The Power of Silence

Acoustics and **T**hermo-**A**coustic noise **Mut**ation

Problem: Safe hydrogen combustion

- Traditionally burners are fuelled by fossil-fuel gasses such as propane or natural gas, thereby emitting lots of CO_2 (202 kg/MWh) and NO_x (20 g/MWh) during combustion.
- Replacement by hydrogen results in zero CO2, half NO_x but termo-acoustic instability due to hydrogen's high flame speed, reactivity, and elevated temperatures,

leading to:

  - Reduced process efficiency
  - Structural damage to components
  - Unsafe operations due to flashbacks & flame lift-offs

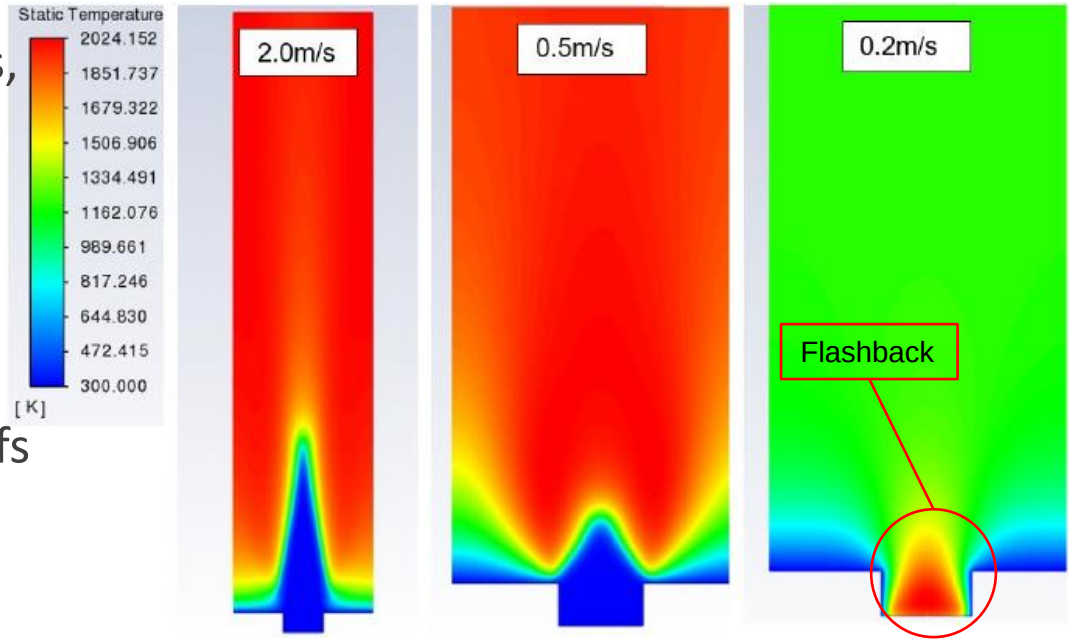

Figure 1 - Traditional burner with 50% hydrogen added to methane as fuel, showcasing the effect of decreased inlet velocity from 2 to 0.2 m/s, which leads to a dangerous flashback condition

Core technology innovation – development status

- We have an optimized ABC muffler-burner deck by performing iterative simulations and analyses using ANSYS (for combustion), COMSOL (for Acoustic performance) and SolidWorks (for design).
- We have prototyped and tested various burners with different designs for methane combustion at various velocities and a wide range of gas-to-air ratios at the Thermo-Acoustic Lab of TU/e.

Figure 3 – ABC methane-hydrogen burner

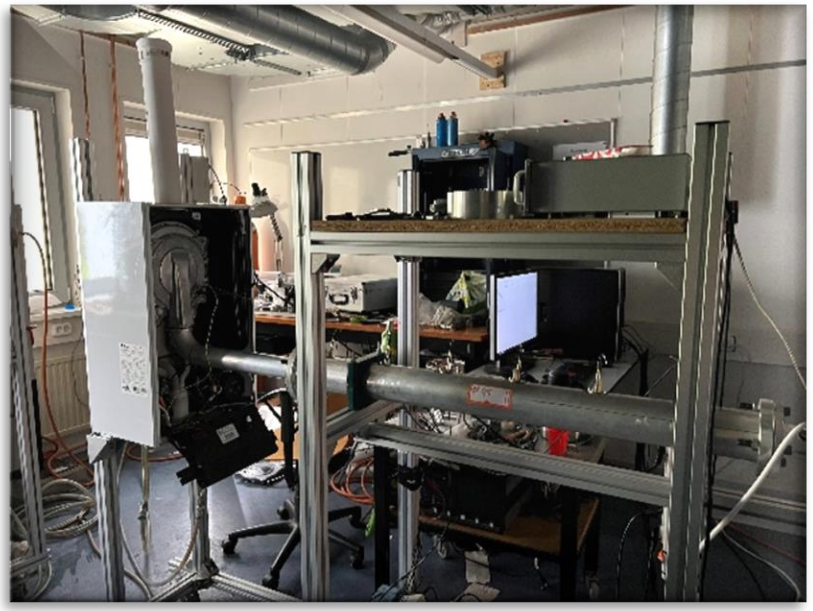

Figure 4 – Testing at Thermo-Acoustic Lab TU/e

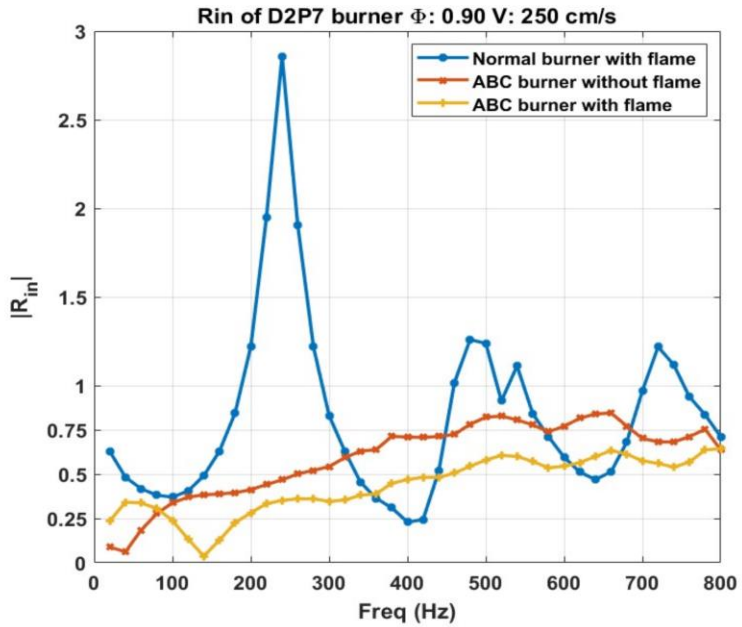

Figure 5 – Test results

Value proposition – ABC-hydrogen burner

Technical value:

- *Thermo-Acoustic Stability across a broad frequency range:* The ABC-muffler burner is achieving full thermo-acoustic stability.
- *Broad Frequency range:* The optimized perforation pattern and layered design enable the muffler to operate effectively across a wide range of instability frequencies, from 2 Hz to 10 kHz.
- *No lift-off or flashback:* The narrow channel between the perforated plates acts as a built-in flame arrestor, preventing flashback and lift-off.
- *Low NO_x-emissions:* The inherent stability allows for Lean Premixed (LPM) combustion to keep the flame temperatures low, thereby minimizing NO_x emissions without compromising performance.

Economic value:

- *Material Efficiency:* Our design prioritizes material efficiency, eliminating the need for additional components such as external flame arrestors.
- *Low R&D and maintenance cost:* Our design offers inherent thermo-acoustic stability, allows to expedite the development of a diverse array of hydrogen and methane burners with superior safety and efficiency without extensive R&D efforts.

INTELLECTUAL PROPERTY

Gas & Hydrogen burner

Safe and stable
No flashback or lift-off

Patent: Burner for Hydrogen-Rich Fuel-Air Premix Having Enhanced Thermo-Acoustic Stability.

- US 63/537,331
- PCT /I B2024/058561

ATA Mute has an exclusive license of the patent.

We reduce any noise

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