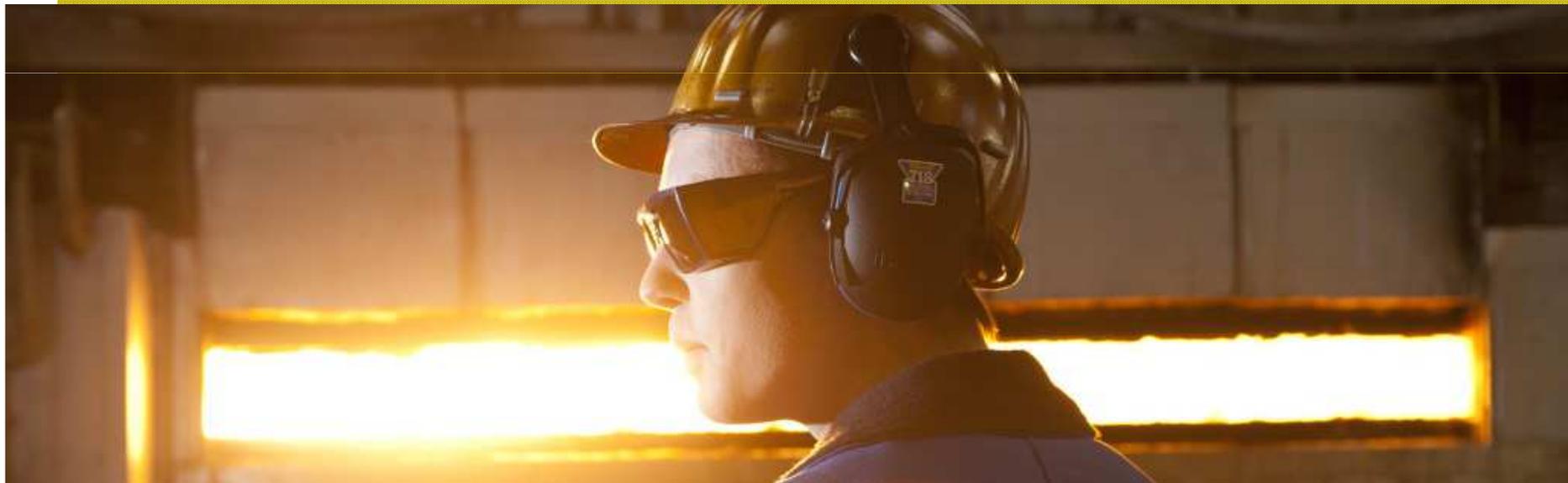


Reducing Energy Consumption with innovative technology

HEATOX: A PACKAGED SOLUTION FOR GLASS

Y. Joumani, T. Kang, R. Tsiava, X. Paubel, L. Jarry



Market Trends & Needs

Statement with glass

- Reinforced regulations on hazardous emission and carbon footprint
- The melting representing 60 to 80 % of total energy consumption
- Demand in term of short payback time

Ambitions

Cost savings and efficiency

- **Energy reduction:** electric boosting, fuel and oxygen
- NOx and CO₂ emissions reduction
- **CAPEX** <3 years payback

Oxygen and natural gas preheated at high temperature

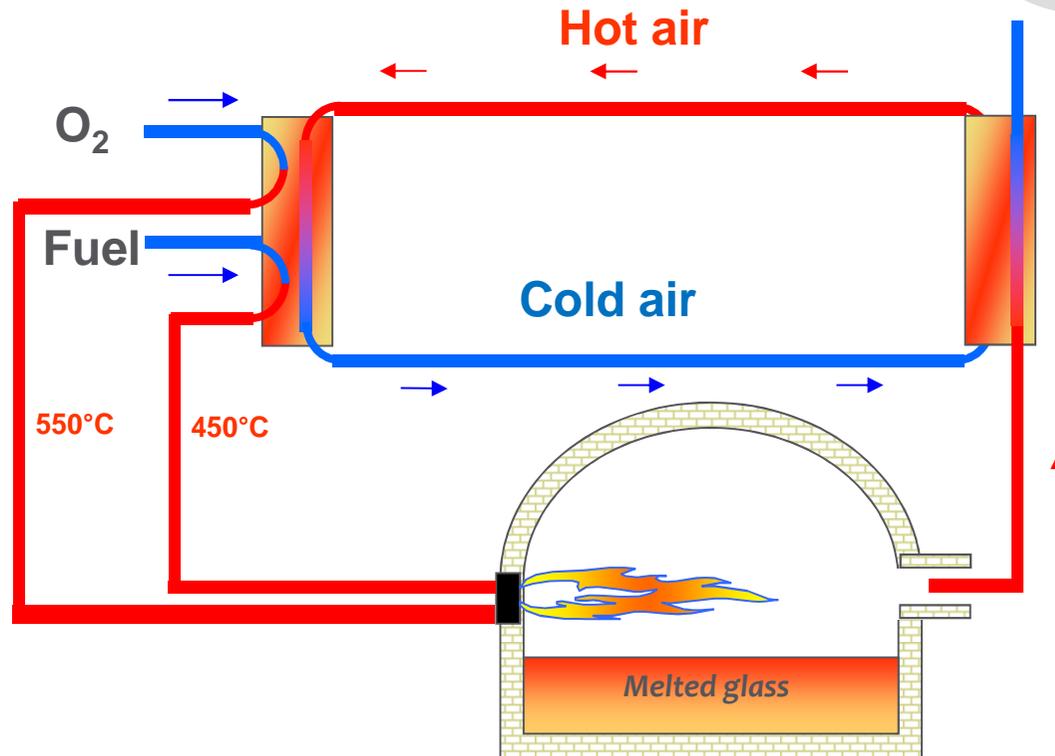
ALGLASS™ HeatOx

GREEN SOLUTION

NO_x & CO₂
reduction

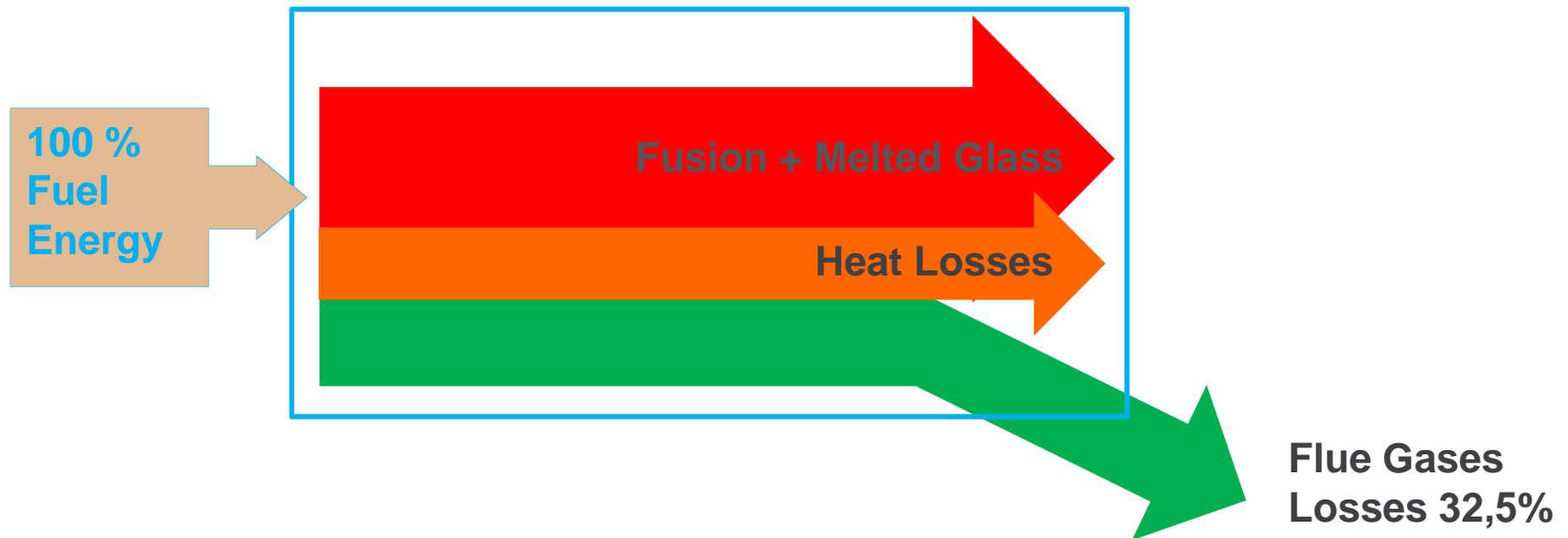
A COMPETITIVE
SOLUTION...

*Mixing advantage of
oxy-fuel and heat
recovery*



ColdOx efficiency – schematic energy balance

- Oxy combustion with cold reactants – real case

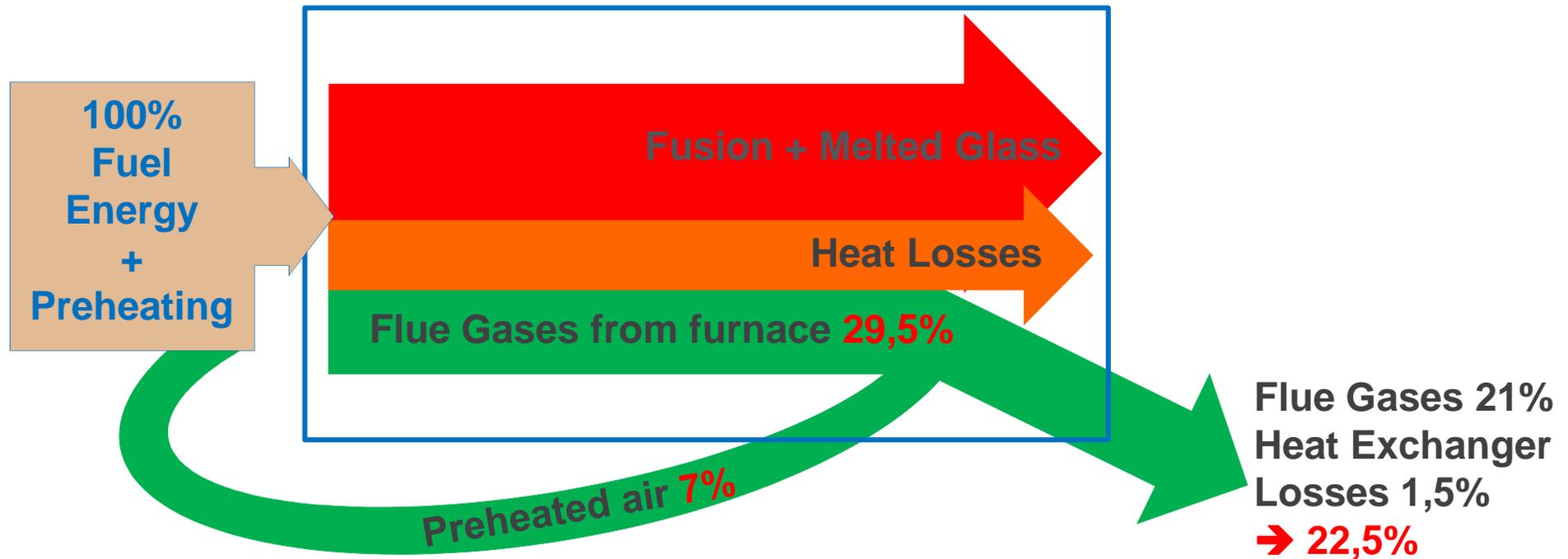


$$\text{Combustion efficiency Coldox} = \frac{\text{Fuel Energy at the burner} - \text{Exhaust gases losses}}{\text{Fuel Energy at the burner}}$$

$$\text{Combustion efficiency ColdOx} = 67,5 \%$$

HeatOx efficiency – schematic energy balance

- Oxy combustion with Hot reactants (550°C O₂, 450°C NG) - real case



$$\text{Combustion efficiency Coldox} = \frac{\text{Fuel Energy at the burner} - \text{Exhaust gases losses}}{\text{Fuel Energy at the burner}}$$

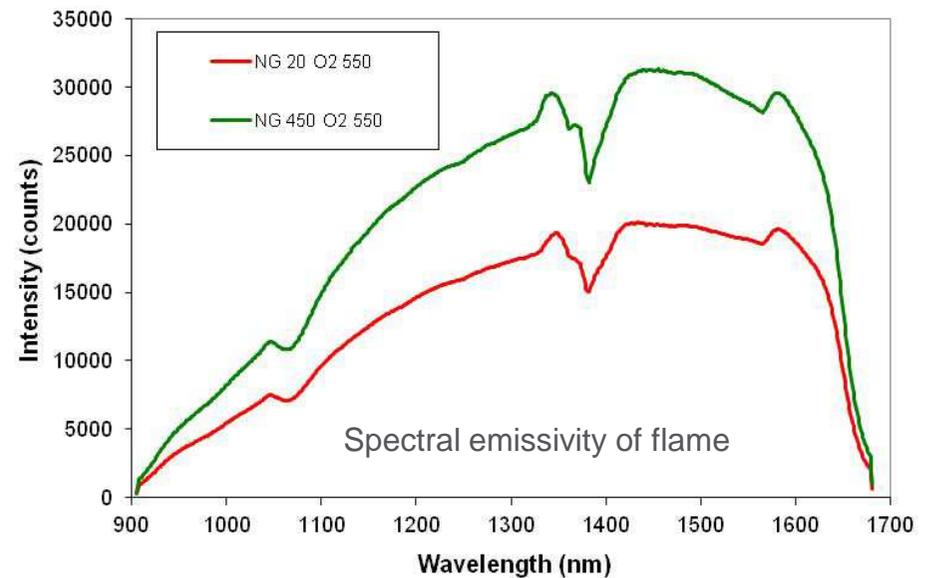
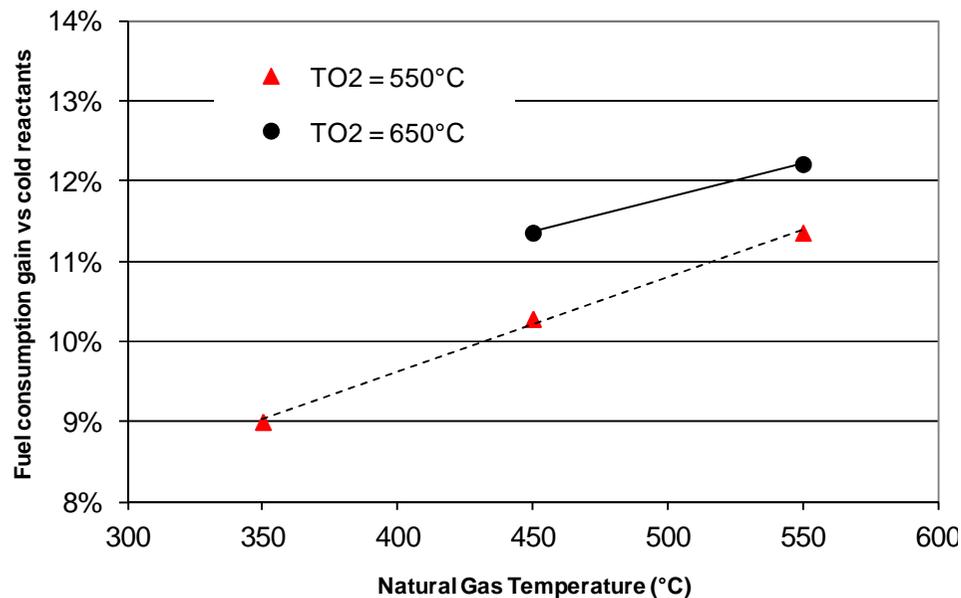
$$\text{Combustion efficiency HeatOx} = 77,5 \%$$

HeatOx efficiency breakdown

■ Savings:

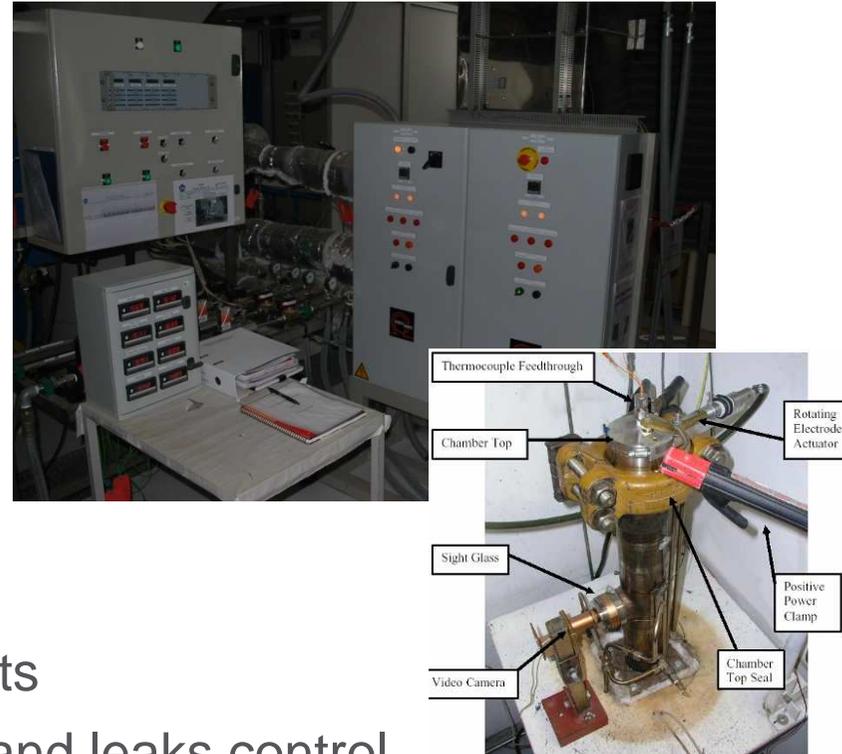
- Reactants enthalpy → 6-7 %
- Less fumes flow (-7.5% mass flow) → 2-3 %
- Higher flame emissivity / (Fumes T° decreasing -50°C) → 1-2 %

HeatOx ~10% additional savings vs ColdOx



Background : 10 years of experience

- One challenge of heat recovery project at the beginning was related to the evaluation of the preheated oxygen/natural gas hazards.
- Main risks :
 - Ignition & Flame propagation:
 - Promoted combustion study
 - Corrosion:
 - Cyclic oxidation tests
 - Long term exposure tests

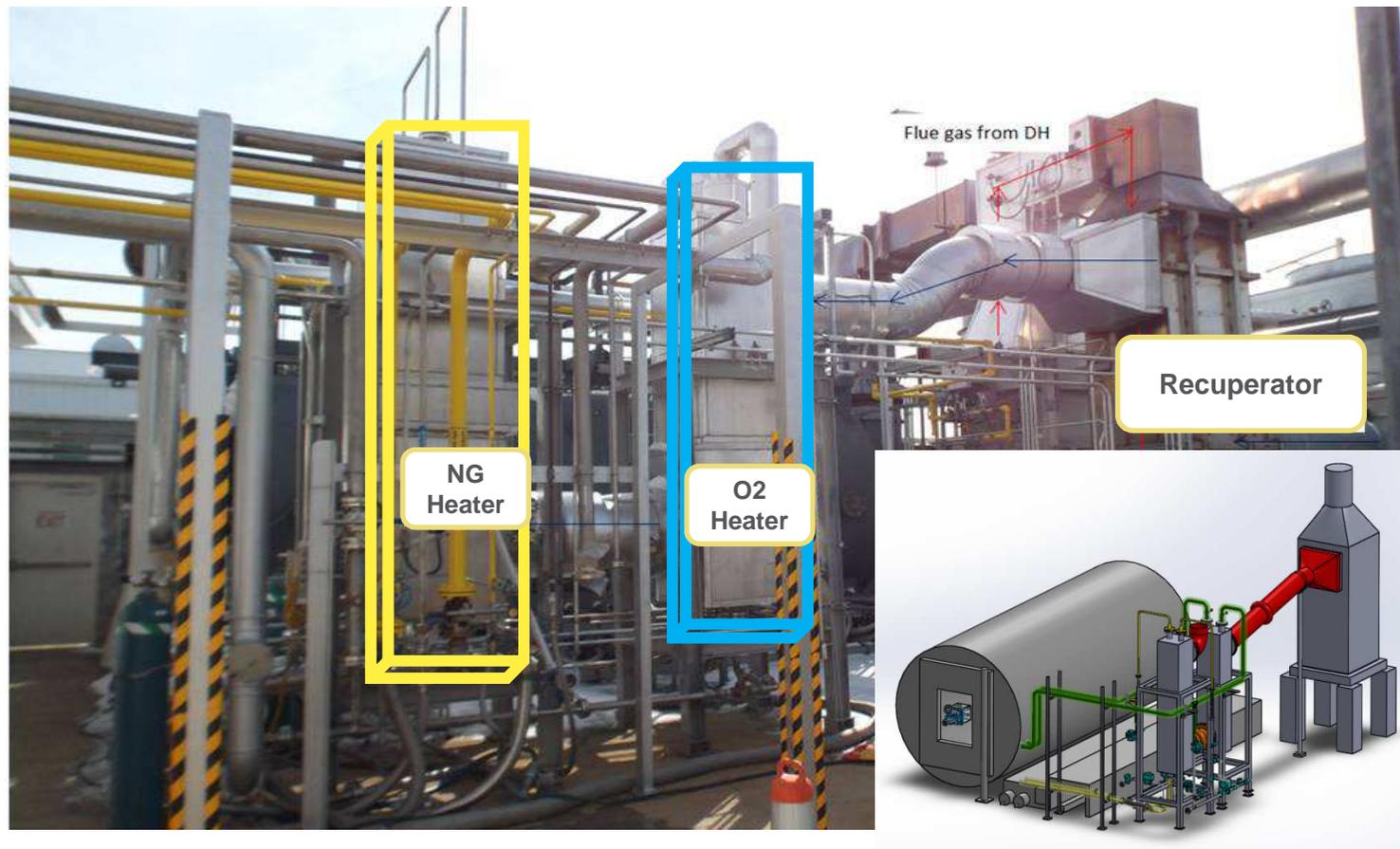


➔ *Specific Technology Design* :

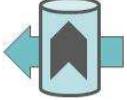
- ❖ Material selection for all equipments
- ❖ Flange & piping design / Gaskets and leaks control
- ❖ Automatic control and regulation of reactants temperature
- ❖ Design requirements & manufacturing process for the O₂ exchangers

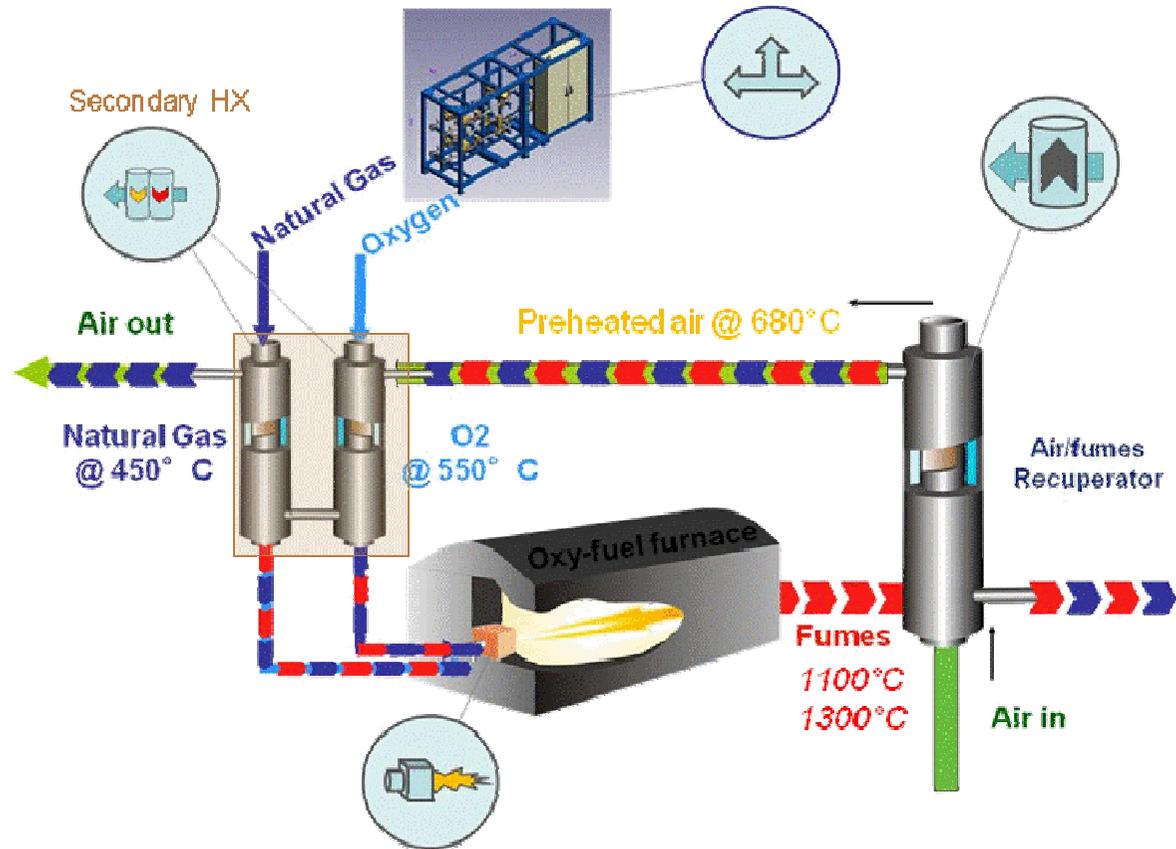
Background : 10 years of experience

- **HeatOx Platform – USA:** fumes heat recovery & reactant preheating
- **1-2MW burners**
- **Heaters with temperature control schemes**



HeatOx: Features

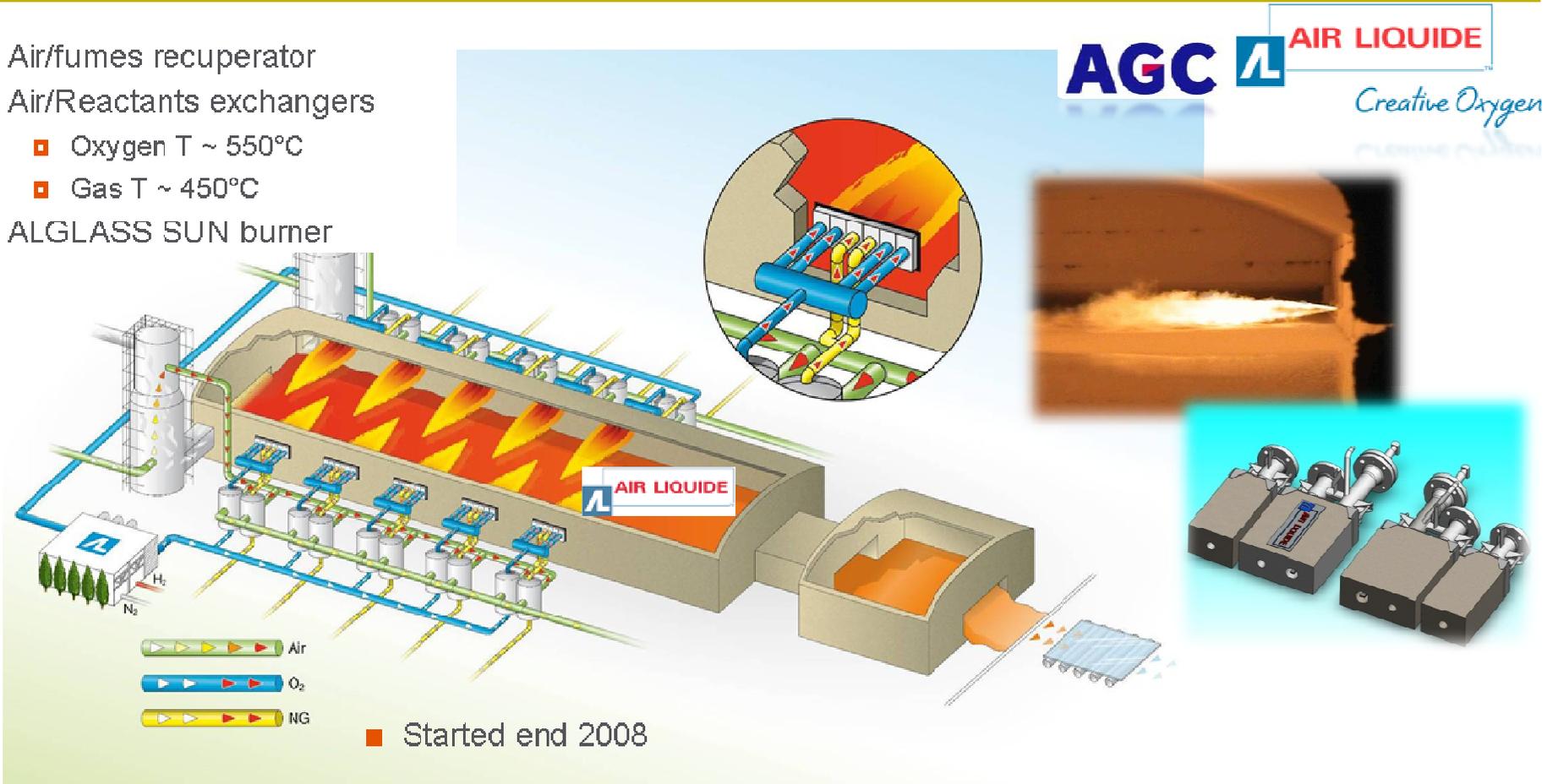
Components	Item
	Burners
	Valve train
	O2/NG Heaters
	Heat recuperator
	Engineering, installation and integration



✓ New Patented AL Technology: Oxygen preheating in glass melting

HeatOx : Proven on float glass

- Air/fumes recuperator
- Air/Reactants exchangers
 - Oxygen T ~ 550°C
 - Gas T ~ 450°C
- ALGLASS SUN burner



- **HeatOx** 20 to 25% fuel saving is validated with **two** float glass tanks.
 - Burner ALGLASS SUN HeatOx
 - Parallel hot air flow distribution & 2 secondary HX per burner

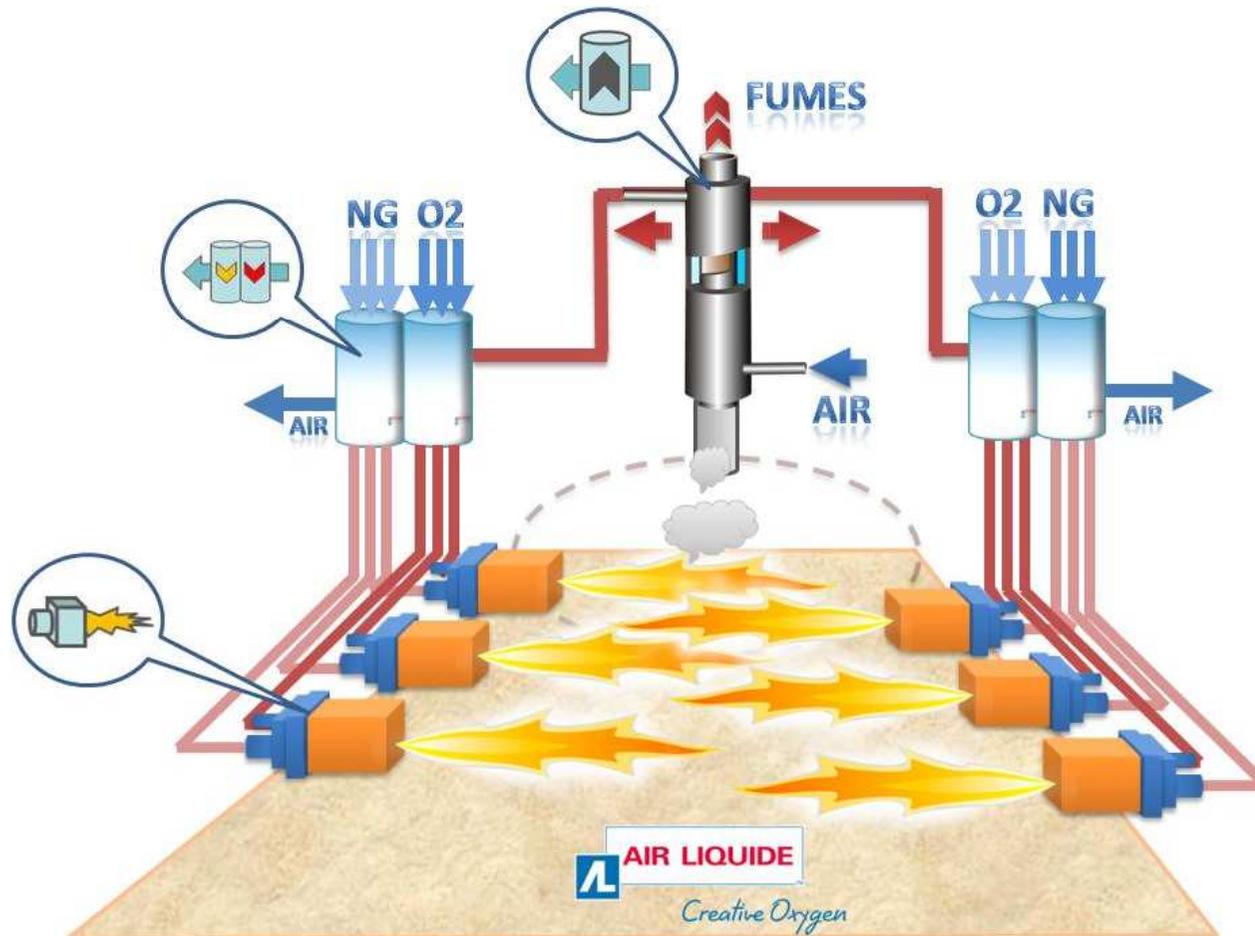
HeatOx process versus Air-fired furnace

- Performance of **HeatOx** versus state of the art air-fired furnace on **650 tpd** float furnace (AGC)
 - Energy consumption - 25%
 - CO2 emission - 15%
 - * *Taking into account CO2 emission from oxygen production*
 - NOx emission - 83%
 - SOx emission - 38%
- No effect on other Furnace performances
 - Batch and foam behavior
 - Crown temperatures
 - Glass quality
 - Furnace refractory
 - Flue gases

ALGLASS HeatOx for small-medium size furnaces

HeatOx tailored for mid-size furnaces (50-400tpd) as glass packaging or fiber furnace.

ALGLASS FC Burner managing cold & hot reactants
Heat exchangers which could feed multiple burners independently



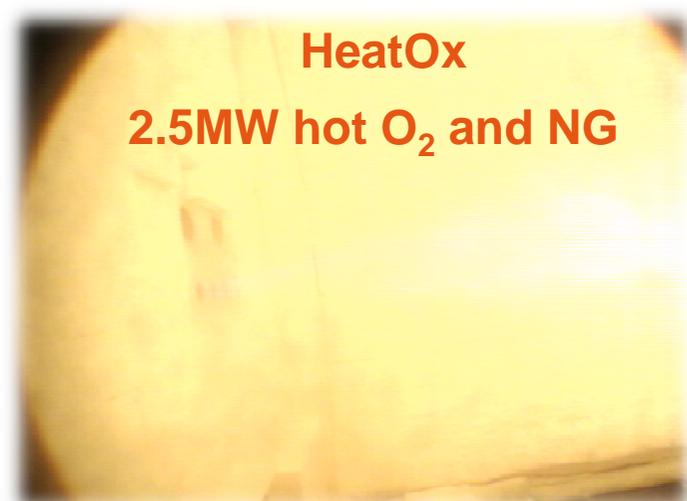
New HeatOX

- **New Patented AL Technology:** Oxygen preheating in glass melting for small/medium furnaces
 - One heat exchanger (O₂/NG) can accommodate multiple burners (patent pending)
 - Flowrate and temperature can be controlled individually (patent pending).
 - CAPEX savings and smaller footprint
 - New ALGLASS FC burner for preheated reactant (patent pending)

ALGLASS HeatOx for small-medium size furnaces

ALGLASS™ HeatOx burner

- Compact and operable with **hot Oxygen** and **hot Natural gas**
- Automatic setting from cold to hot reactants (*patent pending*)
- Could be operated with Hot Air back up
- Constant flame length & shape (~3m)
- NOx identical in ColdOx and HeatOx



From 500kW to 4MW - NOx emissions : 0.3kg / t glass

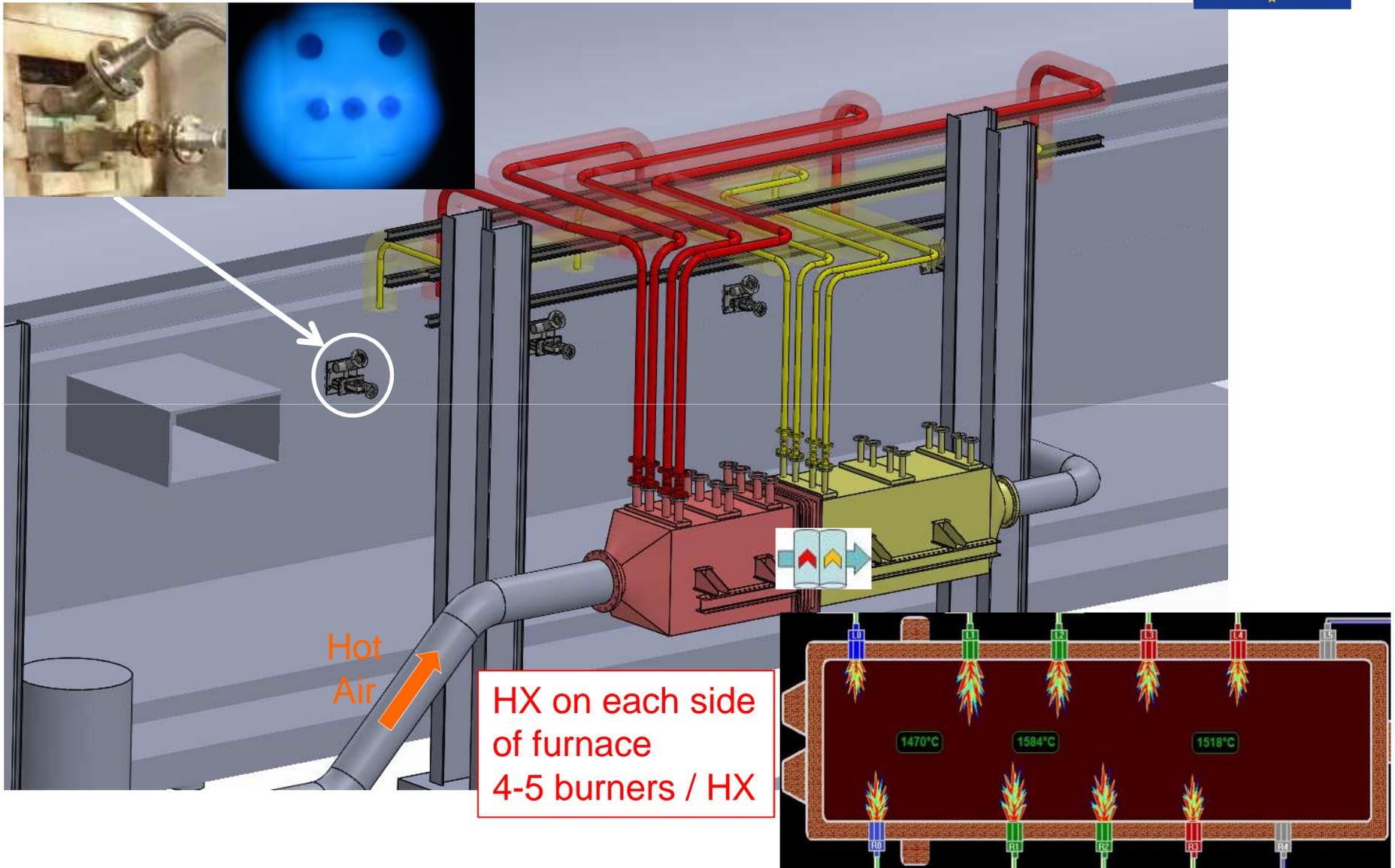
LIFE+ Eco-HeatOx ŞIŞECAM



- LIFE+ Eco-HeatOx a project granted by LIFE European commission
- **Demonstration** of the operation of a full **industrial** facility with the new **Burner** and **Heat Exchanger** at Trakya plant Bulgaria
- Process benefit targets
 - Reduction of GHG emissions linked to tableware glass production: **20% less CO2 and 90% less NOX**
 - Increase of thermal efficiency in tableware glass plants: **20%**
- Status of project
 - Start-up of furnace (ColdOx) in 2014
 - Detailed design of HeatOx process & heat exchangers done
 - Manufacturing of equipment on-going
 - HeatOx FC burner already in operation with cold reactant
 - Installation on-fly and start-up in Sept 2015



LIFE+ HeatOx ŞIŞECAM : Implantation



Customer benefits

1. Reduction in energy costs:
 - Electric boosting for glass melting, Fuel and Oxygen
2. Flexible energy sourcing
3. Limited additional CAPEX with less than 3 year payback
4. Compliance with new environmental regulations
5. Reliable suppliers capable of offering complete solutions
6. Energy performance commitment

Thank you

Please visit our website : www.ecoheatox.com

The screenshot shows the Eco-Heatox website interface. At the top left are the logos for AIR LIQUIDE and ŞİŞECAM. To the right are search and language selection options. Below the logos is a navigation bar with 'Partners' and 'Technology' links. A blue sidebar on the right lists 'SISECAM' and 'Air Liquide' with their respective website URLs. The main content area is titled 'Welcome to Eco-Heatox' and contains a paragraph about the project's funding by the LIFE European Commission, followed by a list of challenges and a description of the technology. A 'Contact' section is visible at the bottom left of the main content area.

Information ...

Eco-heatox

Project funded by European commission for helping industry to reduce its environmental footprint.

Life

Contact

Welcome to Eco-Heatox :

A project granted by LIFE European commission aiming at demonstrating at industrial scale the environmental benefits of an R&D innovation.

For making glass, two primary materials are necessary : sand and energy. In Europe, tableware and container glass factories are facing two challenges :

- decreasing energy consumption to be more competitive
- reducing greenhouse gas emissions

Traditionally, energy is provided by burning natural gas with air to get a temperature that is able to transform sand into hot glass ready to be moulded. Oxycombustion that uses pure oxygen instead of air (only 21% oxygen) is a proven efficient way to reduce fuel consumption and therefore to lower production costs.

LIFE Eco-Heatox project goes one-step beyond as it uses a part of the fumes heat of the oxycombustion in order to preheat natural gas and oxygen at 450°C. This energy recovery reduces again natural gas consumption and greenhouse gas emissions.