Hydrogen Oxyfuel for Decarbonization of Industrial Processes for Heating & Melting.

- Now and In the Future.

David Muren

dissHEAT Webinar, May 30th, 2023

Making our world more productive

Linde Technology Centre Munich
- Hydrogen Oxyfuel Trials Spring 2019

Control system

500 kW H_2 O_2 Burner Control System

Performing burner trials for customers

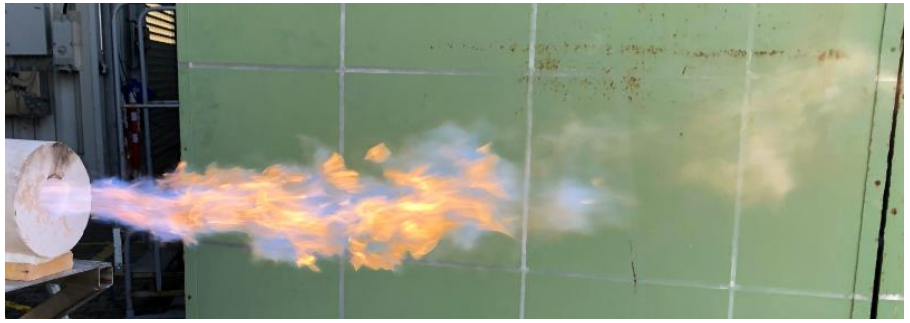
Firing rate – 400 kW

100% H_2

100% NG

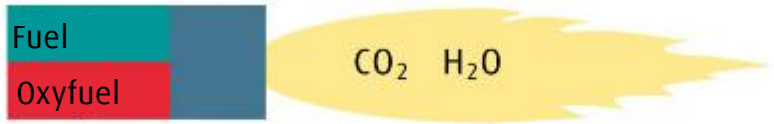
Blend –

35% H_2, 65% NG

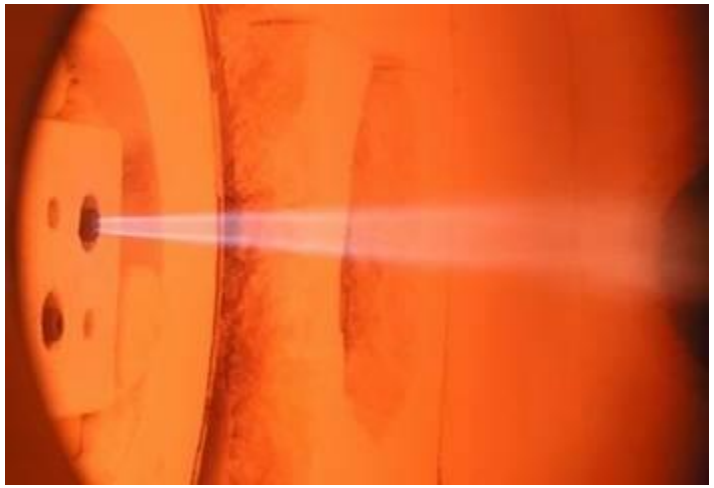


Flameless Oxyfuel Combustion

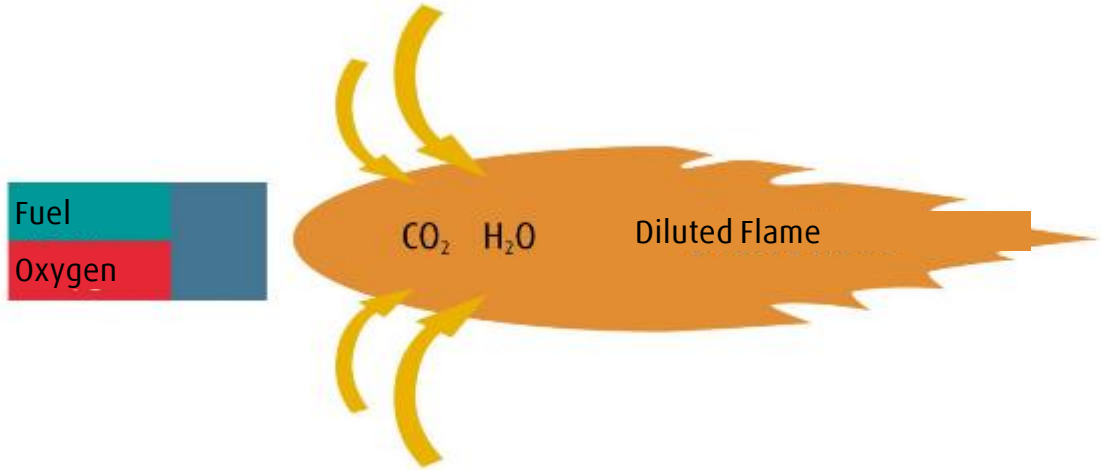
Conventional Oxyfuel Combustion



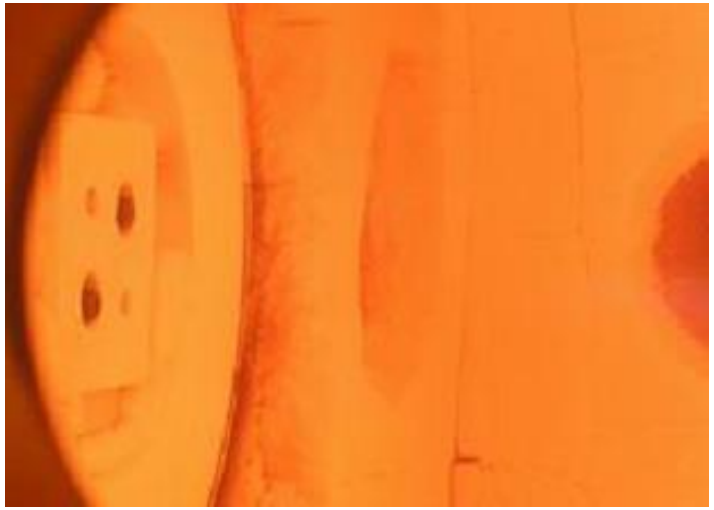
$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ + Heat



Flameless oxygen combustion

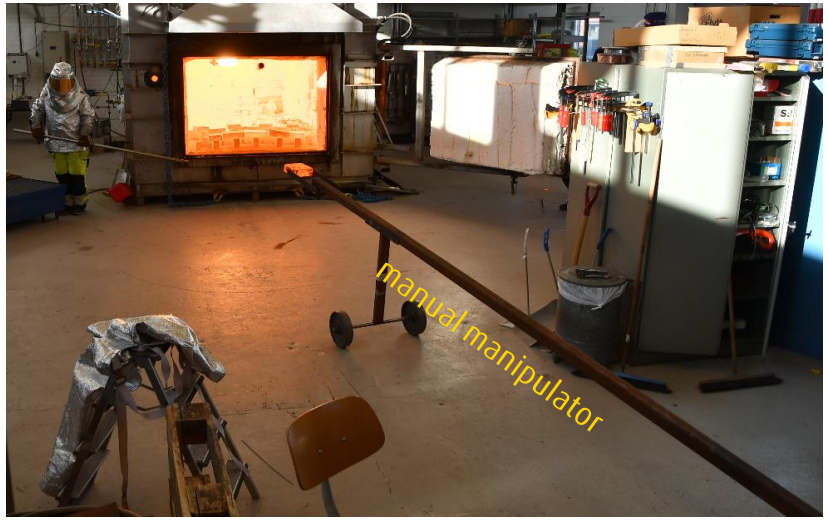


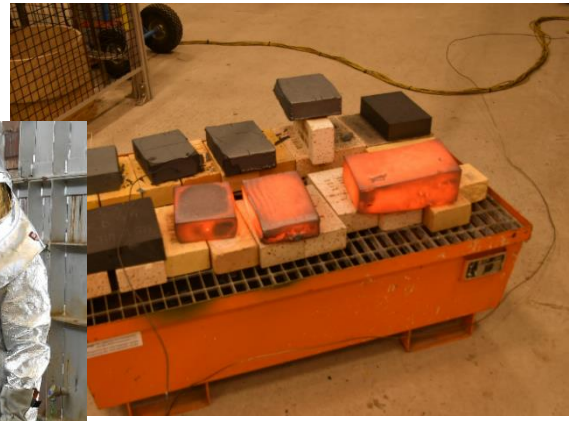
$CH_4 + 2O_2$ + Hot Gases $\rightarrow CO_2 + 2H_2O$ + Heat



Steel Reheating Tests with Hydrogen Oxyfuel

Linde Technology Centre Stockholm, October 2019





Material tested from four steel companies, including engineering and stainless steel grades

Aluminium Melting: LTOF with 100% Hydrogen Tests at Linde Technology Centre in Sweden

To evaluate the impact of H_2-combustion, Linde has hosted multiple series of tests.

Melting and holding 10 kg samples of 5xxx and 6xxx alloys in various atmospheres using LNG, H_2 and mixtures thereof as fuel.

Evaluation of the results indicate no increased oxidation and no negative impact on the final product.

Acknowledgements

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- Real Alloy,
- Alcoa,
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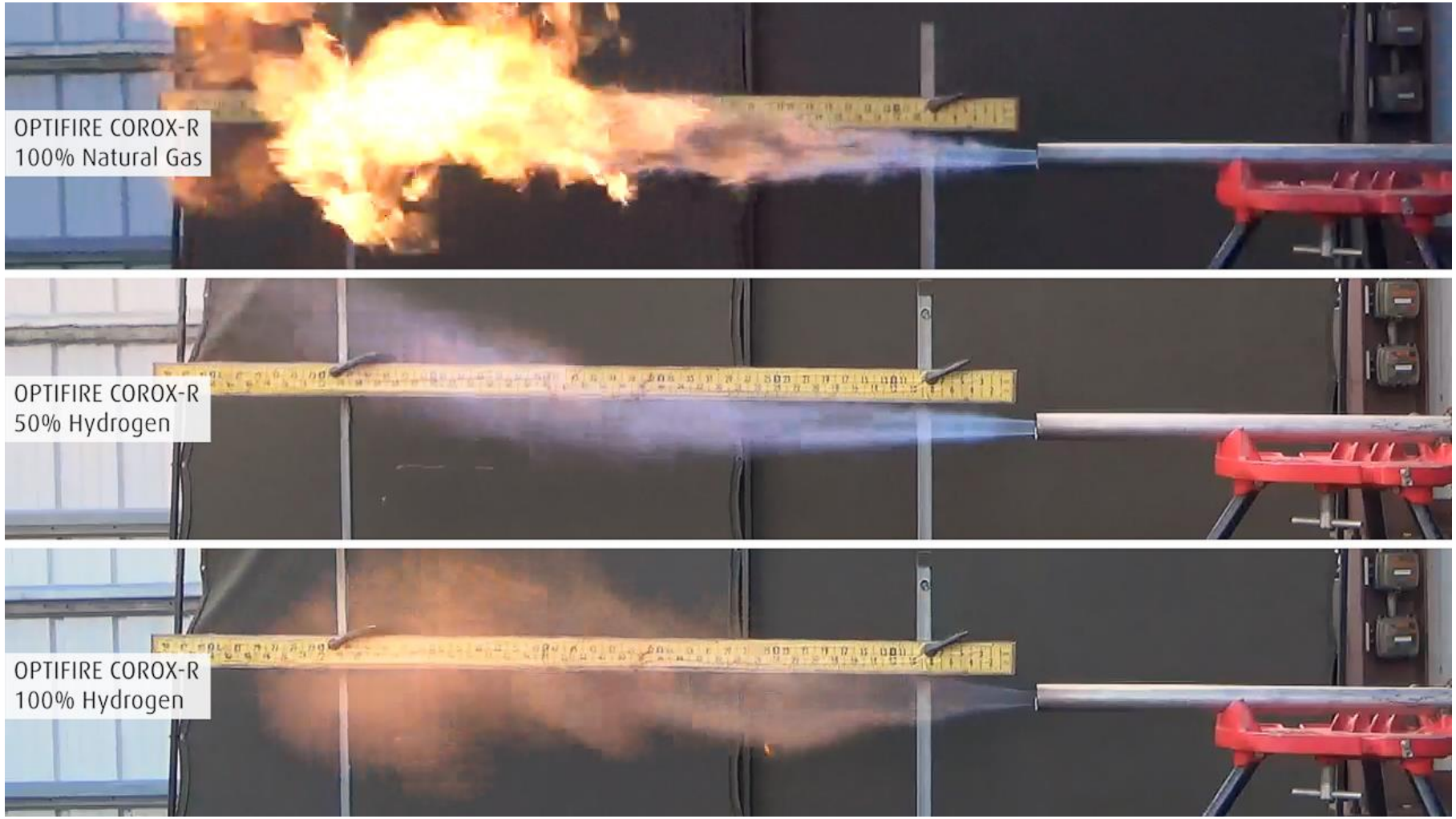
- Gränges,
- Linde Gas,
- Benteler,
- Hycast,
- NTNU,
- SINTEF,
- Research Council of Norway
- All staff at Linde's lab in Älvsjö

Hydrogen Oxyfuel Trials at Linde Tech Centre, Tonawanda (US)



Linde is Involved in Several European Industrial Hydrogen Technology Research and Demonstration Projects

- Steel
- Aluminium

HyTecHeat

HYINHEAT

GreenHeatEAF
Gradual integration of REnewable non-fossil ENergy sources and modular HEATing technologies in EAF for progressive CO2 decrease

Several process demonstration projects ongoing

- Glass
- Copper
- Zinc
- Cement

HARARE

Slaggreduktion med vätgas

ZincVal

Fundamental process R&D work and supply of significant hydrogen volumes for short term trials

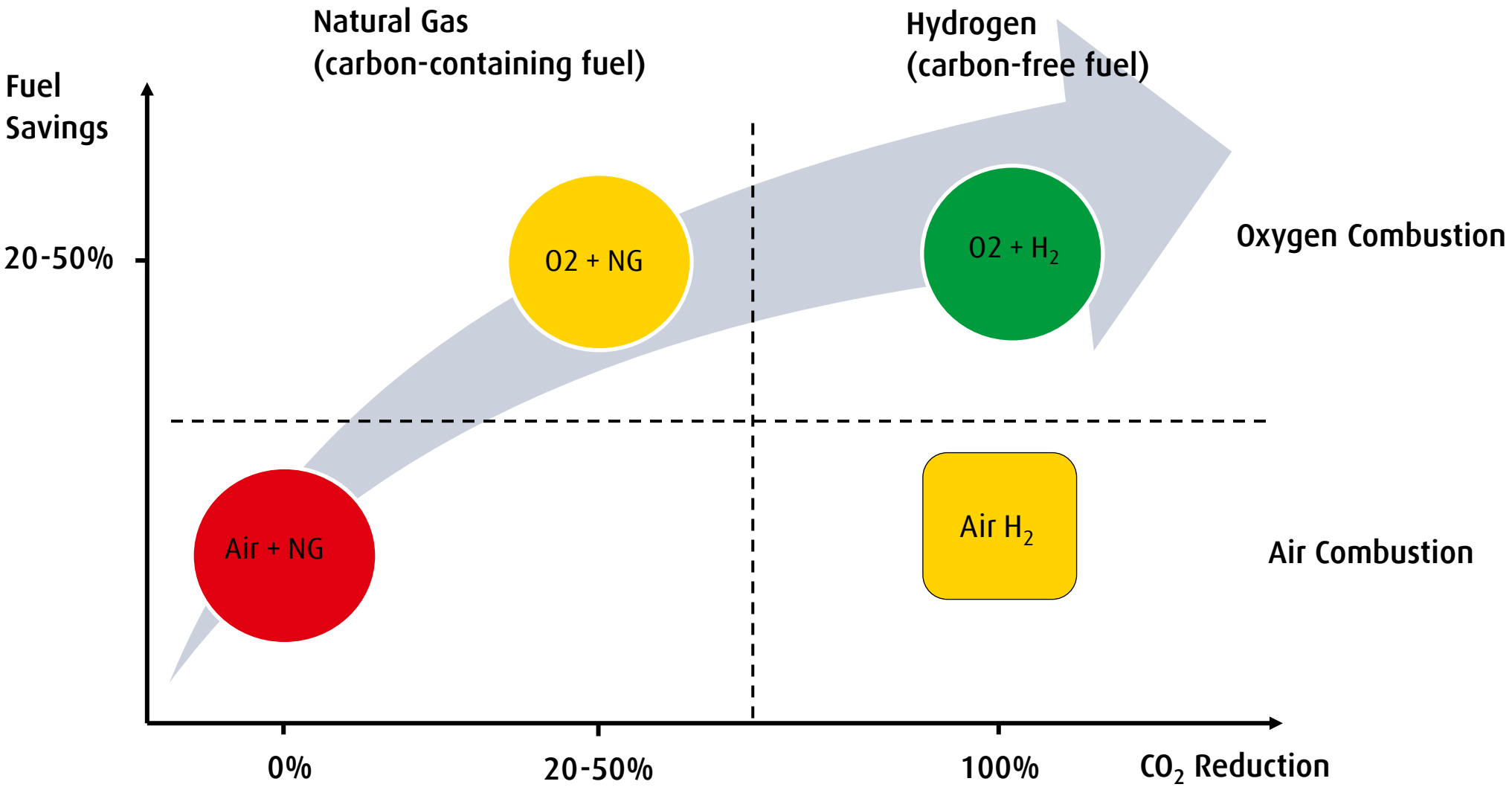
Hydrogen Combustion Economics
Oxygen is a Prerequisite for Hydrogen Combustion

Hydrogen will be an expensive fuel with limited availability in the foreseeable future

Oxygen Combustion will improve viability of hydrogen as fuel and provide decarbonization benefits now

Air-fuel ⇨ **Oxyfuel** 20-50% CO_2 Savings ⇨ **Oxyfuel w/ H_2** Full Decarbonisation

Route to Decarbonize Industrial Heating Operations



Thank you for your attention.

Think Hydrogen. Think Linde.

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