Transition from natural gas to hydrogen in the fired clay brick industry

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Industrial environment

Reducing CO_2 emissions in brick industry

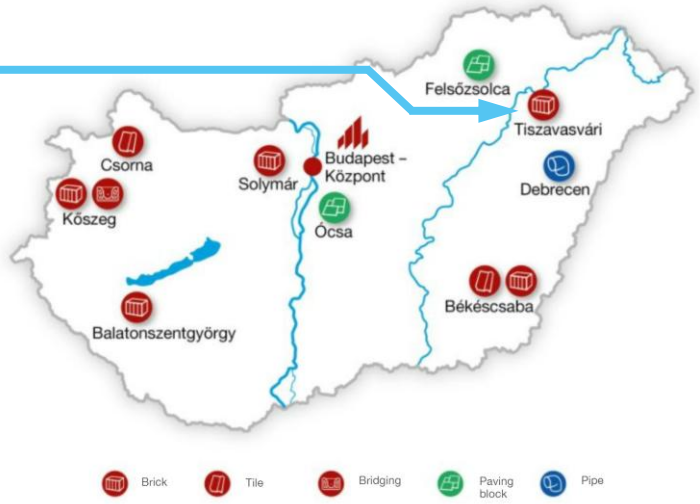
by introducing hydrogen-based technologies

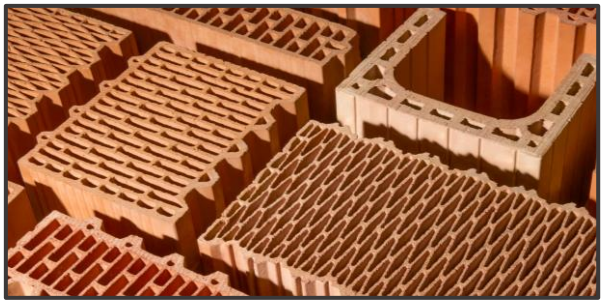
Installed power: ≈10 MW

CO_2 emission: ≈8 kt/yr

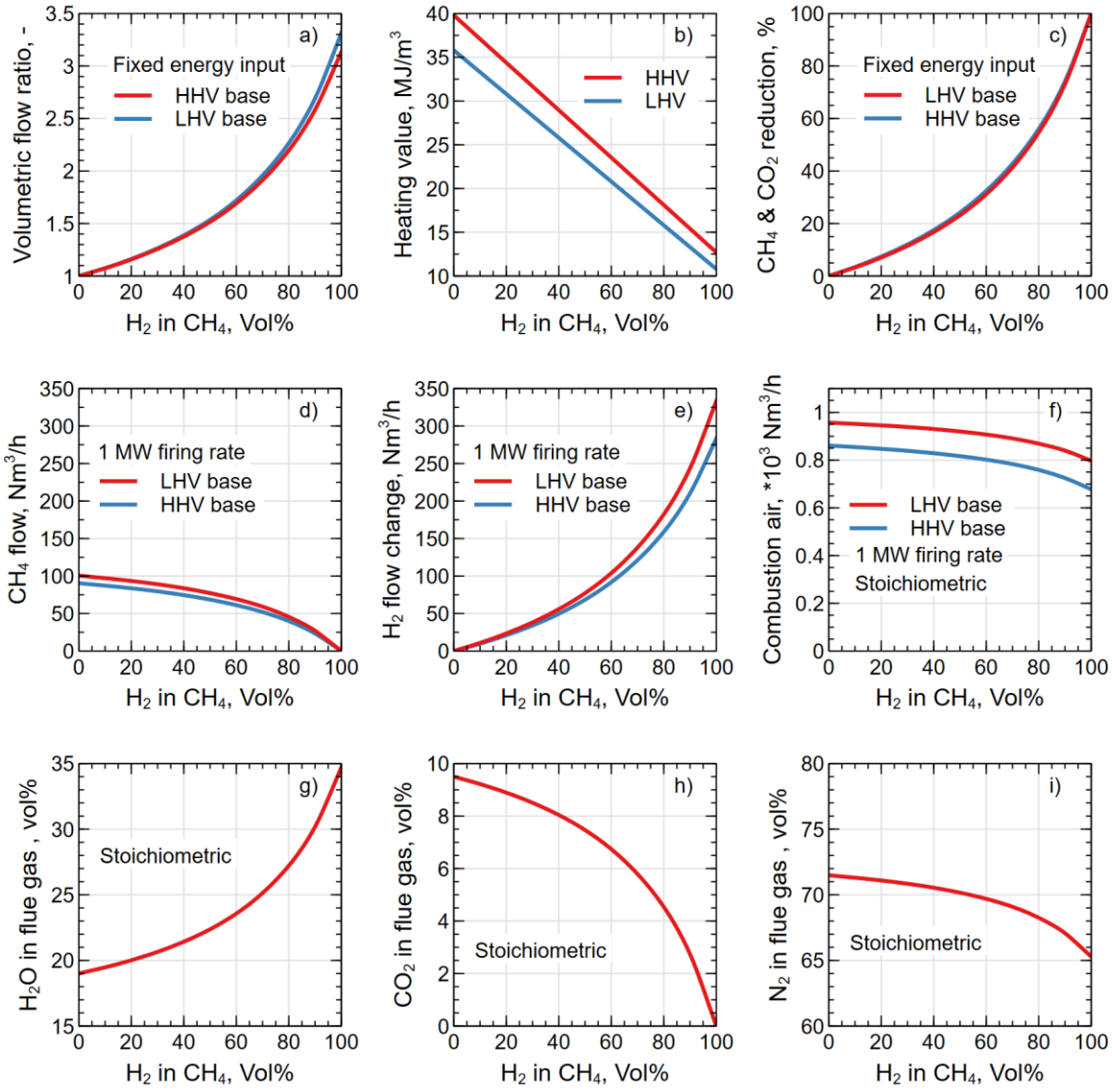
Main fuel: natural gas

Goal: transition to 100% hydrogen combustion maintaining recent productivity





Calculations



How do various parameters behave due to hydrogen addition?

What should we expect? What models can we create?

How to control the combustion?

What are the different approaches to adding hydrogen to existing infrastructure?

Risks? Pros and cons?

Pilot for hydrogen combustion

- Pilot-scale combustion experiments to support upscaling
- Test different hydrogen blending approaches
- Experience, behavior, impact, borders
- Robust equipment capabilities (gas analyzers, MFCs, thermal camera, spectrophotometer, heat transfer, safety, etc.)
- Testing various burner types, burner prototypes

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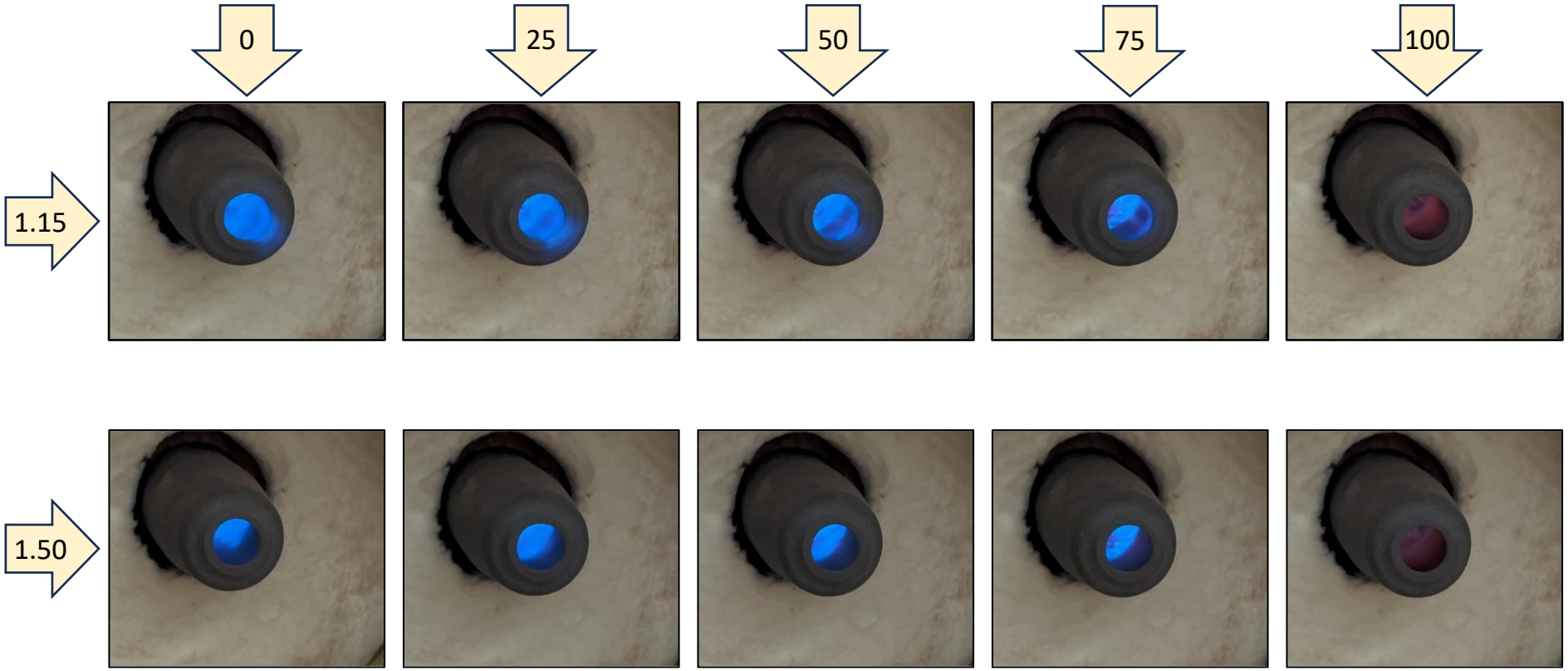
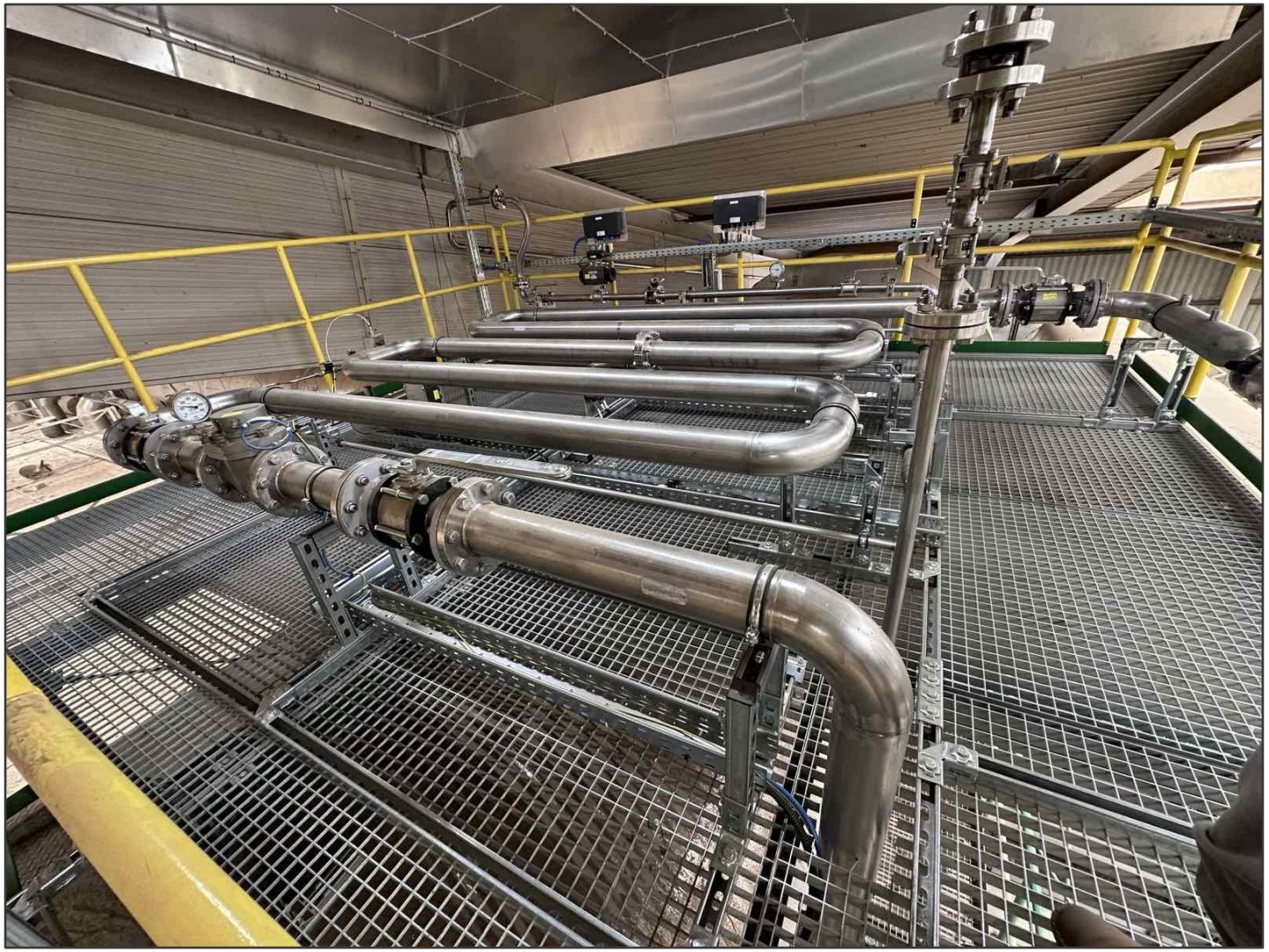
Methane hydrogen flames

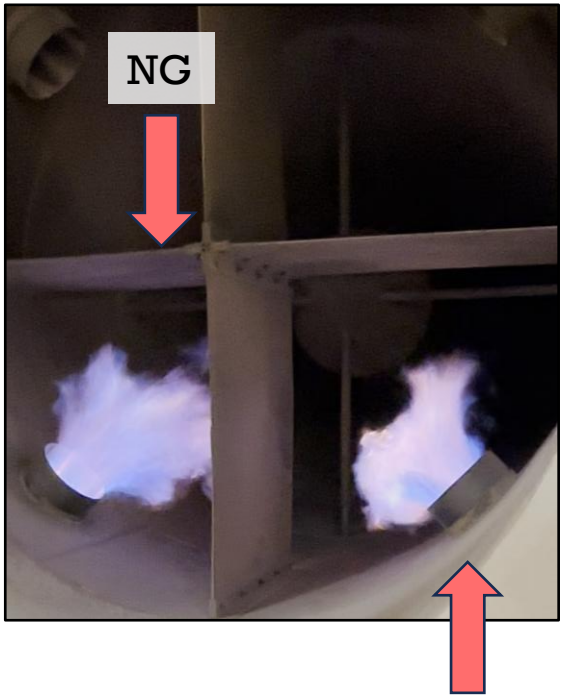
5 kW, n = 1.15 - 1.50, H_2 = 0 - 100 vol%



Industrial implementation – mixing platform

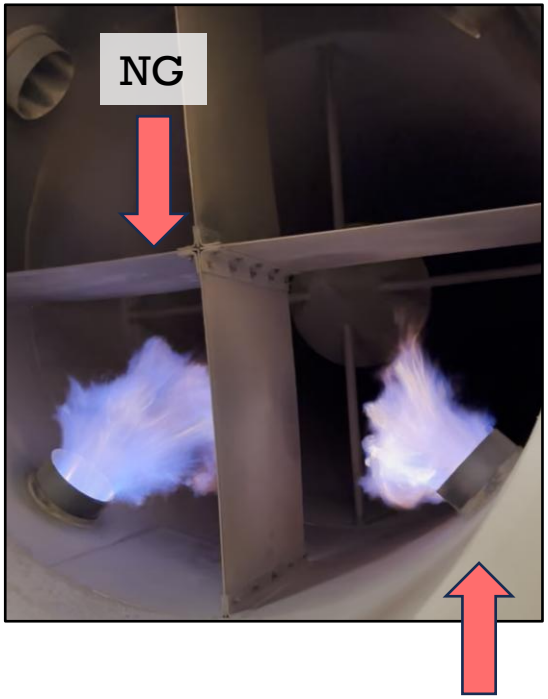


Hydrogen injection - Tiszavasvári



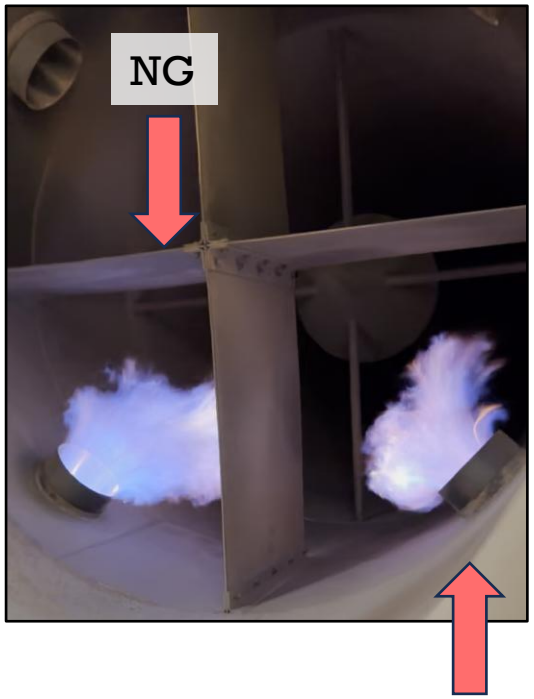
Hydrogen: 2 Nm^3/h
Natural gas: 76.5 Nm^3/h
Calc. conc: 2.6 Vol% H_2
GC: **2.9** Vol% H_2
P_{fuel}: 120 mbar

78.5 Nm^3/h



Hydrogen: 10 Nm^3/h
Natural gas: 72.0 Nm^3/h
Calc. conc: 12.2 Vol% H_2
GC: **12.9** Vol% H_2
P_{fuel}: 120 mbar

82.0 Nm^3/h



Hydrogen: 22 Nm^3/h
Natural gas: 66.1 Nm^3/h
Calc. conc: 25.0 Vol% H_2
GC: **25.4** Vol% H_2
P_{fuel}: 120 mbar

88.1 Nm^3/h

100% H_2 - dryer

22 h Total hydrogen combustion time

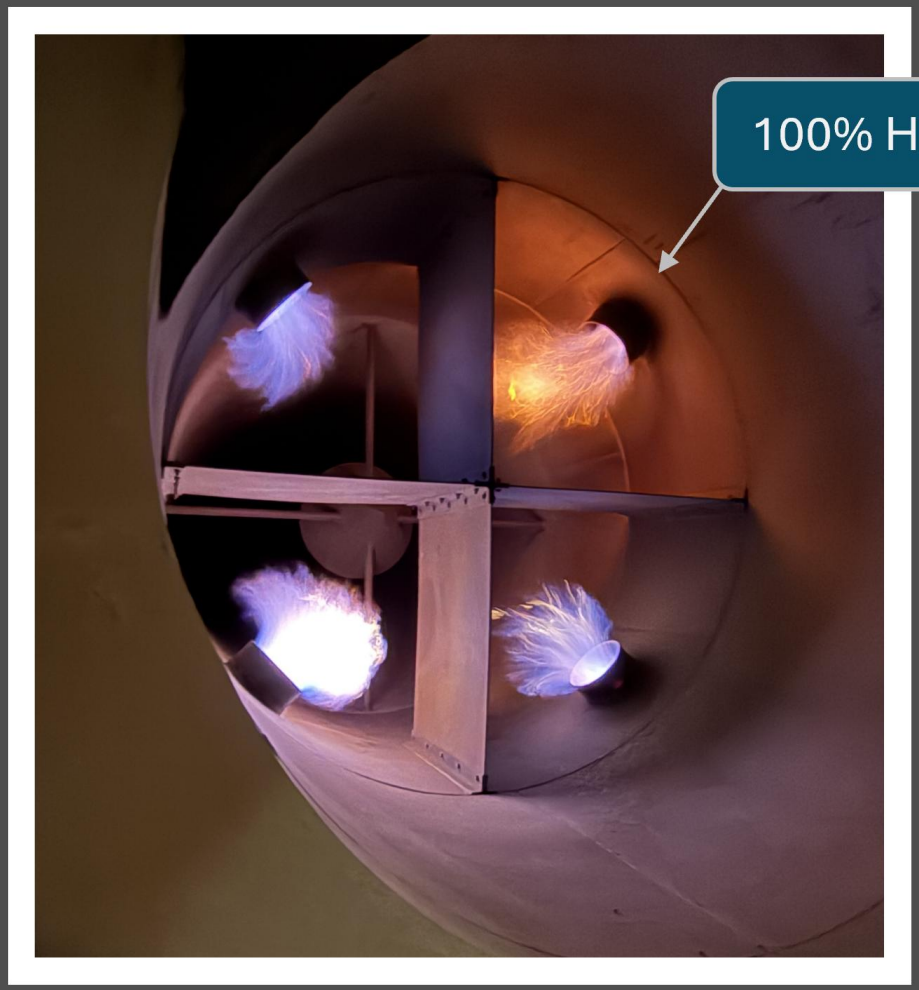
Properties:

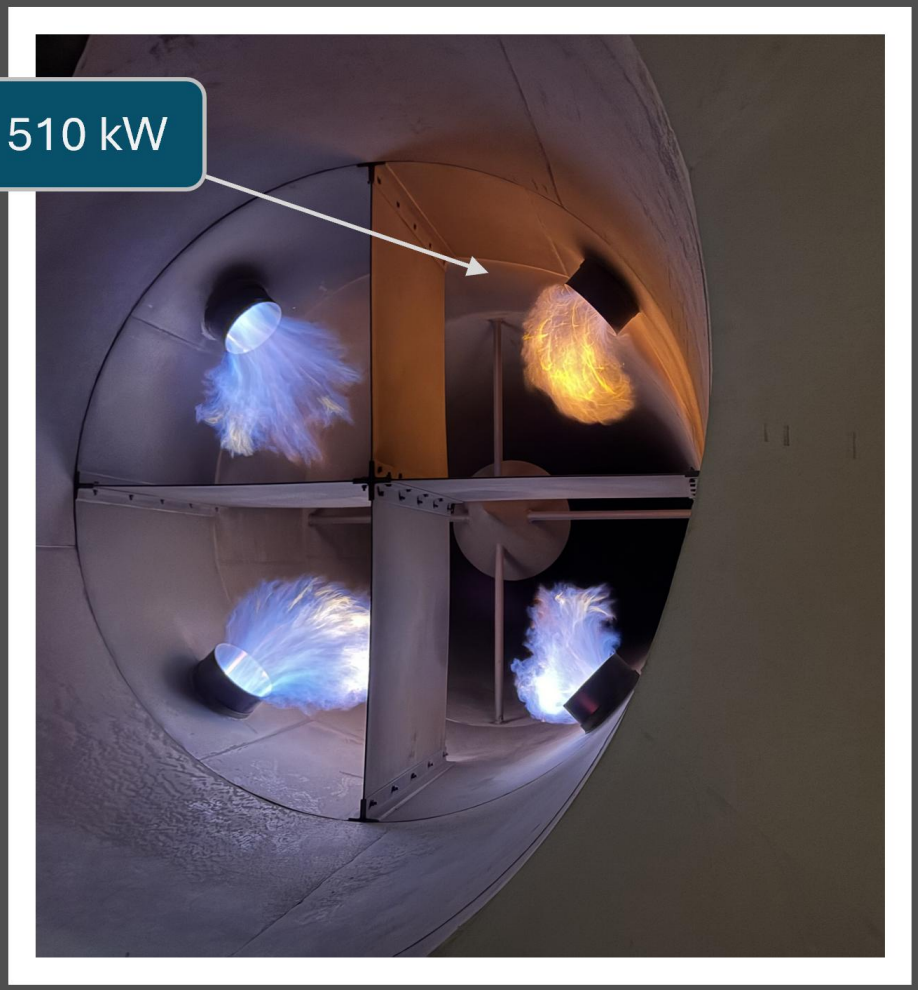
- One of four hydrogen burners running at 100% H_2
- Automatic power control of NG burners according to the drying process requirements
- Hydrogen supply from a truck
- Multistage pressure reduction – 200 bar ➡ 100 mbar

Main conclusions:

- Successful demonstration of H_2 utilization during clay brick drying
- No detrimental effects of H_2 on final brick properties were observed
- Long-term influences on infrastructure still need to be analyzed

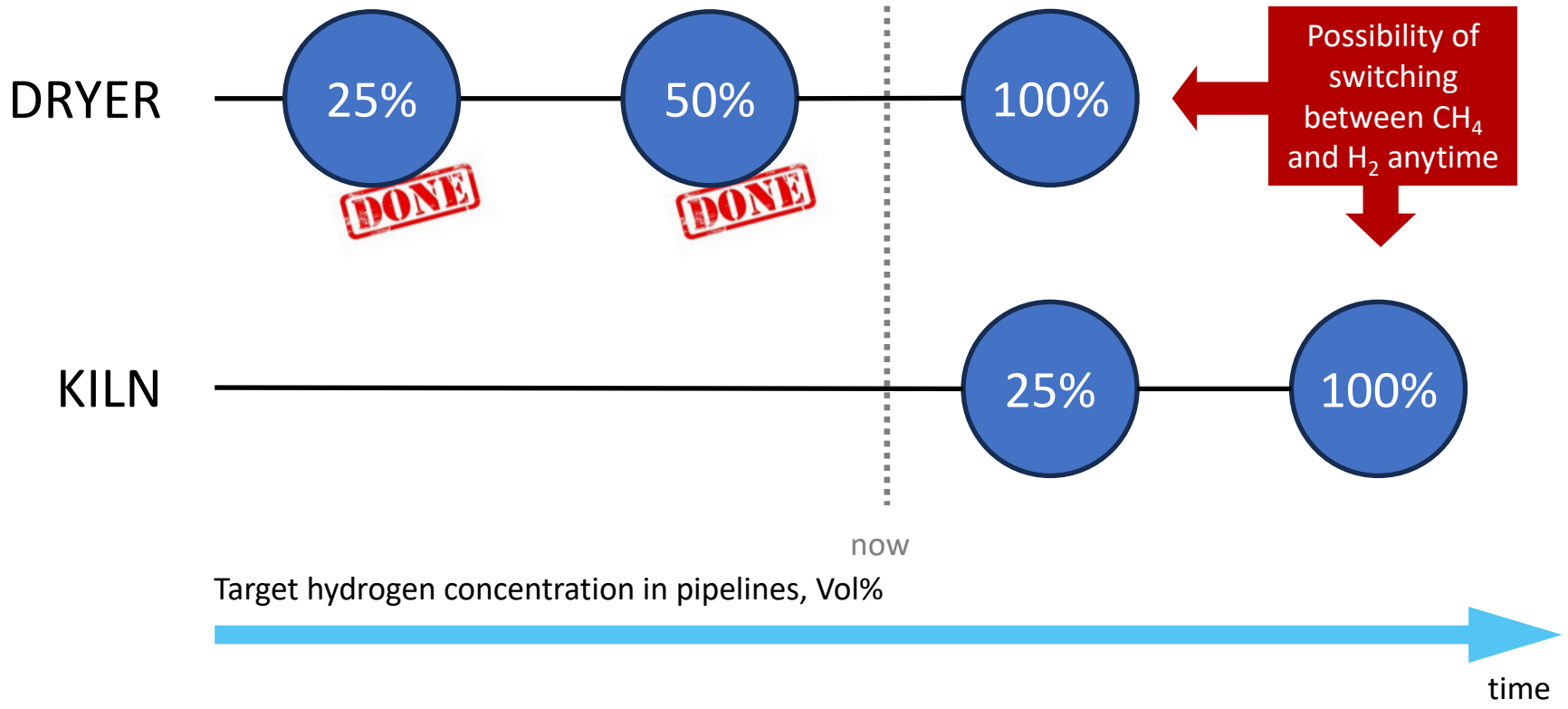
Flame - dryer





Where are we now?

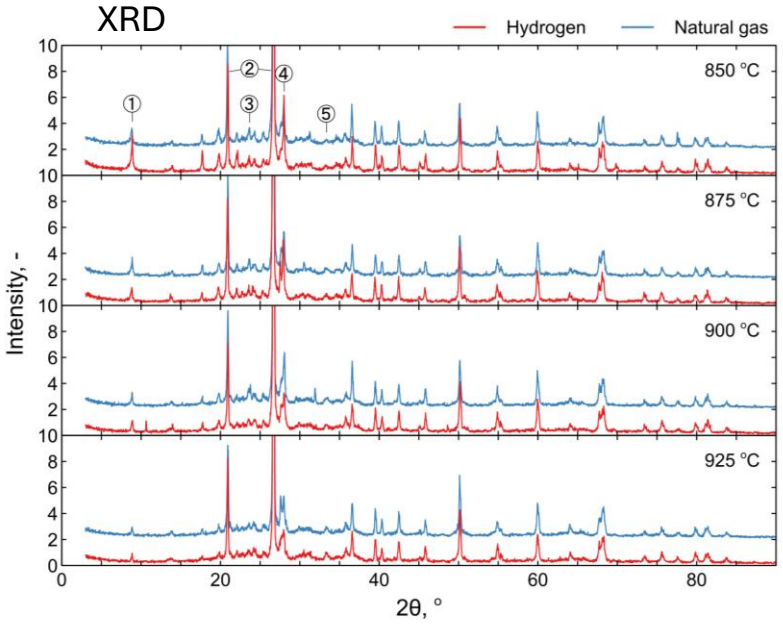
wienerberger



Pilot demonstrations

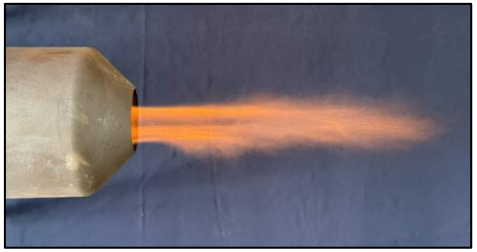
- Focus on kiln operation, investigation up to 925 °C
- No detrimental influence of atmosphere change on brick properties
- Compressive strengt -> slight increase with H_2, needs validation

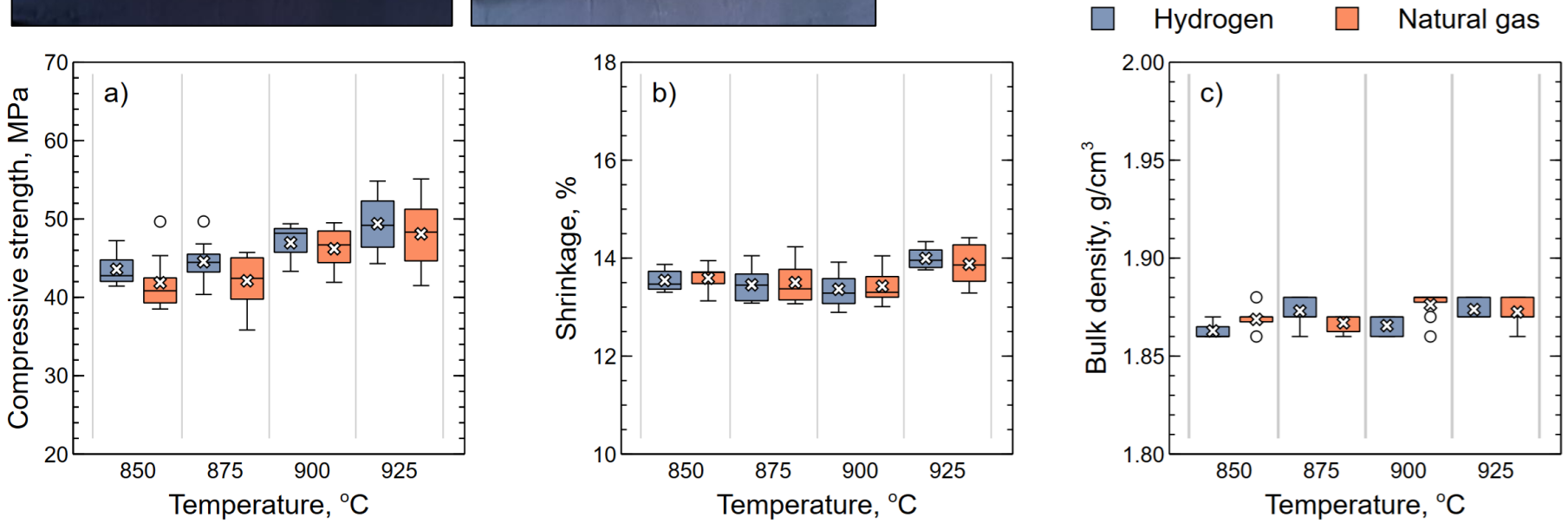
XRD



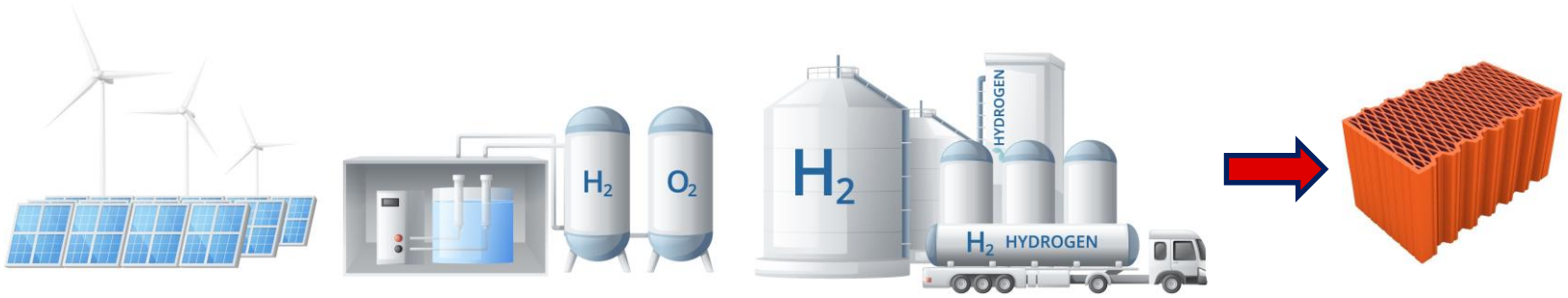
Natural gas

Hydrogen





Source of hydrogen?



Renewable power generation

Water electrolysis

Storage and transportation

Combustion


Thank you for your attention!
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