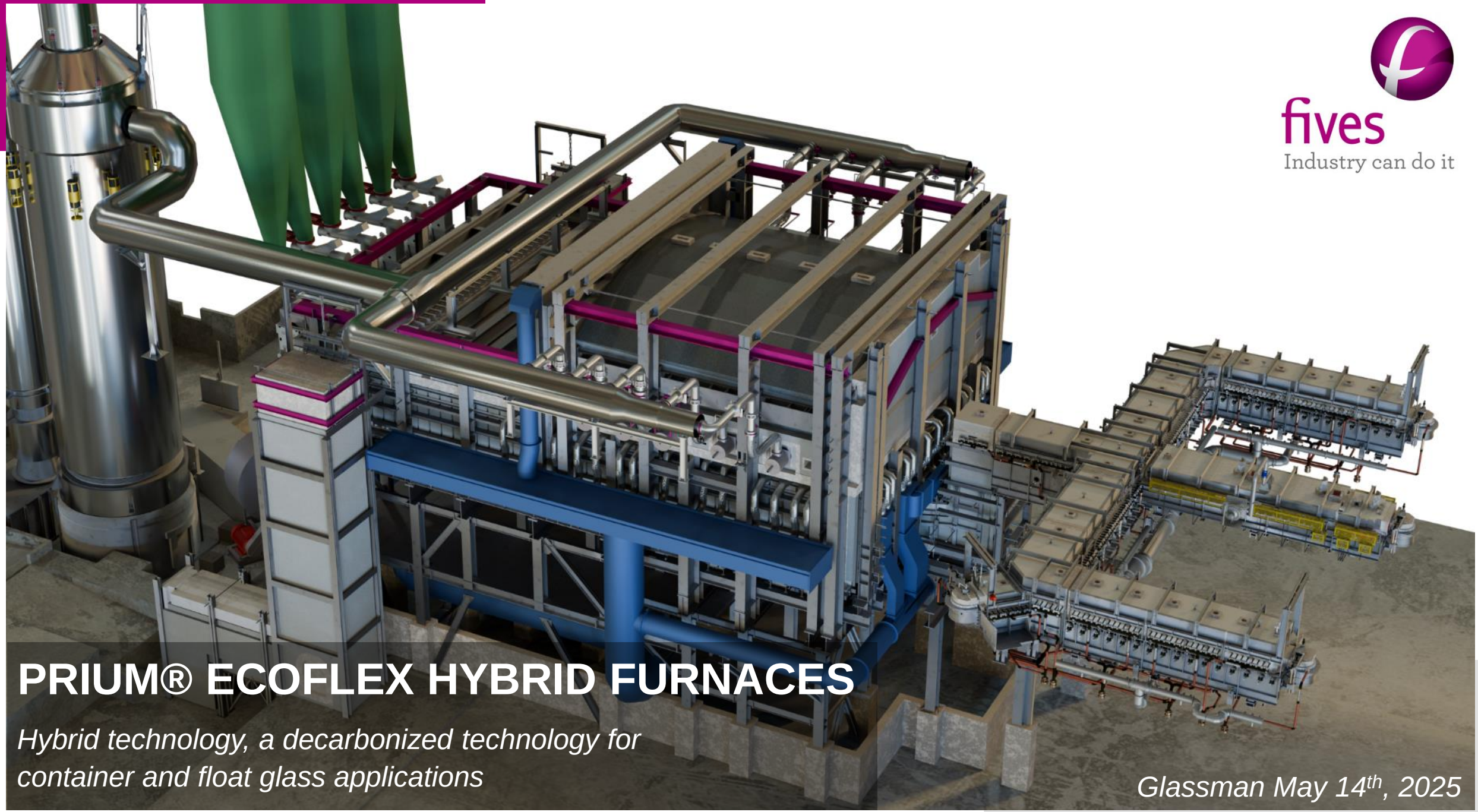


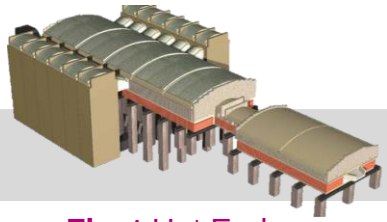
PRIUM® ECOFLEX HYBRID FURNACES

Hybrid technology, a decarbonized technology for container and float glass applications

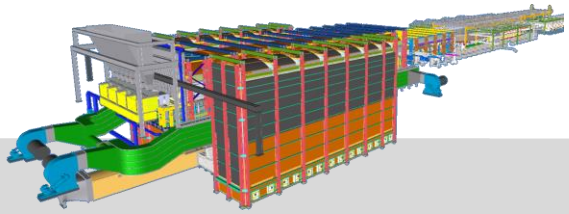
Glassman May 14th, 2025

FIVES HYBRID FURNACES: 45+ YEARS OF INNOVATION

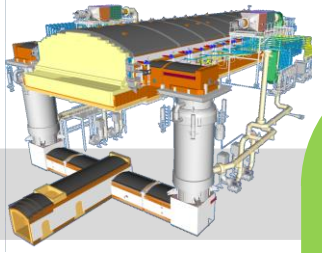
1989



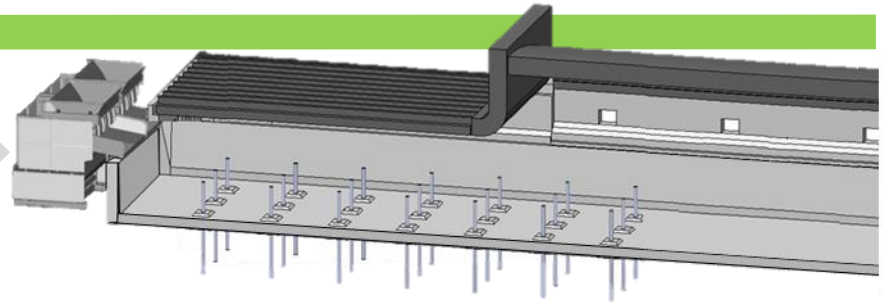
Float Hot End
Regenerative 350 to 1000 tpd
25 lines in the last 25 years



Prium® Float L.E.M
Low Energy Melters

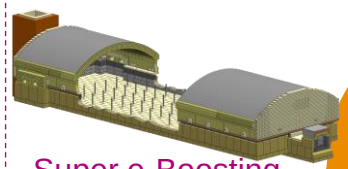


Prium® Oxygas Float L.E.M



Prium® Ecoflex Float L.E.M
20 – 70% E-Boosting

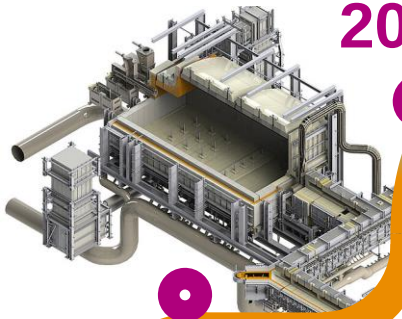
1980+



Super e-Boosting

e-Melters

2010+
Heat Recovery Area (HRA) V1 :
Recovering of energy lowering the crown in the batch area



1st oxy/gas cross-fired 40% E-Boosting & HRA
2015

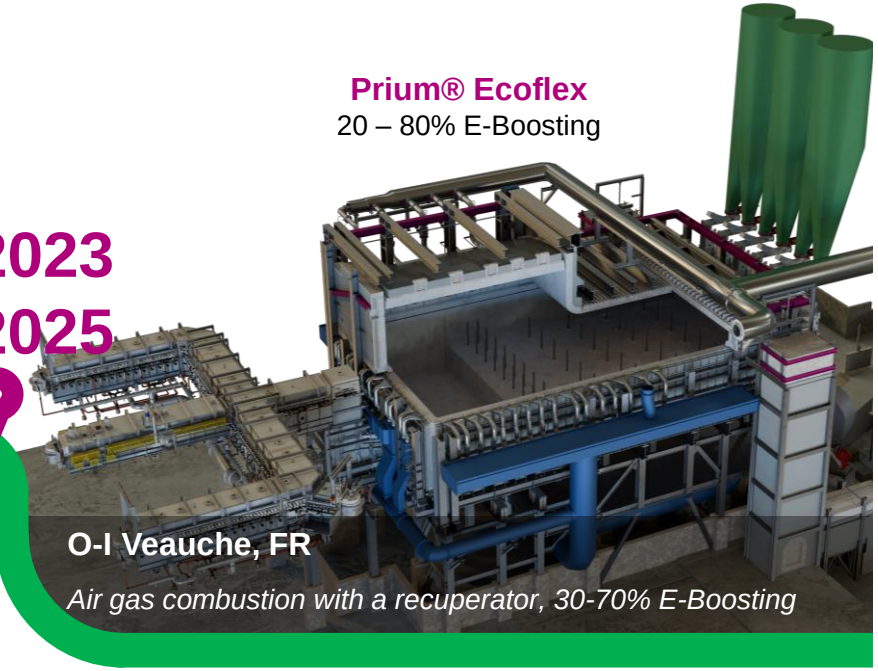
2018

Extended HRA V2
Further R&D shown that the HRA is the perfect complementary design feature for high EB furnace

2018 to 2021
Development of hybrid

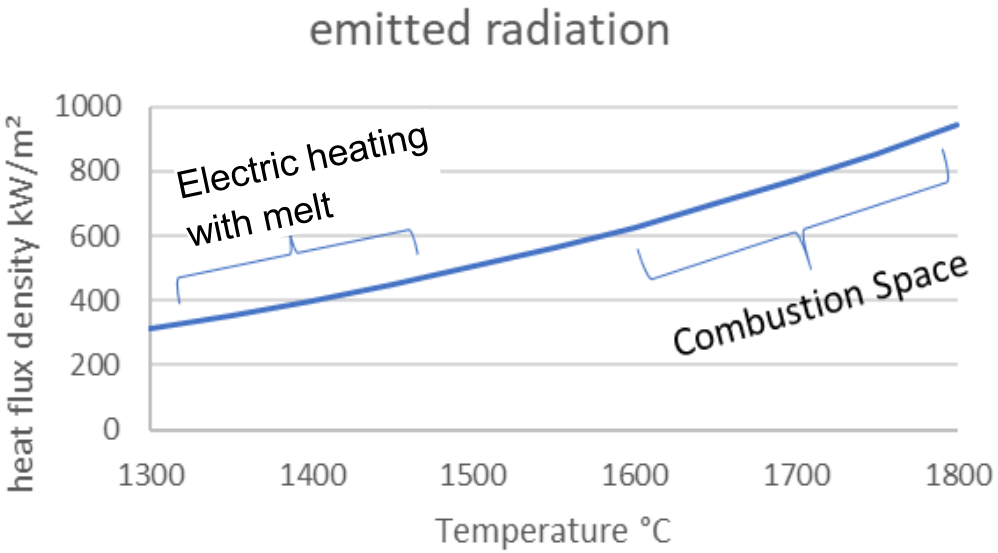
2023 to 2025

Prium® Ecoflex
20 – 80% E-Boosting



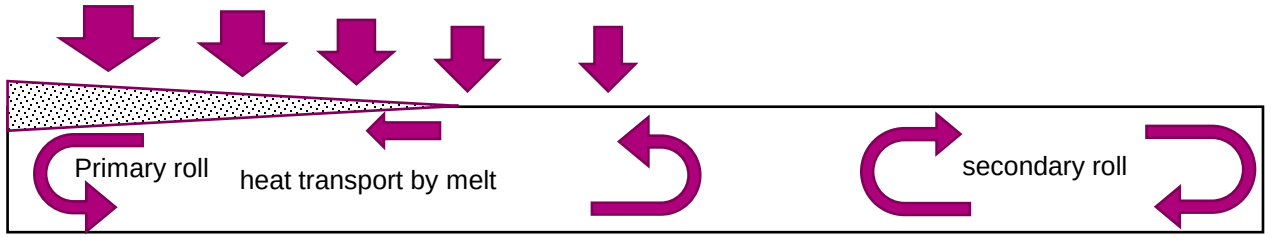
O-I Veauche, FR
Air gas combustion with a recuperator, 30-70% E-Boosting

FUNDAMENTAL CHANGES IN HEAT TRANSFER



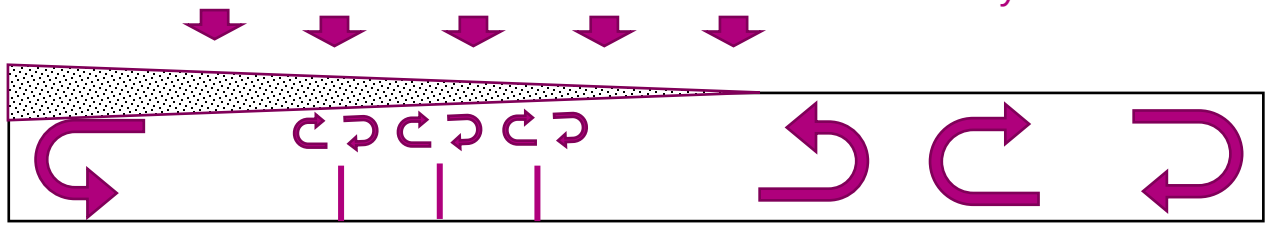
EB% = 0

Standard float tank



EB% = 70

Hybrid float tank



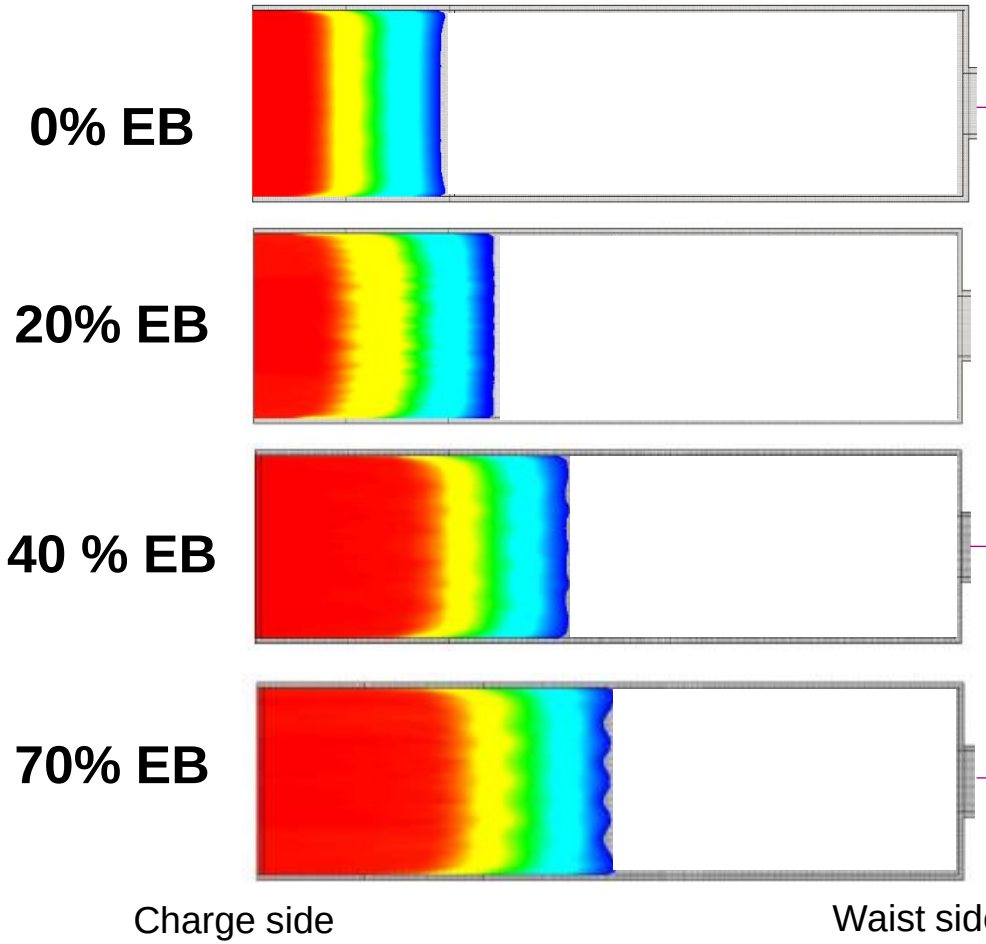
Expected Impacts:

- Longer Batch Blanket
- Lower temperature over batch
- Convection gets activated locally
- Impact on residence times

Confirmed by CFD and practical experience

MODELING STUDIES – HYBRID FLOAT EB% 0 TO 70 %

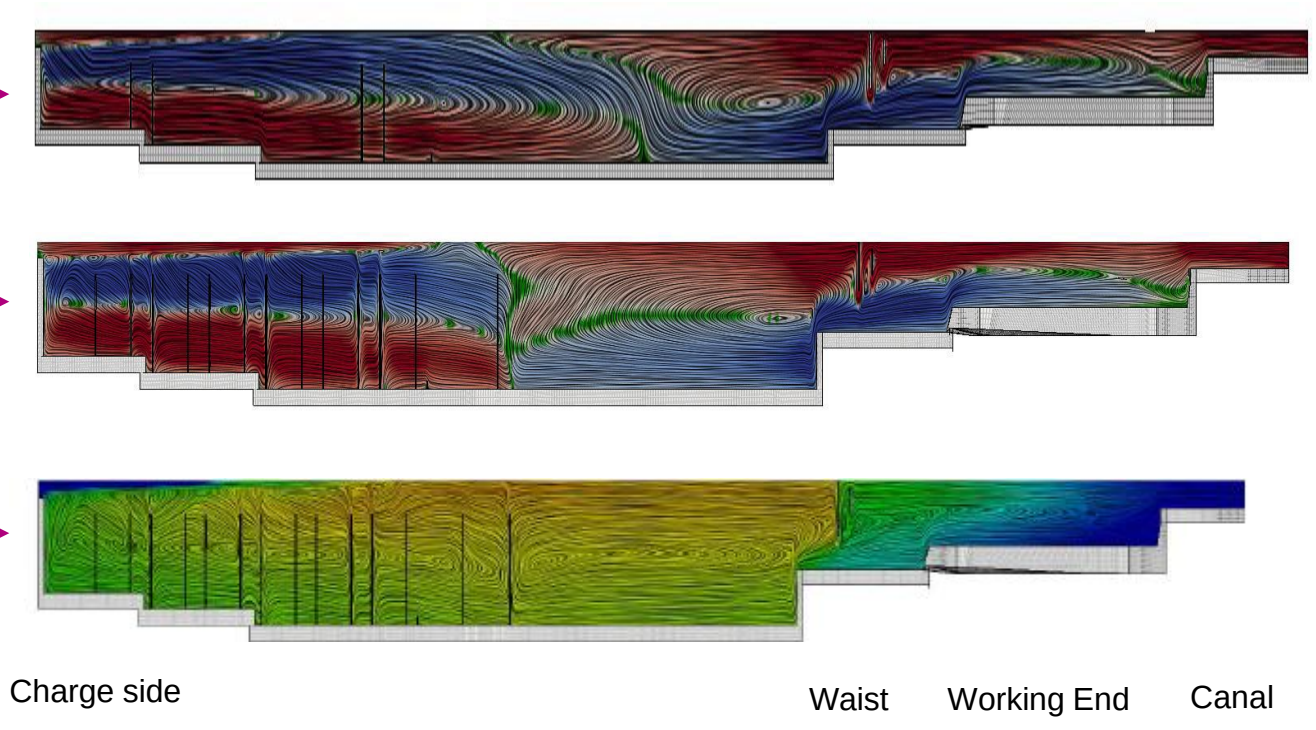
Batch blanket thickness – top view



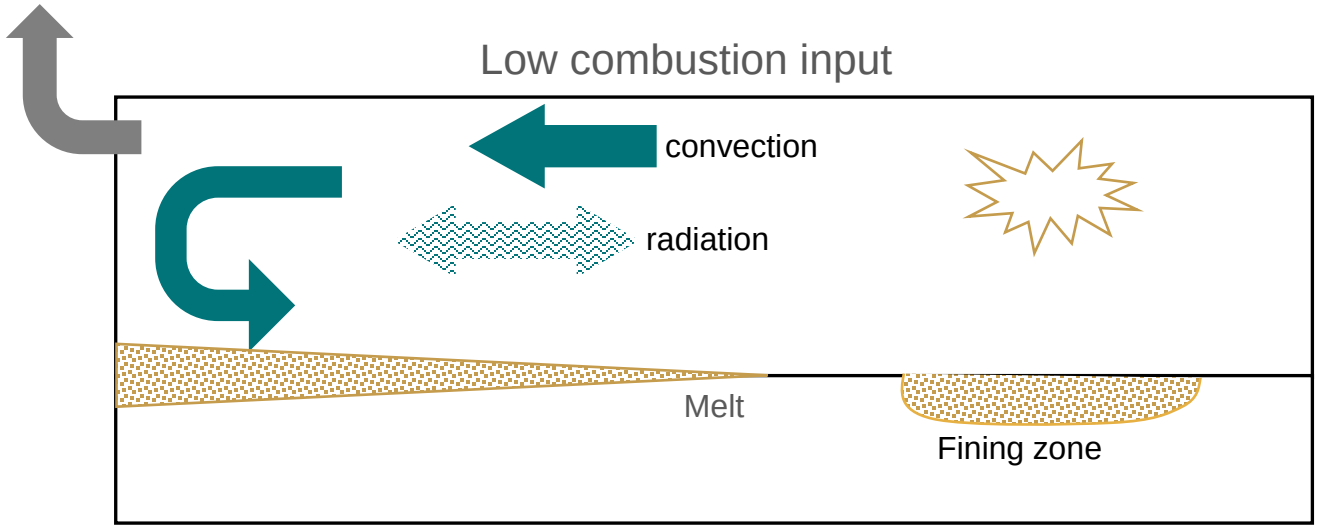
1 – Higher E% = longer blanket surface

2 – General flow pattern remains similar

3 – Bottom temperatures remain acceptable < 1400 °C



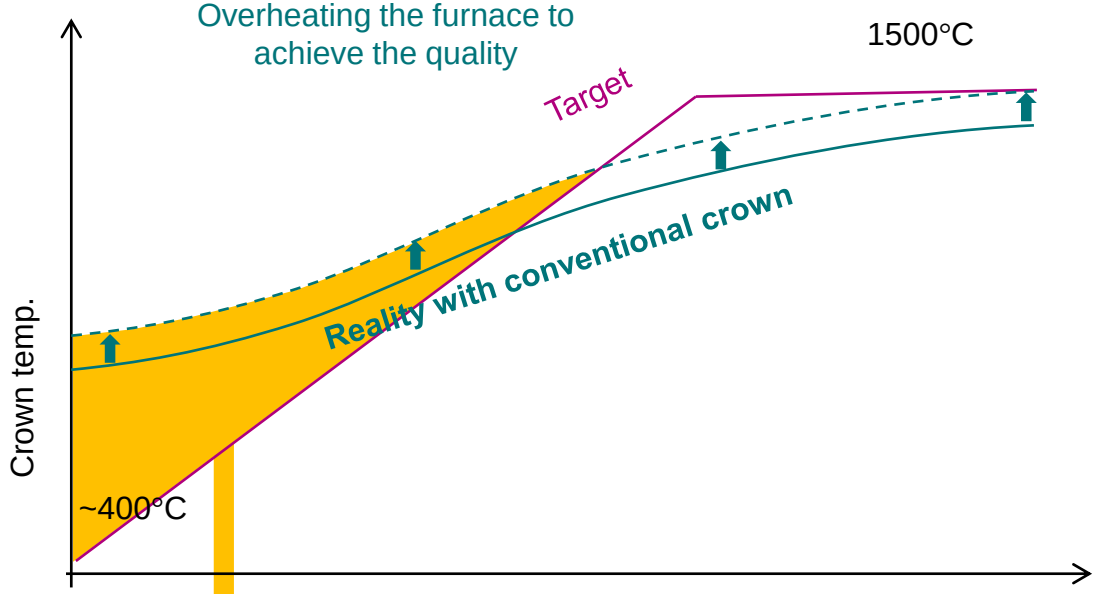
TEMPERATURE GRADIENT TO BE TARGETED TO ACHIEVED A GOOD EFFICIENCY



Fining still requires a high temperature melt surface

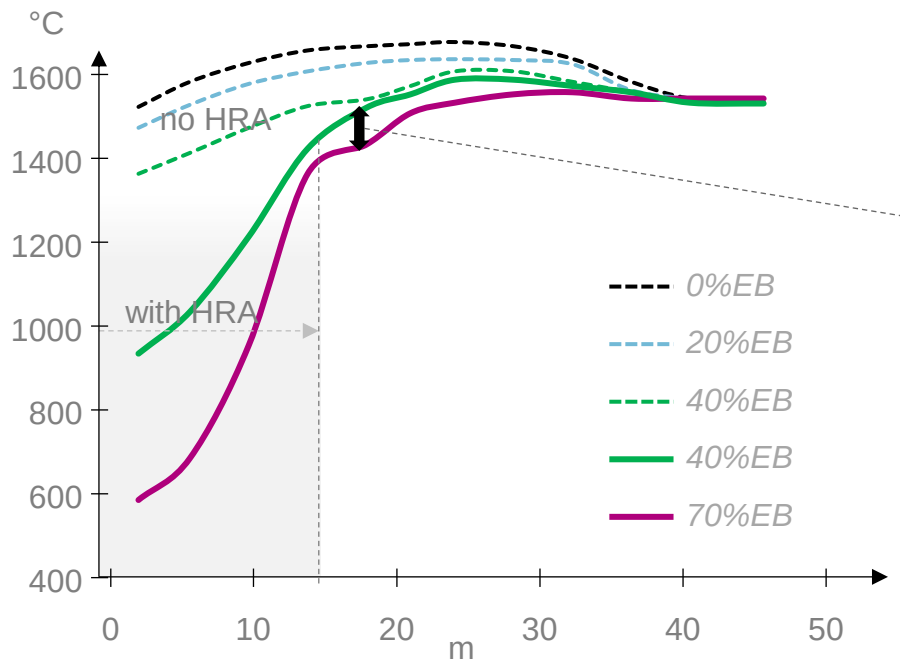
➔

Overheating the furnace to achieve the quality



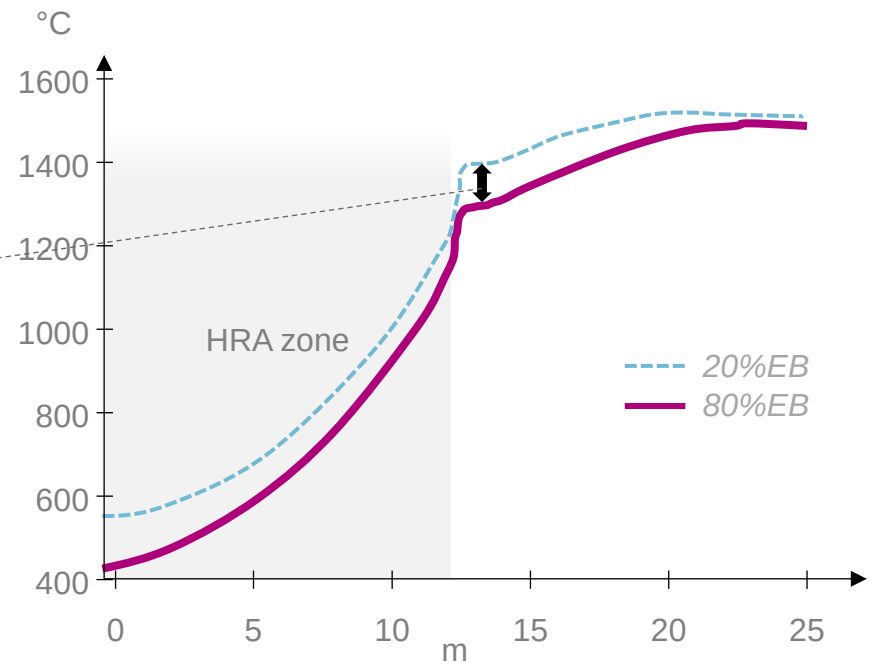
Loss of efficiency (~ 10%)

FIVES SUPERSTRUCTURE DESIGN FIT WELL EXPANSION NEEDS & HIGH THERMAL GRADIENT

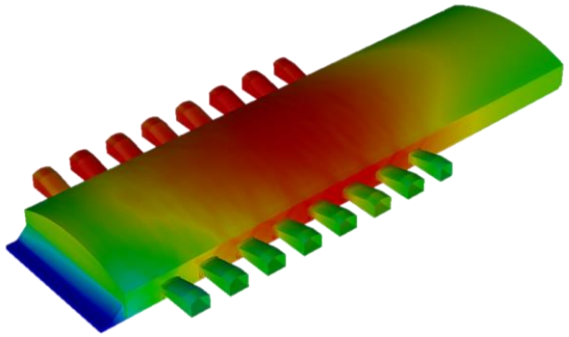


ΔT is limited (100-150°C)

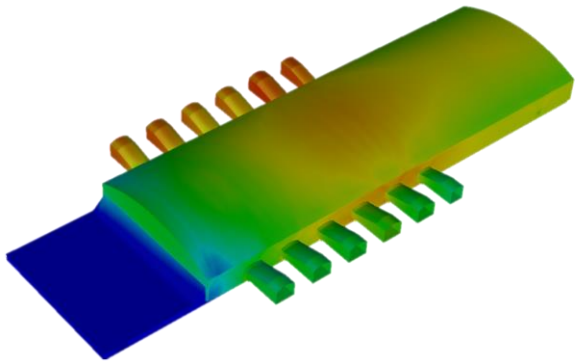
➔ the temperature regime variations (because of EB% variation) is made possible by the HRA, and not with a conventional crown



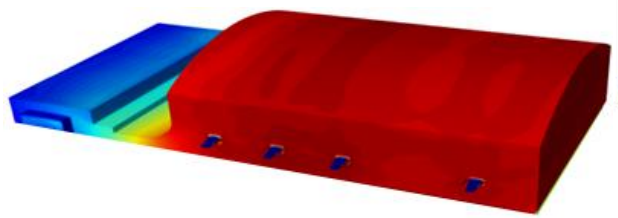
Cross Fired Reg. 0 – 40% EB



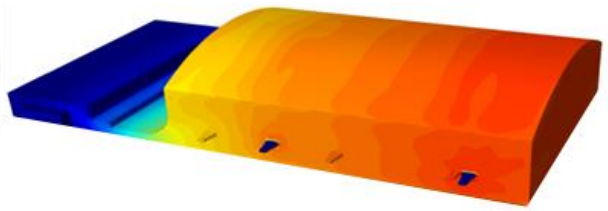
HRA 40 – 70% EB



HRA 20% EB

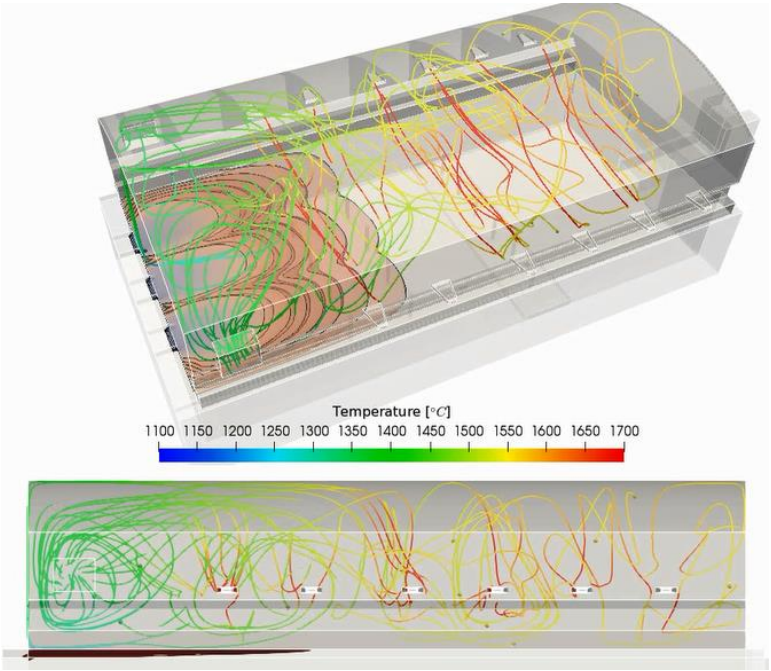


HRA 80% EB

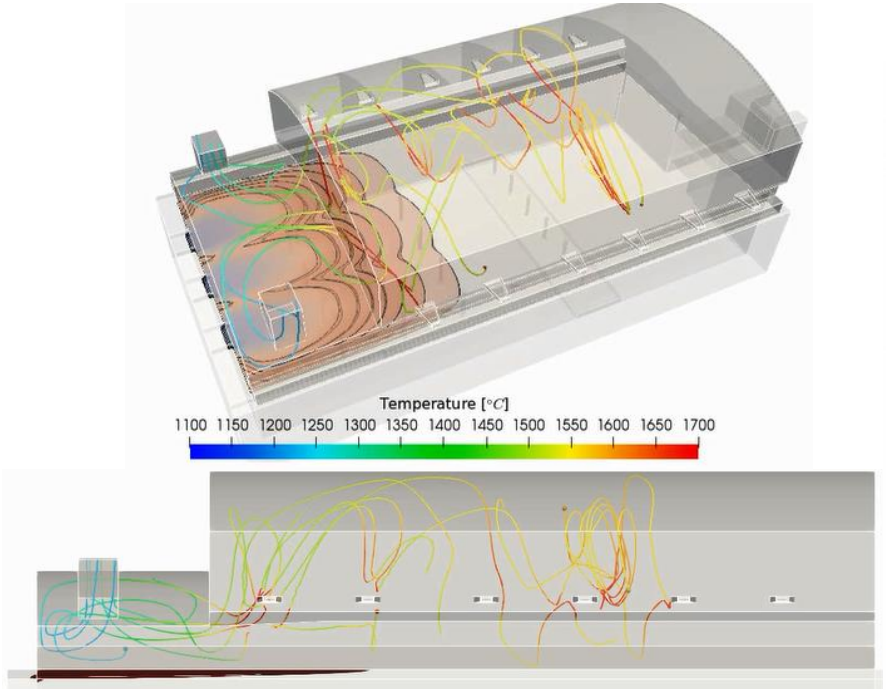


THE HRA DEMONSTRATES A GOOD INFLUENCE ON PARTICLES FROM COMBUSTION

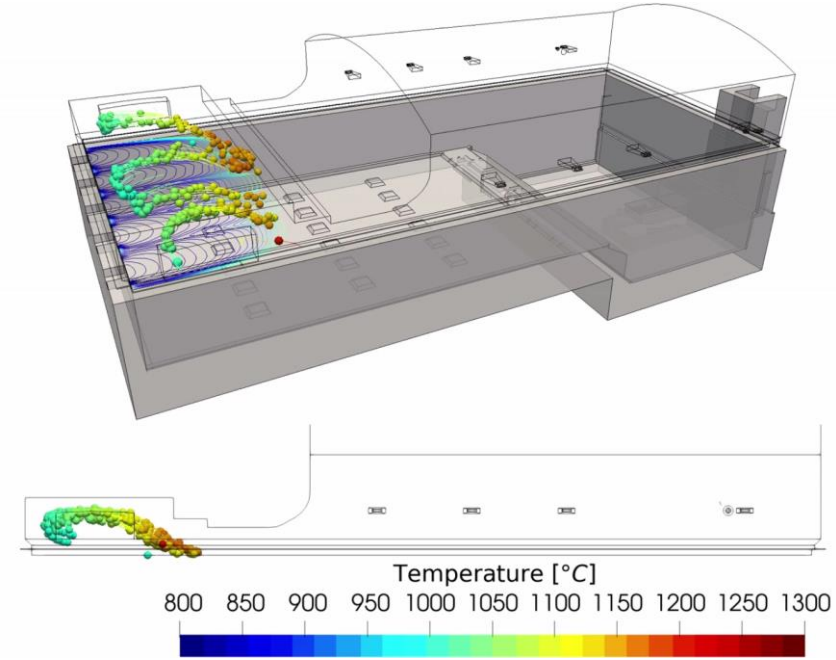
Without HRA



With short HRA



With long HRA



Significant difference in amount and distribution of the particles!

- ideal evacuation of any dust emitted in the unglazed area of the batch!
- Any dust emitted during charging or by decrepitation is readily evacuated into the flue outlets
- The superstructure is well preserved from corrosion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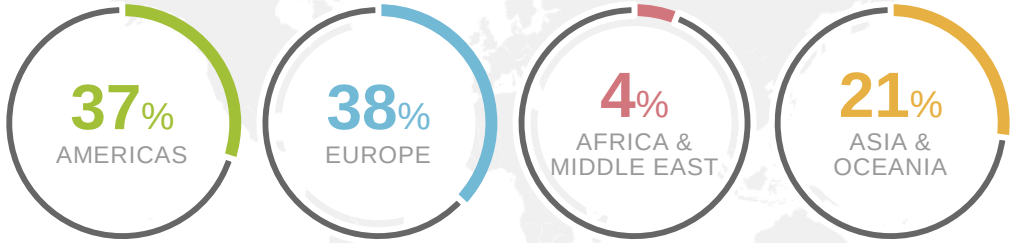

MAIN ACTIVITIES

Machine tools

Process technology
Aluminium – Energy – Glass – Steel

Automated solutions

Maintenance, piping solutions, AI & data processing

GLASS ACTIVITY

KEY REFERENCES

PRESENCE

5 Locations in 5 countries

France – UK – China – USA – India

EUROPE

verallia · HEINZGLAS family-owned since 1622 · SAINT-GOBAIN · BA · O-I · BORMIOLI LUIGI GLASSMAKER · SGD PHARMA · GROUPE POCHET · ST LOUIS · DÜZCE CAM SAN.TİC.A.Ş. · ŞİŞECAM

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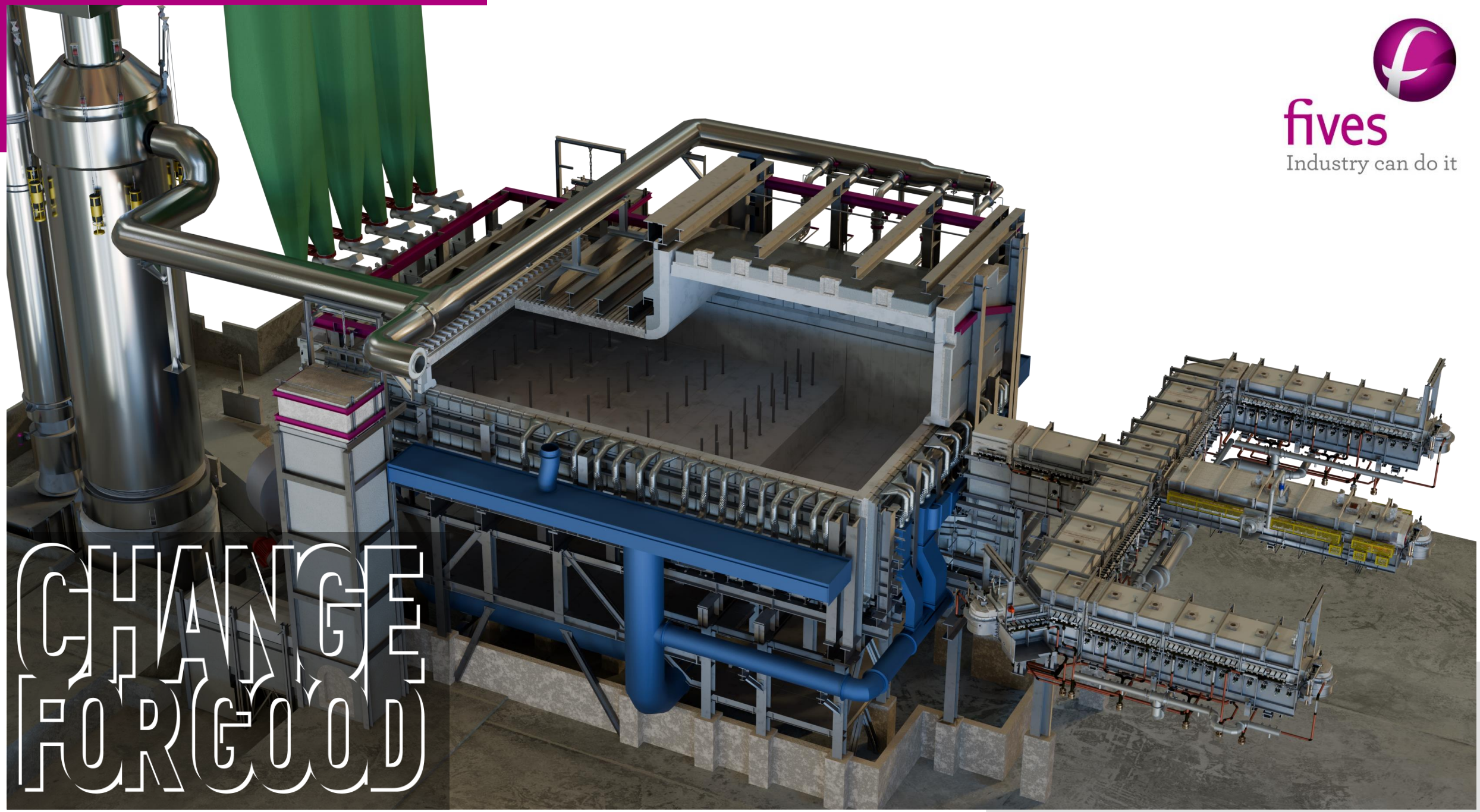

fives
Industry can do it