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PROJECT PARTNERS



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#CAIPIRINH3A



Combustion of liquid ammonia, assisted
by plasma discharges, as a novel and
clean energy conversion method

PROJECT DETAILS

Start Date: 1 November 2024

Duration: 4 years

EU Contribution: ~ € 2.5M

Funded under
Climate, Energy and Mobility

www.caipirinh3a.eu

5 COUNTRIES



AMMONIA (NH₃) AS AN ALTERNATIVE FUEL

NH₃ is a globally dominant chemical that is combustible while also being carbon and sulfur-free, with the capability of being produced from renewable energy sources.

Compared to hydrogen (H₂), liquid NH₃ offers:

- Higher energy density per volume.
- Easier liquefaction and storage under milder conditions.
- An established storage and distribution infrastructure.



CAIPIRINH₃A concept

Developing and demonstrating an entirely novel technology: The **Plasma Mist Ammonia (PlasMi-NH₃) burner**. This technology is a plasma-enabled, self-learning combustor, that efficiently burns liquid NH₃ with ultra-low Nitrogen Oxides (NO_x) emissions that utilises a cocktail of synergetic effects for enhanced combustion in a smart framework.

TECHNOLOGICAL TARGETS

- Thermal efficiency comparable to traditional diesel engines (~40%).
- Achieving Tier 4 NO_x emissions (≤ 7.5 g/kWh).
- Over 50% reduction in ignition delay and more than 20% expansion of the flammability limits.
- Near-zero NH₃ concentration in exhaust (<10 ppm).

PlasMi-NH₃ combustion engine, with no need for secondary systems is a perfect solution for:



Maritime



Automotive



Aerospace



Power
Generation

Environmental & Societal Benefits

- **NO Greenhouse Gases.**
- **NO harmful pollutants that lead to environmental damage.**
- **NO toxic fumes that lead to respiratory and other health issues.**
- **Reduced Noise levels.**
- **Enabling the transition to a sustainable energy economy.**

METHODOLOGY



Development of an experimentally validated NH₃ combustion kinetic model with plasma-induced effects and sub-mechanisms.



Development of efficient & stable NH₃-adapted plasma systems using advanced diagnostics and modelling.



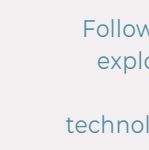
Design, fabrication and optimisation of tailored fuel injection and combustor components with smart, active control strategies to increase performance and ensure safety.



Integration of all modules into the combustor prototype followed by extensive testing (TRL4) to evaluate combustion and emissions performance.



Ensure sustainability and economic viability through Life Cycle Assessment (LCA), Life Cycle Costing (LCC) and market studies.



Follow a tailored dissemination, exploitation & communication strategy to maximise the technologies' market uptake and social acceptance.