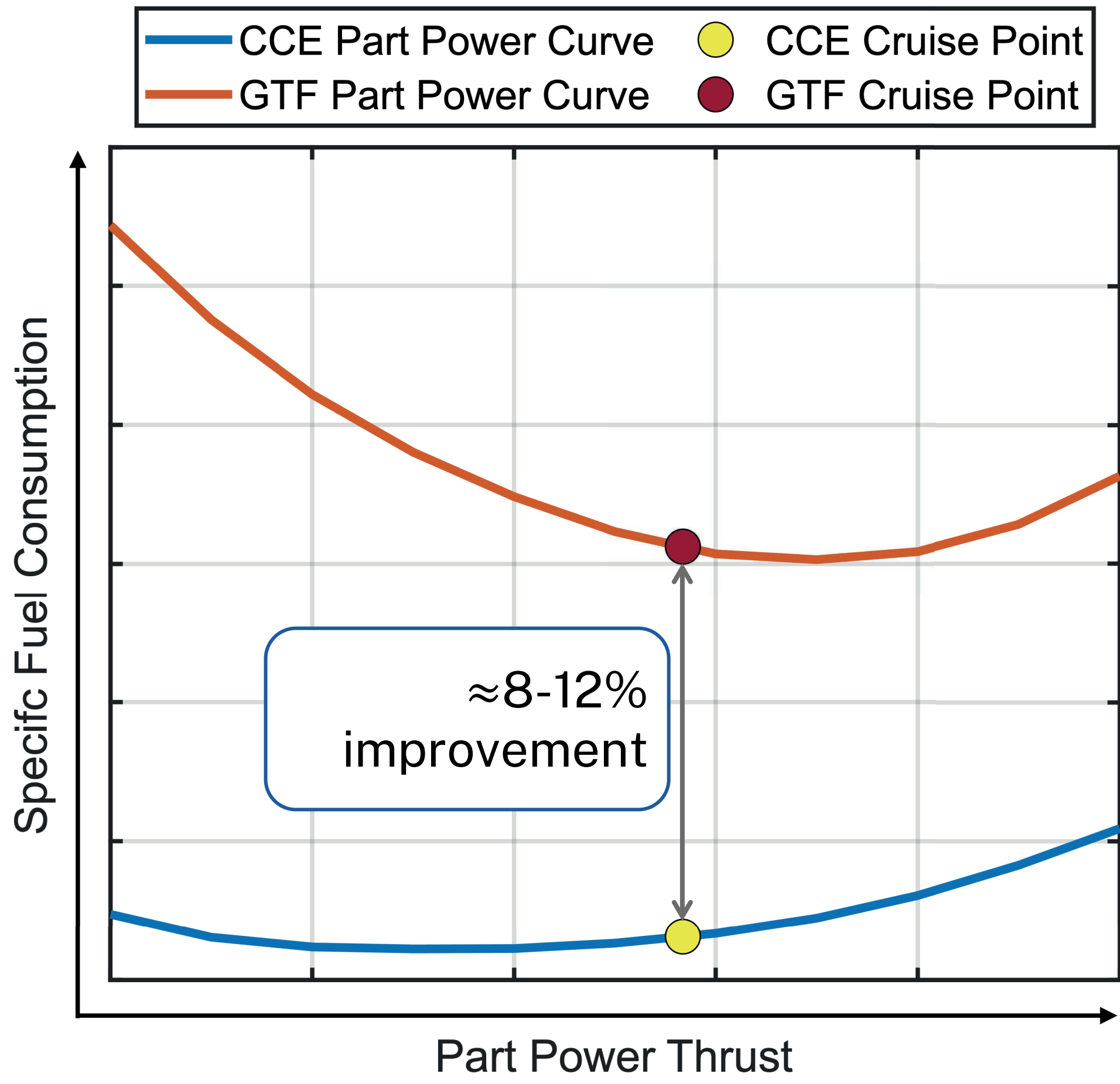


Engine sizing and design study



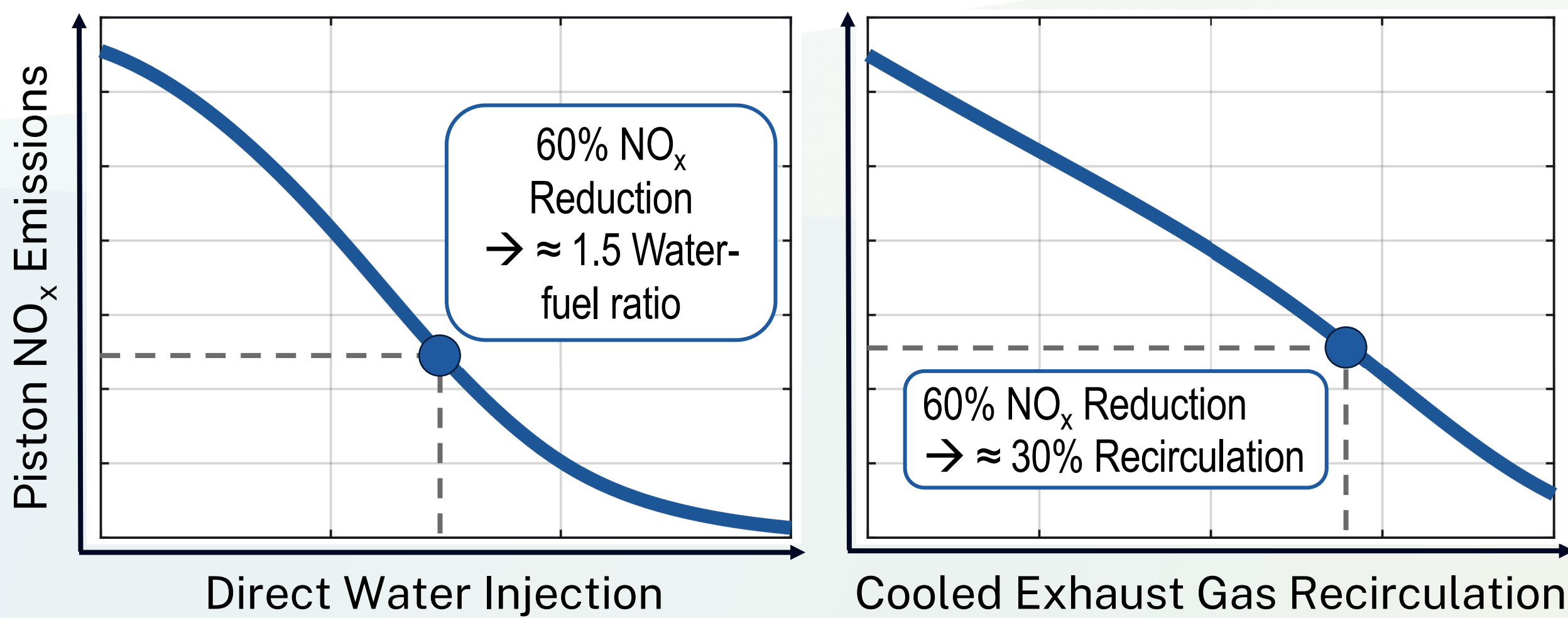
Lin et al., „Engine Design Study for Free Double Piston Integrated Composite Cycle,“ MDPI Aerospace 2026, pp. 13(4), 354, 2026.

Part-load operation benchmarked against a GTF



3. Emissions & Climate Impact

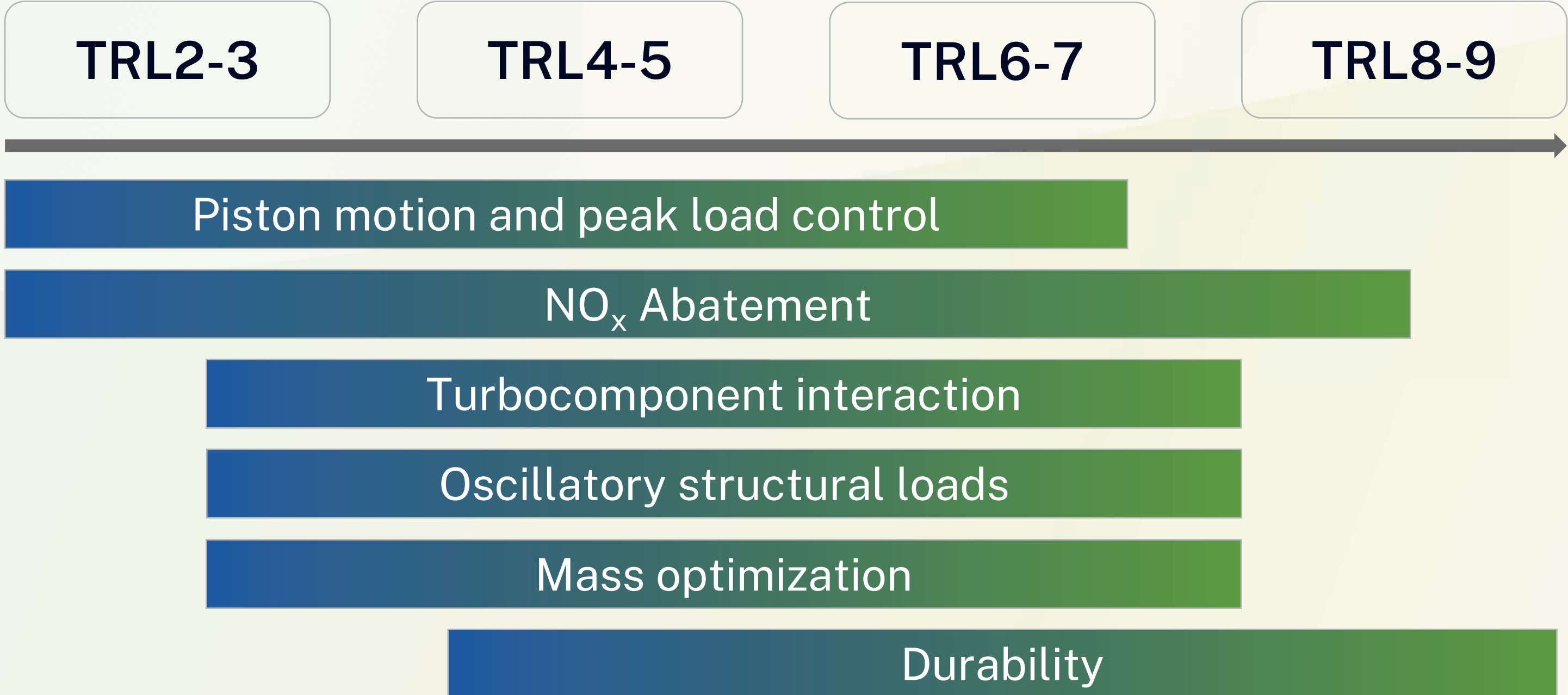
- **Increased NO_x Emissions**
 - High-temperature, high-pressure combustion
- **NO_x Abatement Strategies**
 - Optimisation of combustion characteristics
 - Inlet temperature reduction by compression intercooling
 - Vitiation through water injection or exhaust gas recirculation



4. TRL Roadmap & Key Challenges

Required milestones

- Technology development
- Verification, validation and testing
- Certification aspects



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