



87th GLASS PROBLEMS CONFERENCE

2026



200 YEARS OF INDUSTRIAL REVOLUTIONS

As an industrial engineering group with multi-sector expertise, **including glass**, Fives has been designing **breakthrough technologies and solutions** for more than 200 years.

MAIN ACTIVITIES



High Precision Machines



Smart Automation Solutions



Process Industries



Transversal Activities



GLASS MARKETS



Bottles and Jars



Tableware and Crystal



Cosmetics and Pharma



Glass Fibers



Float Glass



Solar Glass

ENERGY-EFFICIENT GLASS MELTING

Fives is a recognized leader in **decarbonized glass melting technology**. Our range of **Prium® melting technology** ensures the right solution for **any glass production and heat source**



All-electric



Hybrid



Oxy-fuel



Regenerative



fives

LARGE SCALE HEAT RECOVERY AREA

News from a breakthrough hybrid furnace startup in 2026 for O-I

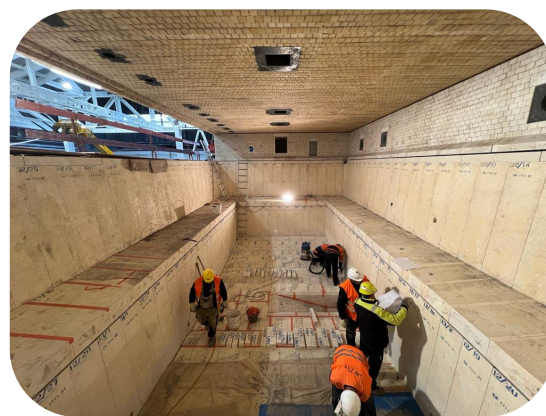
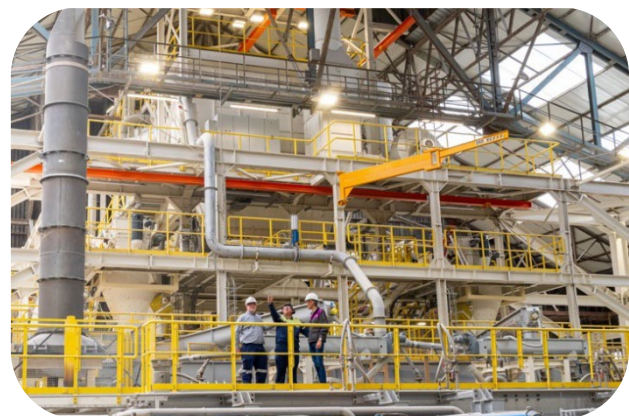
FLASHBACK ON CTVM – 2024



Flint spirit bottles,
Brownfield, Cognac, SW France
Cold Top Vertical Melter (CTVM)

1st of its size 150 – 200 tpd

Quality from day one - Energy on target



Other CTVM



A NEW HYBRID: 2026 ECOFLEX



Heat Recovery Area



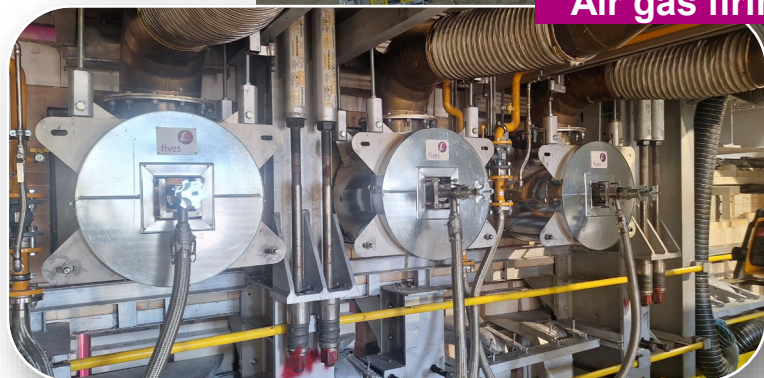
320 tpd flint spirit bottles



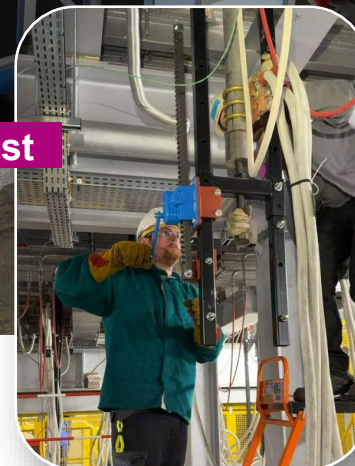
Recuperator



Air gas firing



30 - 70 % boost



2026 ECOFLEX BOOSTING SYSTEM

5 zones – 42 electrodes – clear access



In-house holder design
Proven on all electric

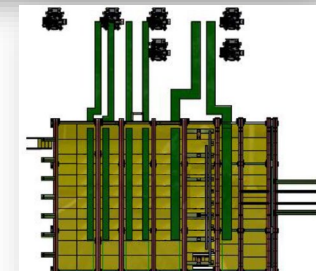


Electrode pushing
Improved tooling for faster operation



Power System
5 Continuous Variable Voltage Transformers

Busbar system
Minimizing losses



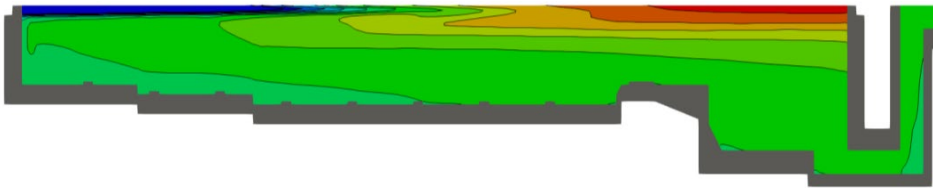
FLEXIBLE TANK DESIGN

☹️ Trier warns – CFD model confirms:

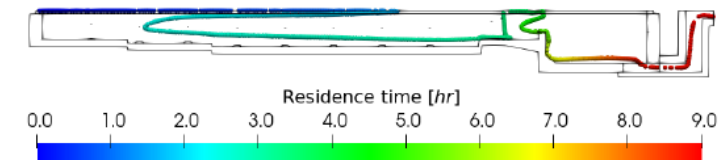
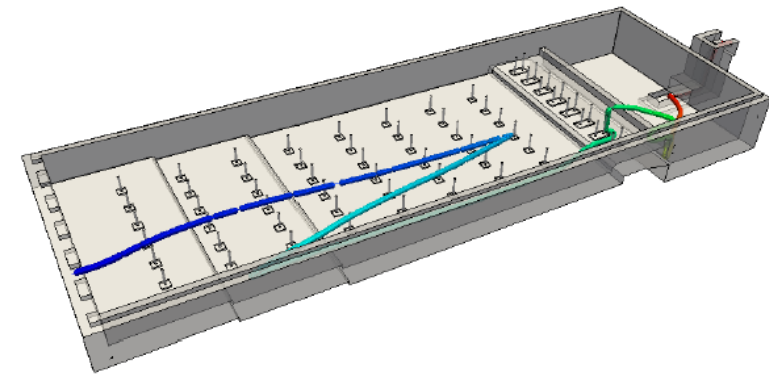
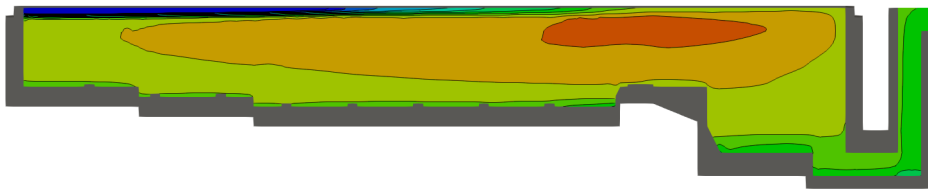
Ecoflex has a special tank geometry + boosting distribution

= adequate residence times & melting KPIS

Low boosting – clear hotspot on surface ✓



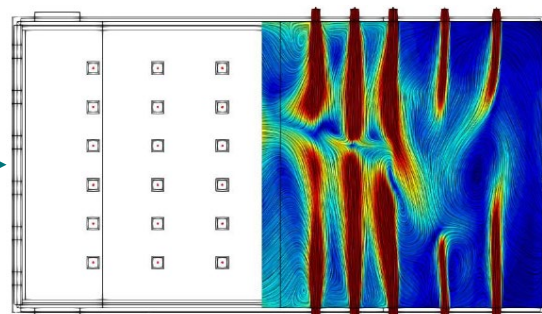
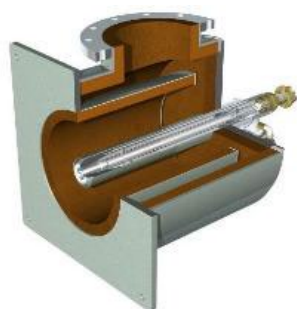
High boosting – hotspot below surface ⚠️



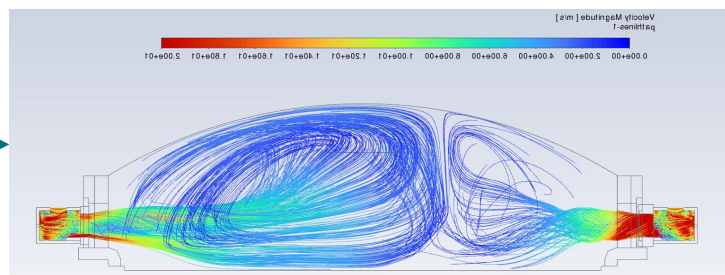
Source: Fives studies for F4F – 2020 – Dr W Kuhn – A Reynolds

IMPROVING AIR-GAS BURNERS

Standard air/gas burner



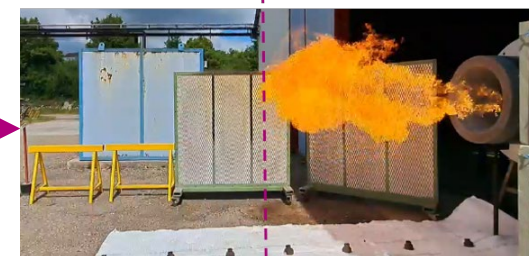
Flames are **not symmetric**, velocity is **high**, development is long and **unstable**, etc. creating **hotspot** on the glass surface and on the crown and particle volatiles in the combustion space



Fives Ecoflex air/gas burner

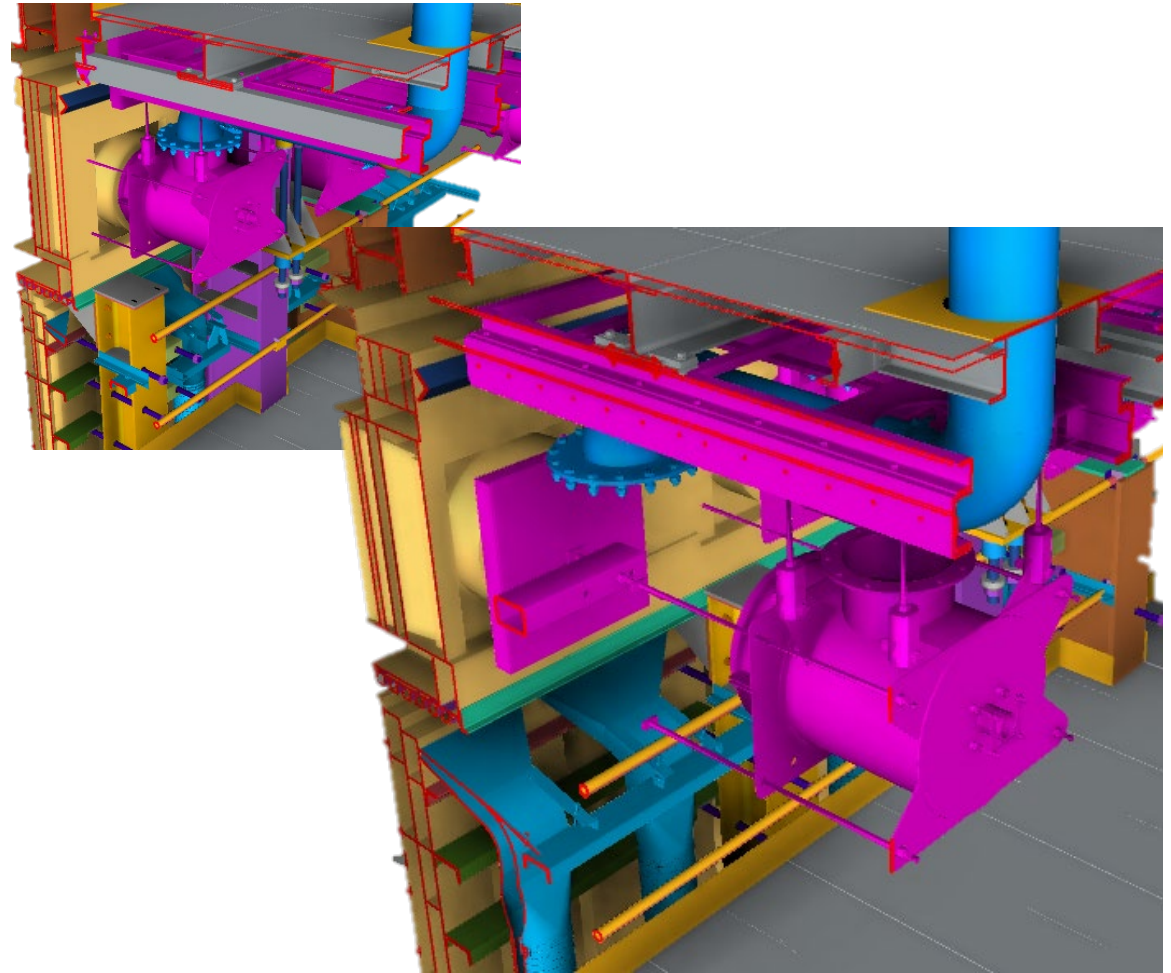
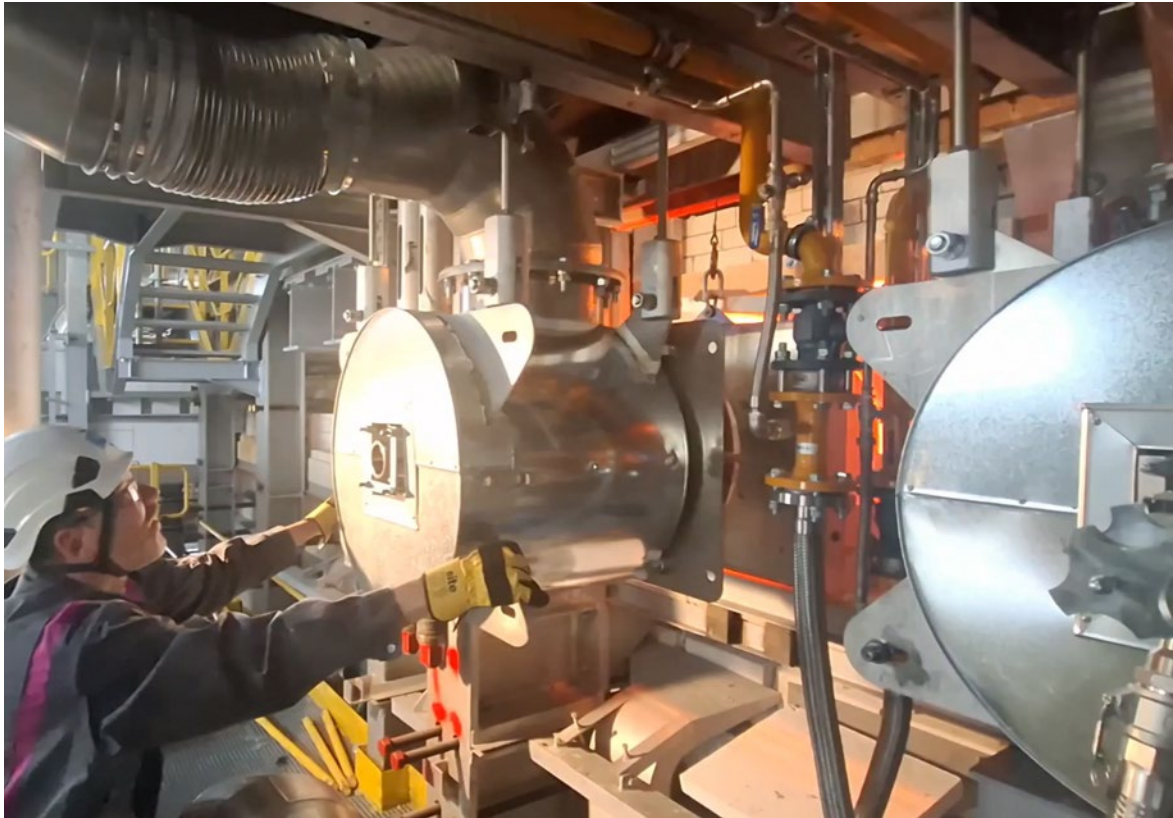


Significant difference in the pulse and length of the flue gas flow – at same power



Flames are **stable**, development is shorter with **no interference** between them with better heat transfer to the glass, etc.

BURNER FLEXIBILITY IN ACTION



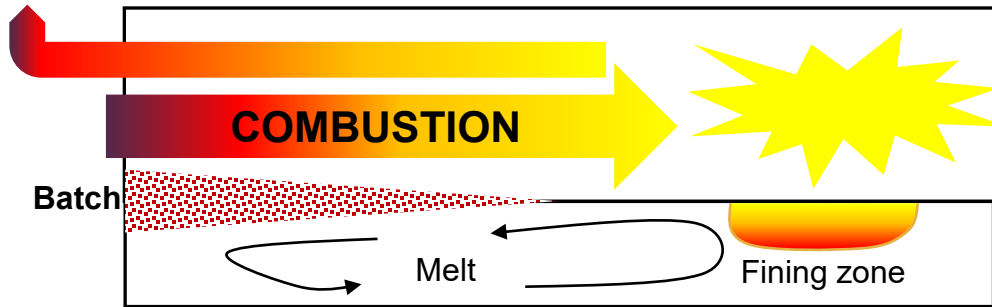


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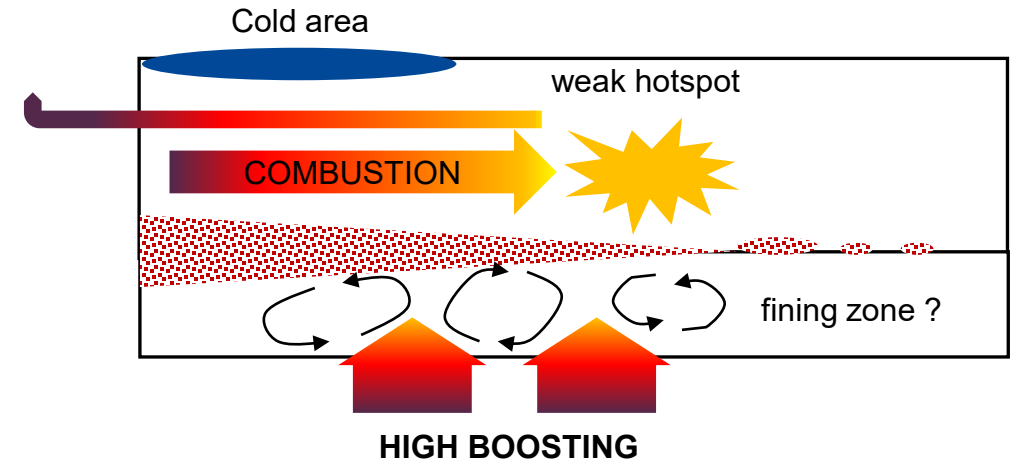
BUT WHY THIS HRA ?

LIMITS OF STANDARD FURNACES

END FIRED – LOW BOOST

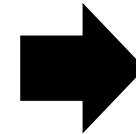


END FIRED – HIGH BOOST



Standard superstructure with high boosting result in:

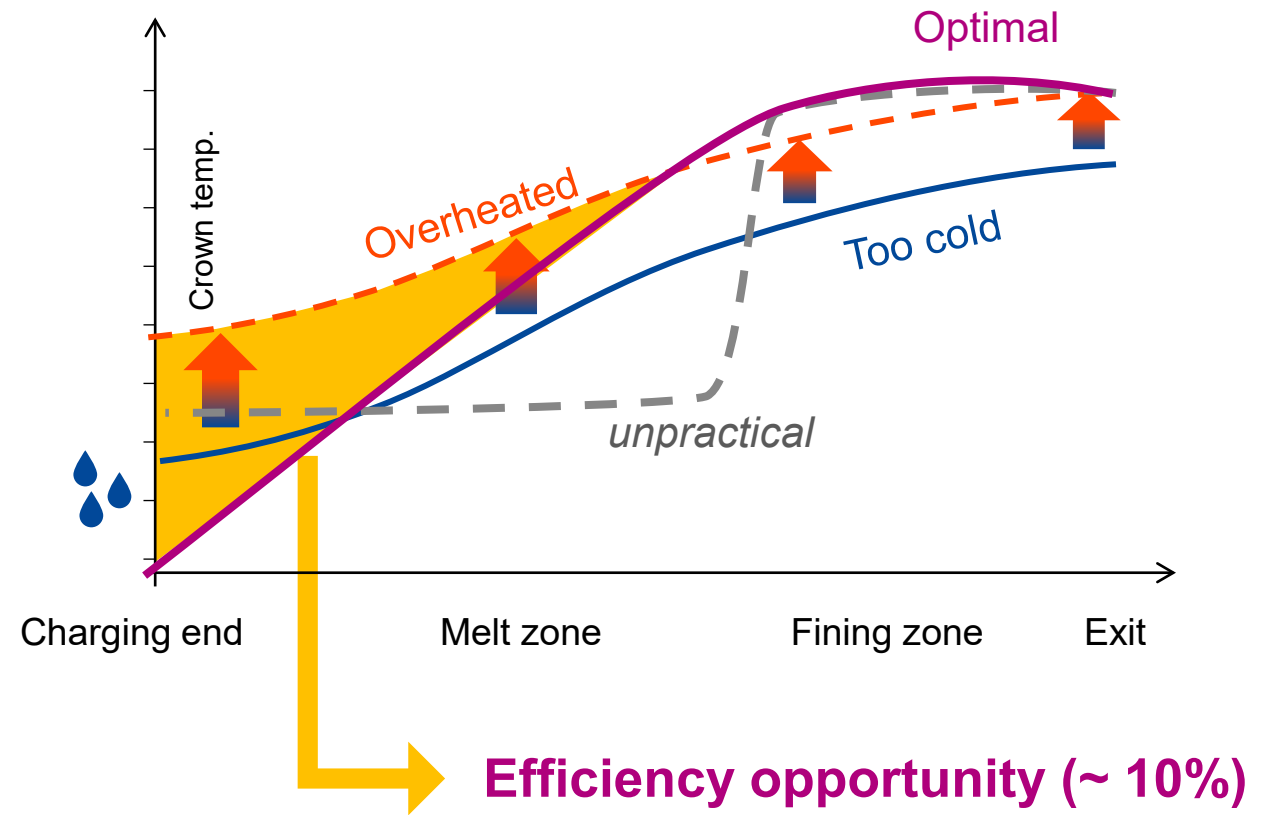
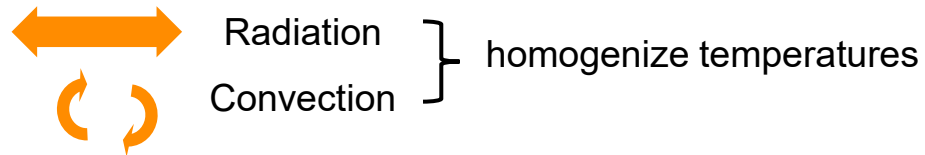
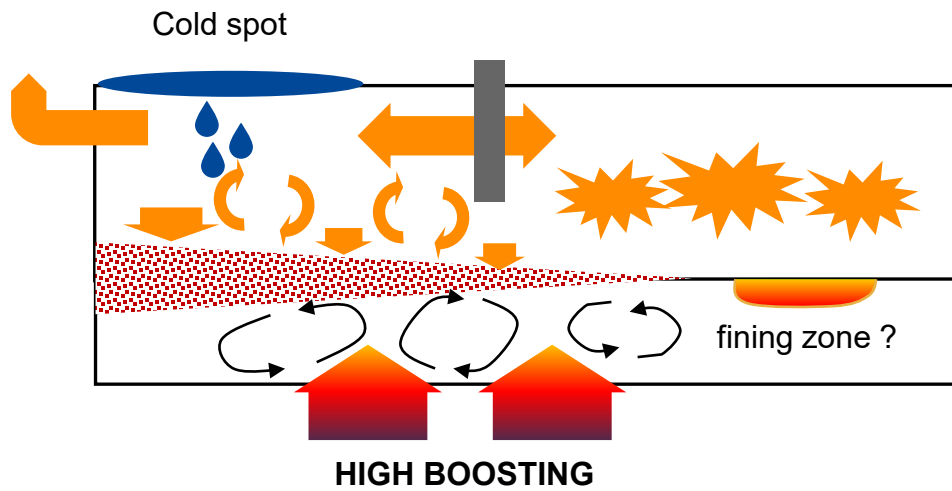
- Lower crown temperature – cold spot on charging side
- Longer batch blanket – risk on quality
- Weaker fining



- **Overheating to keep glass quality**
- **Low energy efficiency**
- **High Wear**

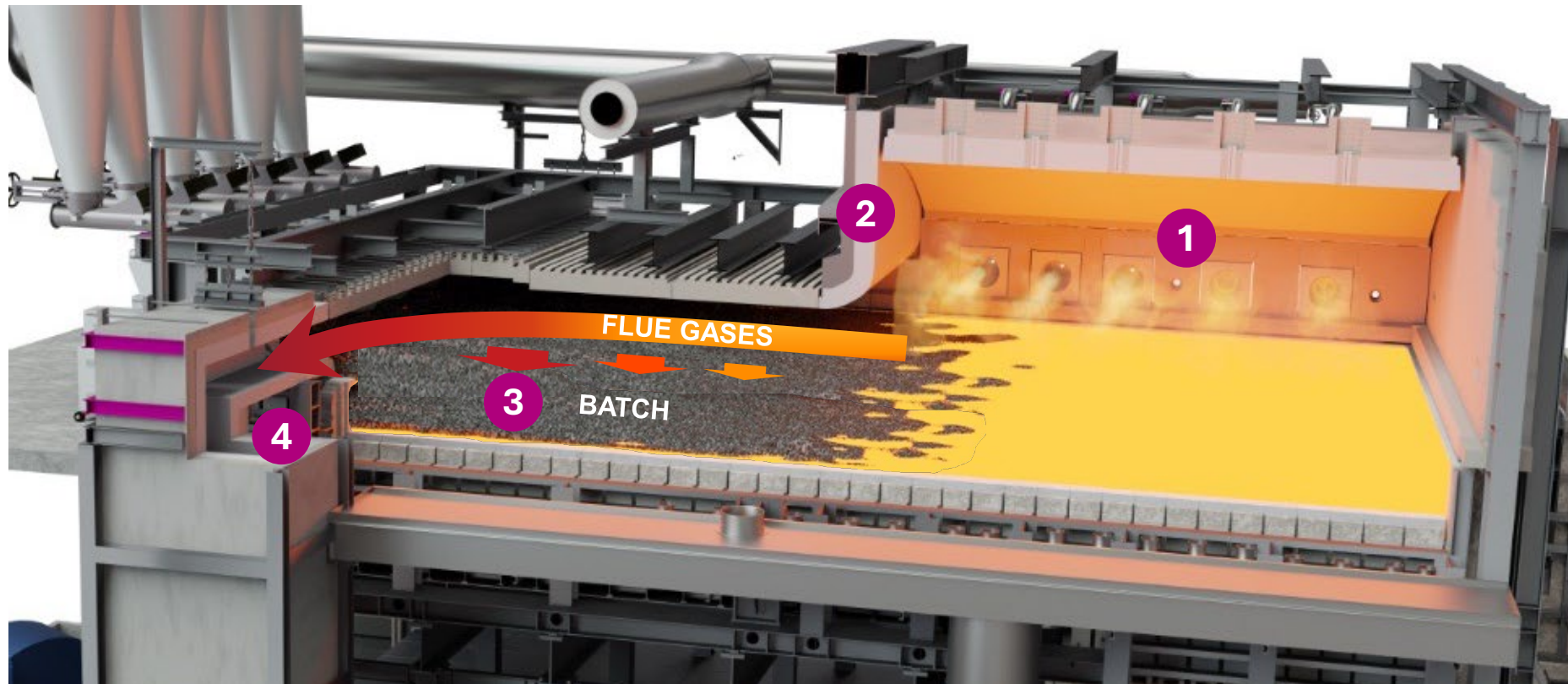
CROSS FIRING – THERMAL PROFILE HUNTING

CROSS FIRED – HIGH BOOST

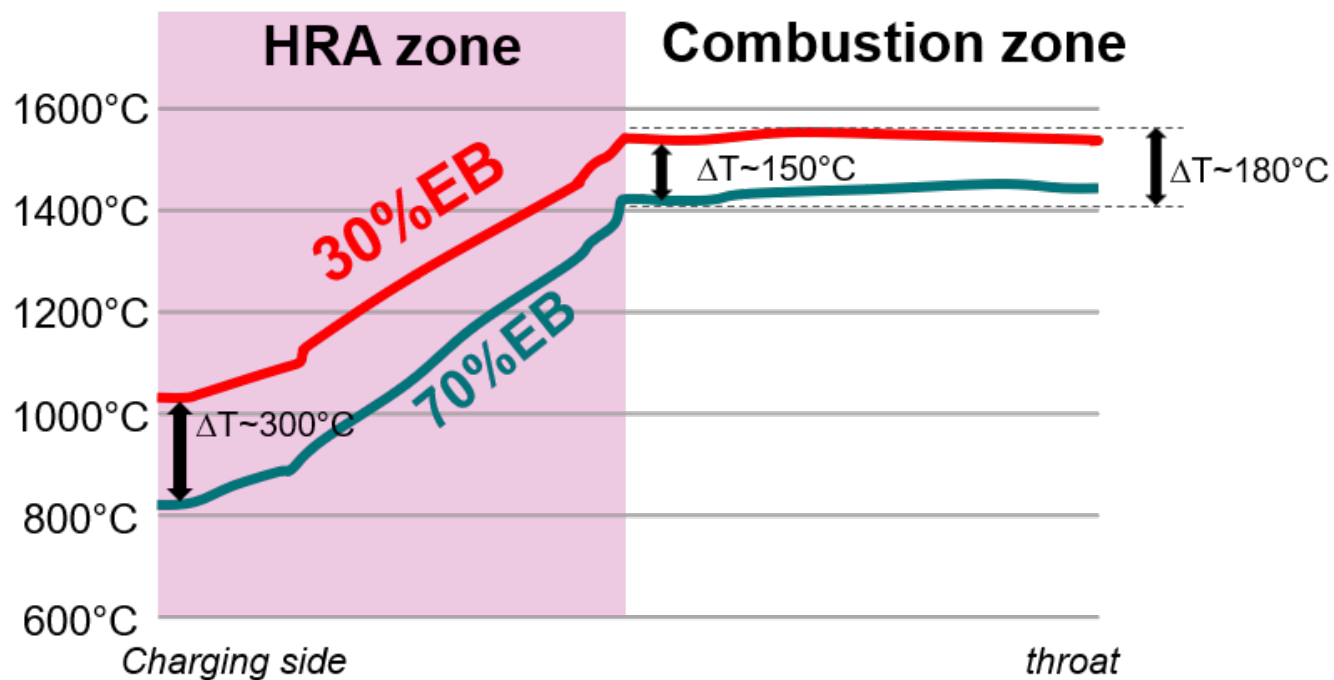


THE HEAT RECOVERY AREA (HRA) SOLUTION

- 1 Continuous side firing
- 2 Wall limits radiation leakage – clear hotspot
- 3 Flue gases under lowered flat roof – one way flow
- 4 Exhaust discharge on charging end – batch blanket preheating



SUPERSTRUCTURE TEMPERATURE SWINGS



HRA zone:

- gradient 800 - 1400°C
- swing 300°C

= Not OK for arched crown

Combustion zone:

- 1400°C, low gradient
- swing 150°C

= Silica crown ideal

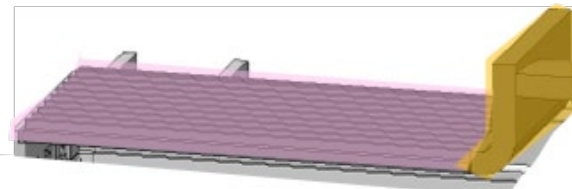


HRA CONSTRUCTION



Suspended interlocked bricks
Suspended wall with nose
Special steel supports
Contained expansion

FLAT ROOF



TRANSITION WALL





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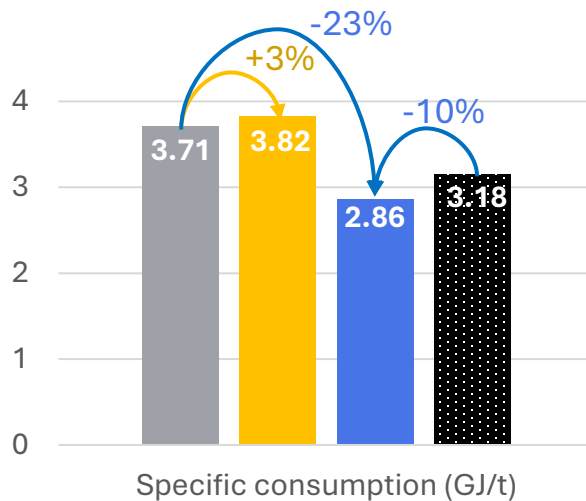
WHAT ABOUT US? LOW BOOST?

ALTERNATIVE: HRA FOR LOW BOOSTING

Conversion to HRA can also bring **10% energy efficiency** in different cases:

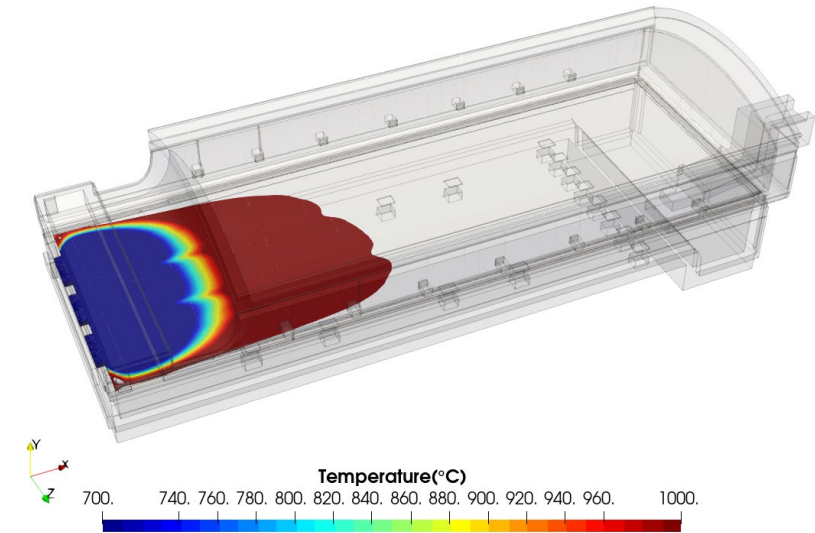
1. **Oxy-Gas to Oxy-Gas + HRA** = even without boosting
- 2 **Cross Fired Regen. to HRA / Air with 10 % Boost** (considering the aging factor)
3. **End-fired regenerative to HRA / Air with ~25 % boost**

- Base case (new)
- HRA + aero
- HRA + oxy
- oxy (without HRA)



consider ageing

420TPD, dark green, 10%EB

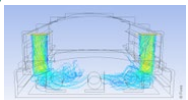


	Aging/year
Regenerative	~1.3%
Recuperative	~0.6%
Oxy	~0.5%

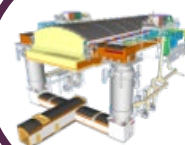
HRA REVOLUTION – 45 YEARS OF INNOVATION

Extended H.R.A.™
Hybrid development

2018



Prium® Eco-Flex
20-80% e-boosting



2018

Prium® Oxy-Melt
with L.E.M.® technology

Oxy-gas furnace with
40% e-boosting & H.R.A.™

2015



Heat Recovery Area
(H.R.A.™)

2010s



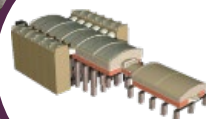
E-melters
Super e-boosting

1980s



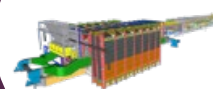
1989

Prium® Float-Melt
regenerative furnace



1995

Prium® Float-Melt
with L.E.M.® technology



CONTAINER GLASS
TECHNOLOGY DEVELOPMENT

FLAT GLASS
TECHNOLOGY DEVELOPMENT



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Industry can do it