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Conference

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**Glass technology session
23rd Septembre 2014**

Flat glass furnace operating with preheated oxygen and natural gas

AGC Europe R&D center , Gosselies

AGC Flat Glass Czech, Řetenice



AGC Glass Europe

Outline

- Economical context of flat glass sector in EU
- Past and present efforts to reduce energy consumptions and emissions
- New possibilities for float furnaces : flat glass furnace operating with preheated oxygen and natural gas
- Conclusions

Economical context

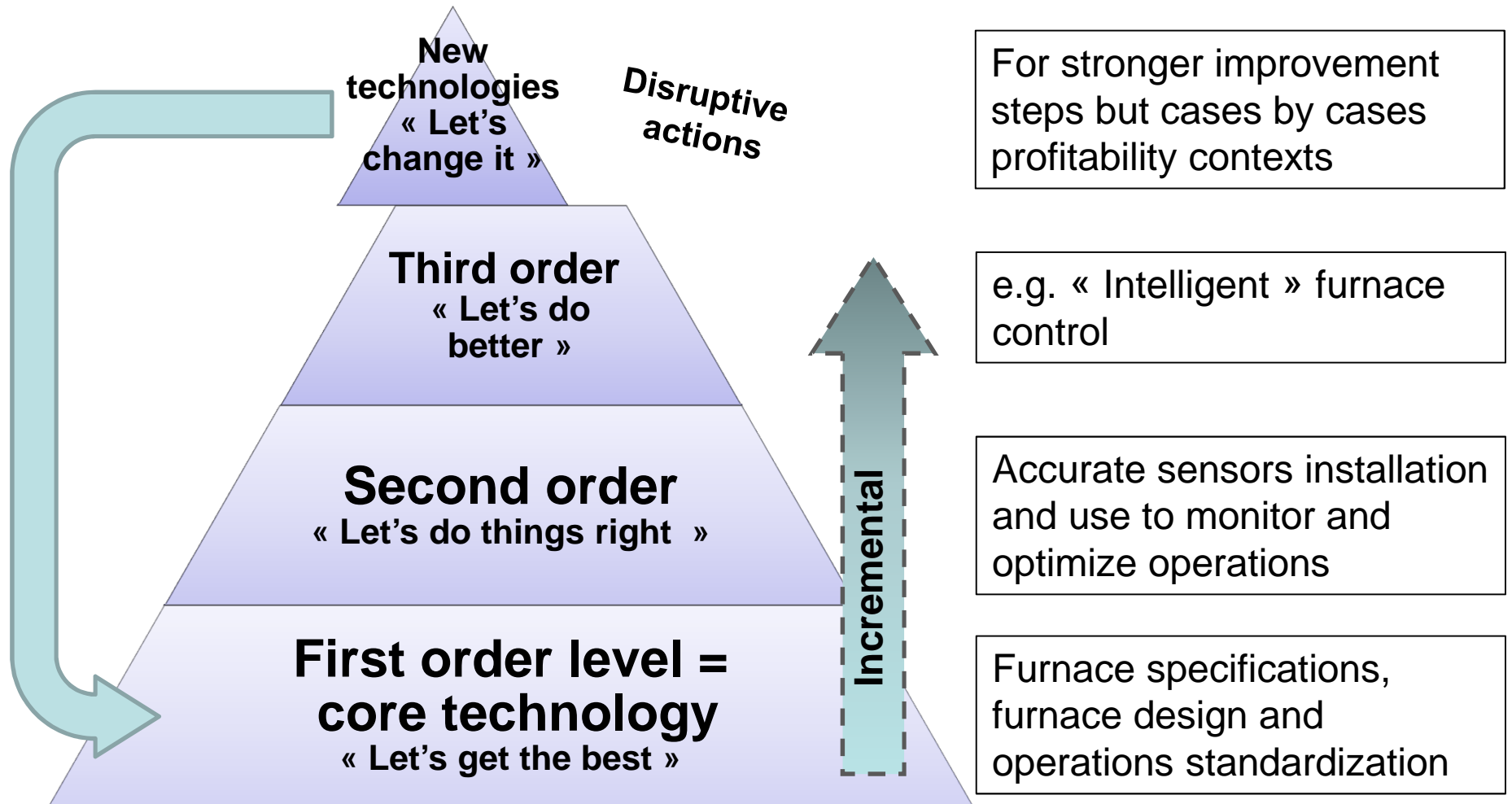
- Flat glass business in Europe is in over-capacity
- Low selling prices (from NW-EU to Russia) for commodities and specialities to some extends
- Adaptation of production capacities to match demand
- Huge pressure to reduce costs :
 - Raw materials
 - FTE
 - Investments
 - **ENERGY**

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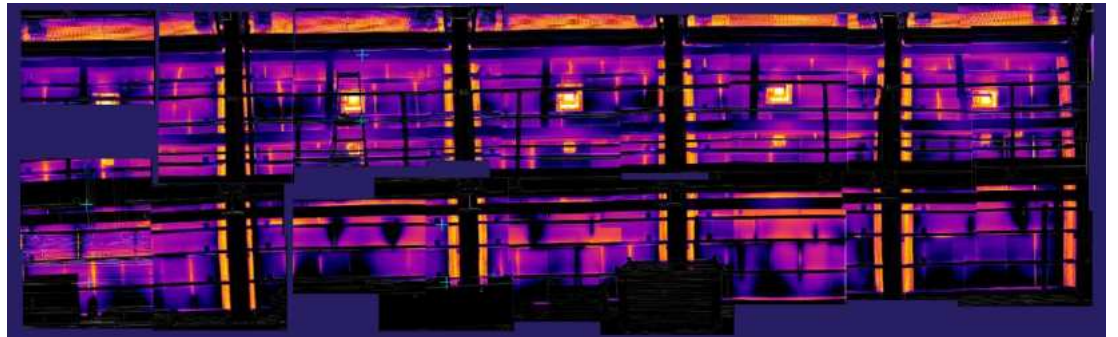
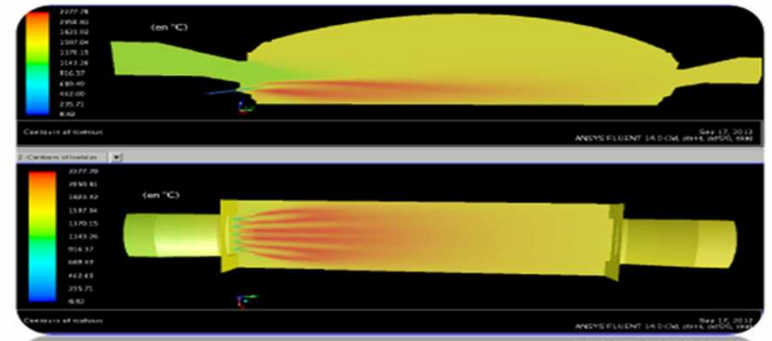
Overview of actions

Classification in 4 main categories



First order actions: Let's get the best

- Extensive use of CFD and DOE for furnace design glass melt, regenerators, color changes, tin bath, lehr,...
- Heat balances of furnaces and on-site validations of trials → Comparison of furnace performances during life-time and with others
- Standardization and/or evolution of design (checkers, port neck dimensions,...)
- Standardization of equipments (burners, waist coolers, bubblers,...)
- Standardization of practices (fire distribution, cooling,...)
- At least, better understanding of basic phenomena and guidelines to follow (or not to follow)



Second order actions: Let's do thing right

- ▶ We need sensors/metering BUT good ones
 - ▶ Ex. O₂ sensors



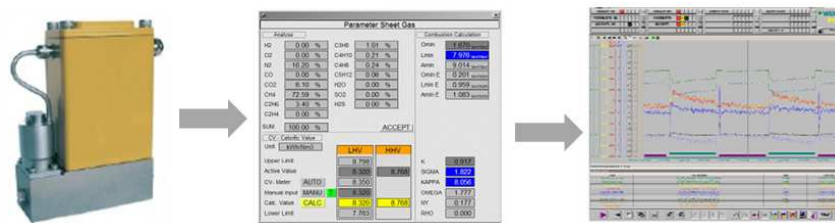
Continuous O₂ measurement in waste gases enables to optimize combustion

1% O₂ reduction if too oxydizing conditions can save 1,5% energy

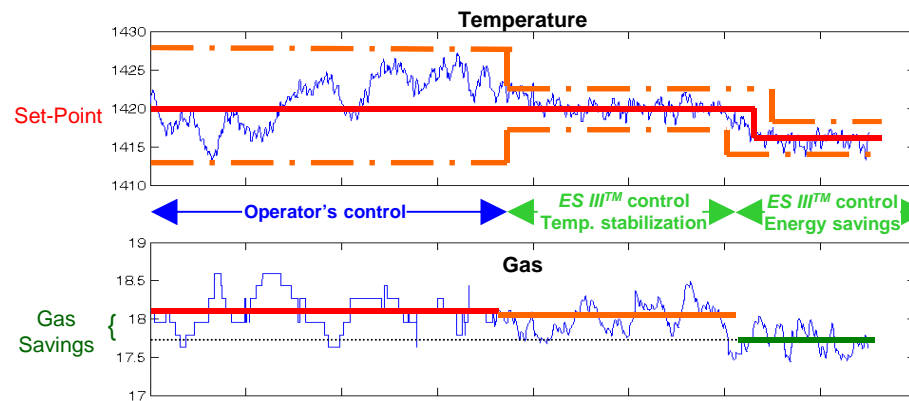
- ▶ Having sensors is a first thing, a second one is optimizing the process and operators training/education

Third order actions : Let's do better

- In some plants huge variation of gas composition (then calorific power and Wobbe index) leading to process instabilities (energy and quality) → control of gas calorific value and air/gas ratio with on-line chromatograph and O₂ sensors



- Expert systems to stabilize crown & bottom furnace temperatures, glass level & canal temperature



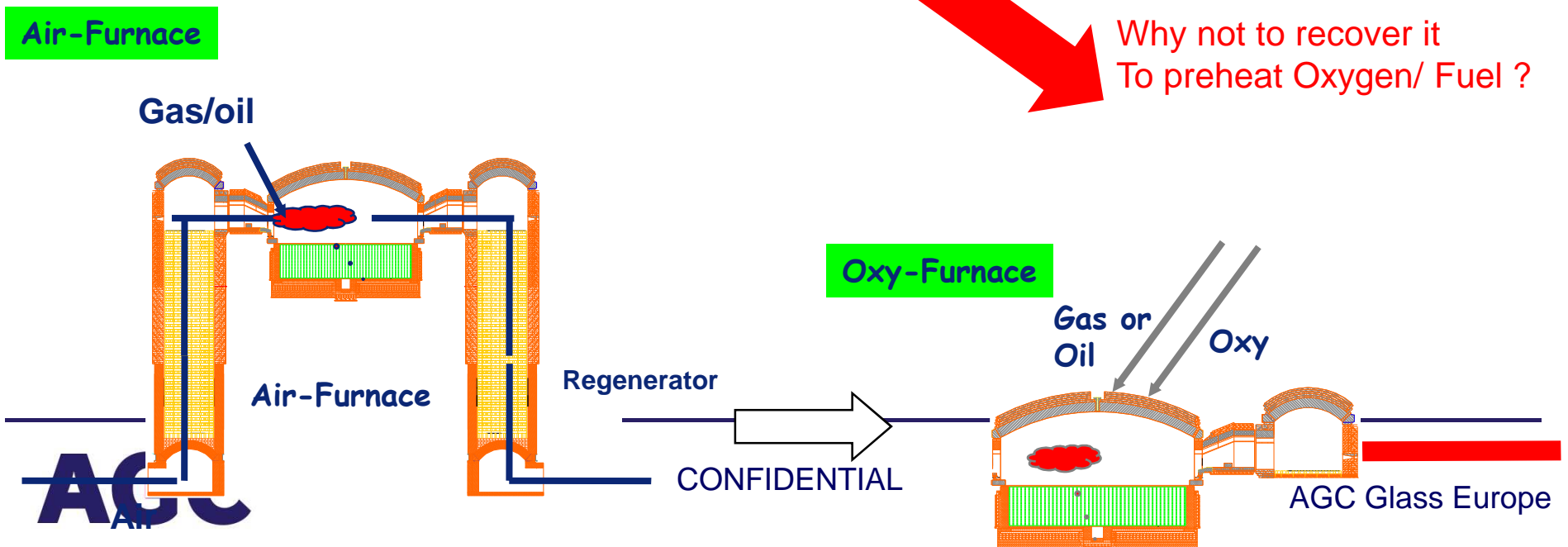
Energy use trend in flat glass sector

- Thanks to combine effect of actions we see over time big improvement of energy consumption to produce glass nevertheless....



New technologies : Let's change it

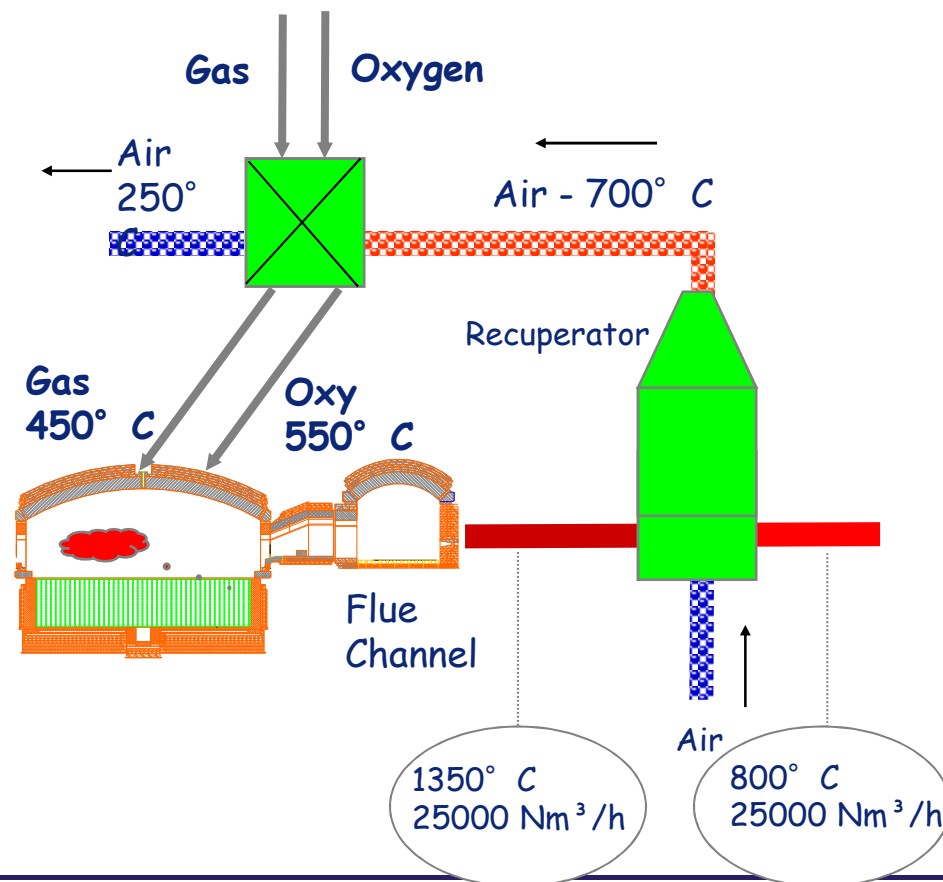
- ▶ AGEU investigated oxycombustion for flat glass process as a breakthrough technology to
 - ▶ Decrease Nox
 - ▶ Decrease energy consumption
 - ▶ Decrease investment (no regenerators)
 - ▶ Increase stability of production (no reversal time) → improve quality
- ▶ Nevertheless the only use of cold oxygen in stead of air as oxidizer
 - ▶ showed a negative profitability
 - ▶ Generated huge lost of energy in waste fumes



New technologies : Let's change it

From Cold oxy to Hot oxy * : Principle :

- Energy of waste fumes is used to preheat air
- Preheated air is used to heat oxygen to 550°C and gas to 450°C



New technologies : Let's change it

- ▶ Hot oxygen combustion technology has to be validated on a real furnace for flat glass production

- ▶ Two steps project

 - ▶ 1st step* : furnace started in 2008 - France

Hybrid fuel : natural gas and heavy oil as combustible

Architectural clear glass

- Check of furnace design , refractories and burners choice
- Check of material choice, clogging impact and efficiency of energy recovery equipment
- Check of safety equipments
- Check of furnace operation regarding foam, crown temperatures and glass quality
- Check of environmental and energetical interest

New technologies : Let's change it

► Hot oxygen combustion technology has to be validated on a real furnace for flat glass production

► Two steps

► 2nd step : furnace started April 2014 – Czech Republic

100 % natural gas as combustible

Automotive colored glass

New challenges are, for each color produced, from lighter to darker one

- Management of foam
- Optimization of furnace operation (crown temperature, burners, fire curve, ...)
- Reach good glass quality with higher level of requirement for automotive
- Reach energy and environmental theoretical expectation

NOX: - 79.2% ; SOX: - 34.5% ; Energy : - 19.7% vs Air/Gas furnace

Conclusions

- In flat glass industry , disruptive technology is necessary to reach bigger decrease of energy consumption and GHG emission
- After more than 10 years R&D study, AGEU industrialized hot oxygen combustion developed in collaboration with Air Liquide
- The new technology had to be validated for all kind of glass and customer
- In april 2014, the second furnace in AGEU using hotox technology has been started with new challenges to face
- After 4 months running, it is too early to conclude on final results because a lot of optimizing action need to be implemented . Nevertheless first glass has been provided with customer satisfaction.



Thank you very much for your attention



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