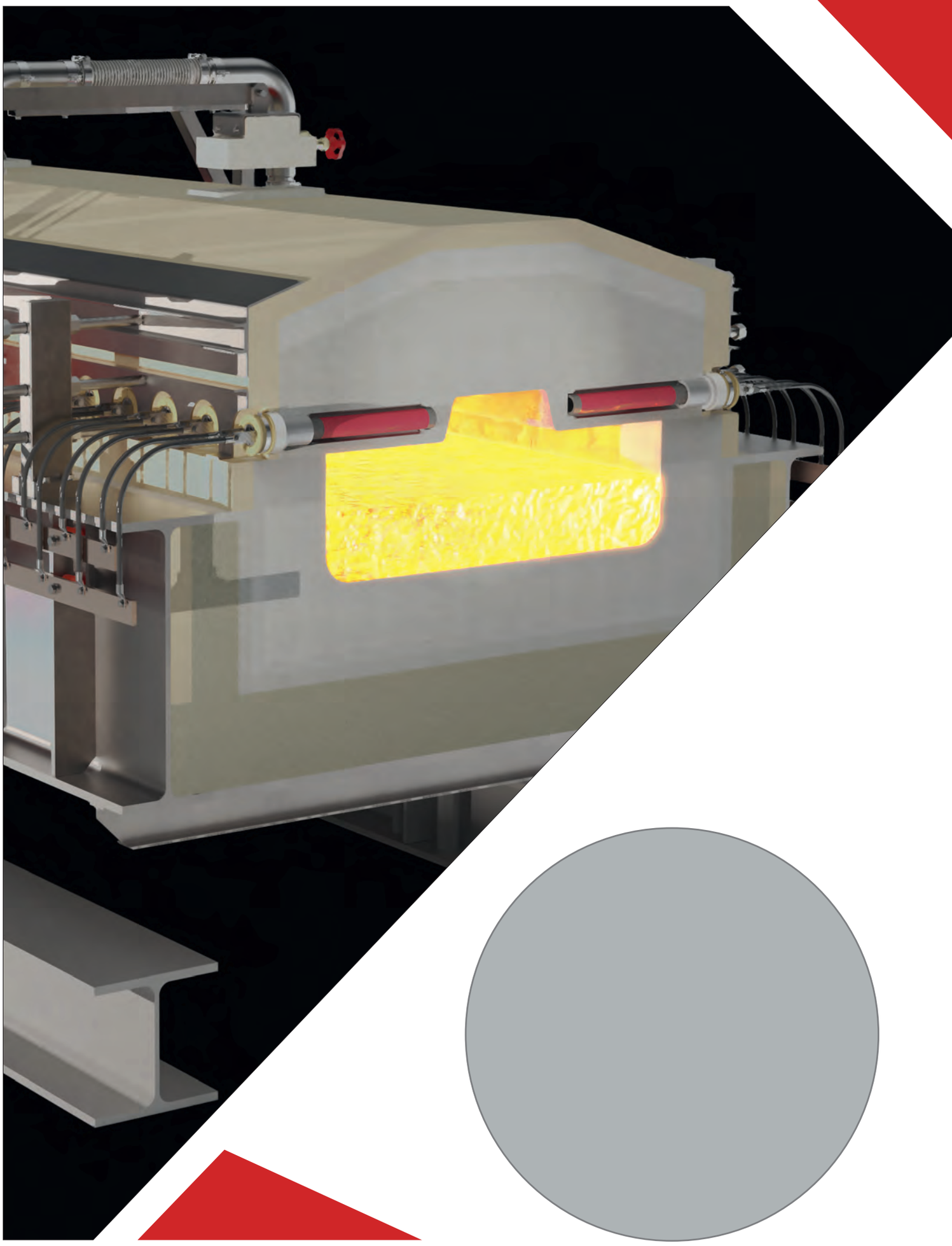
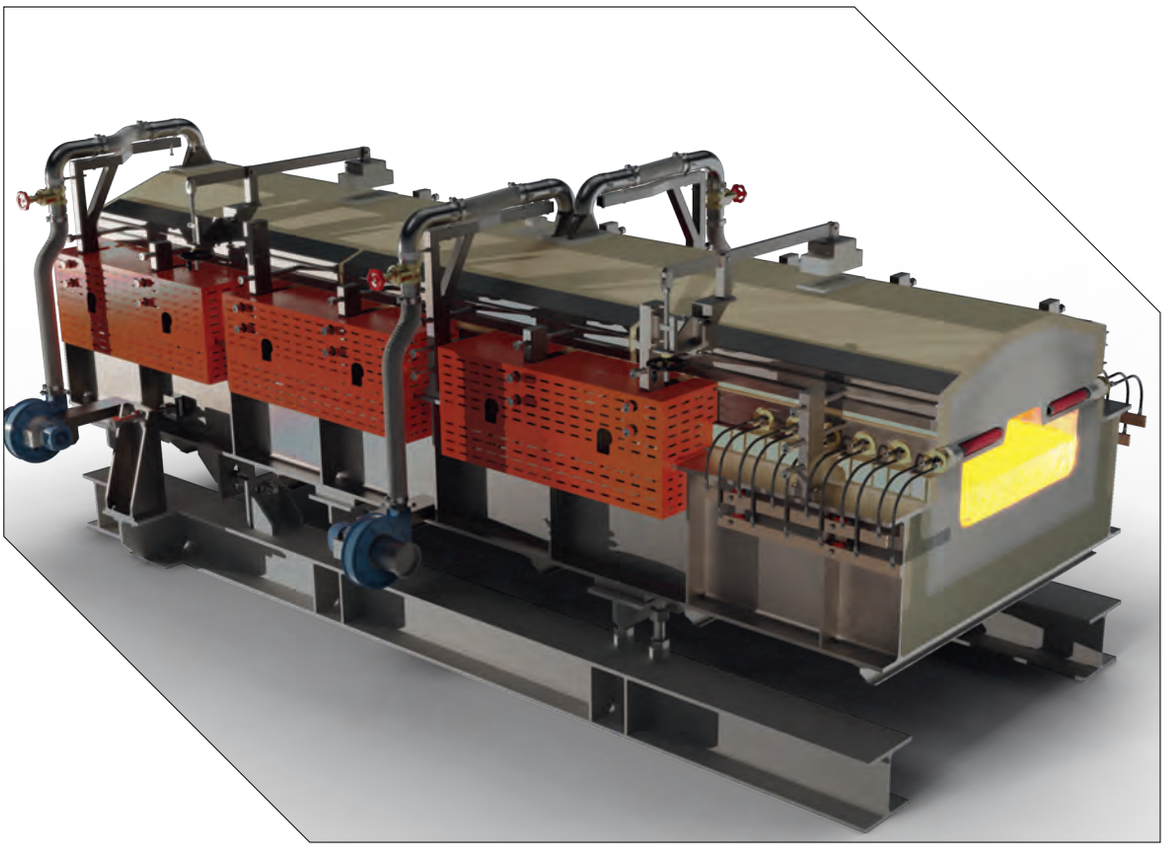


REFRACTORY-EMBEDDED ELECTRIC FOREHEARTH HEATING SYSTEMS

As the glass industry accelerates its transition toward decarbonization and high energy efficiency, conventional air-gas heating systems suffer severe operational limitations.

The Glass Service's patented Refractory-Embedded Electric Forehearth represents a technological breakthrough, converting electrical energy directly into thermal energy with exceptional controllability while completely eliminating direct combustion emissions.

PATENTED

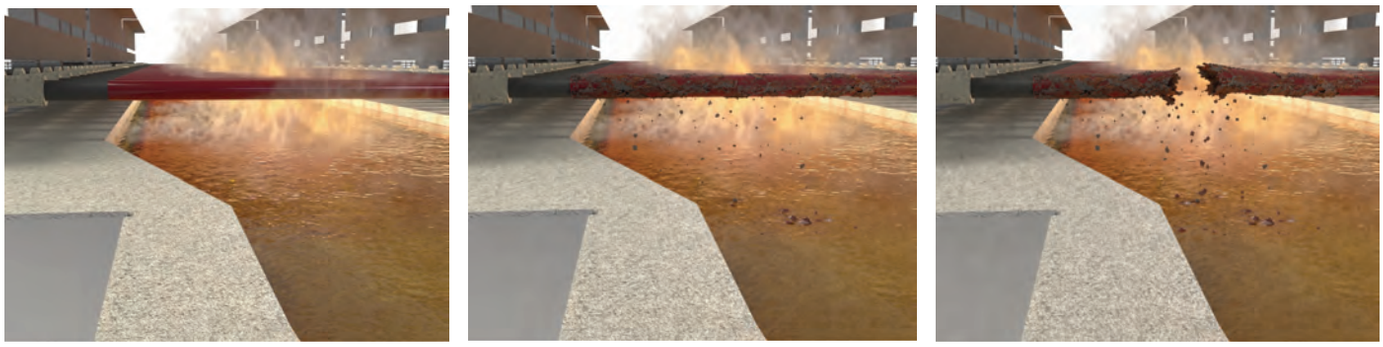


THE LIMITATIONS OF TRADITIONAL ELECTRIC HEATING

Traditional electric forehearths employ radiant heating elements positioned directly above the molten glass.

While effective, this configuration presents critical drawbacks:

- Chemical attack & shortened life: glass vapours chemically attack exposed heating elements, leading to premature failure.
- Contamination risks: element degradation or breakage can cause fragments to fall directly into the glass melt, generating production defects and safety concerns.
- Atmospheric incompatibility: certain glass compositions (such as amber or green glass) require specific oxidizing or reducing atmosphere that traditional exposed elements cannot selectively manage.



CHEMICAL ATTACK & SHORTENED LIFE

GLASS SERVICE SOLUTION: REFRACTORY-EMBEDDED RADIANT ELEMENTS

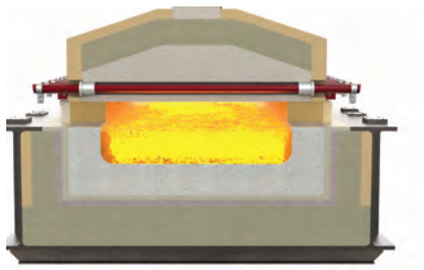
To overcome these limitations, Glass Service has developed and patented an innovative electric forehearth concept where heating elements are fully embedded within the refractory superstructure.

The elements are heated by the Joule effect and the thermal energy is transferred indirectly to the molten glass, while remaining physically separated from the glass chamber.

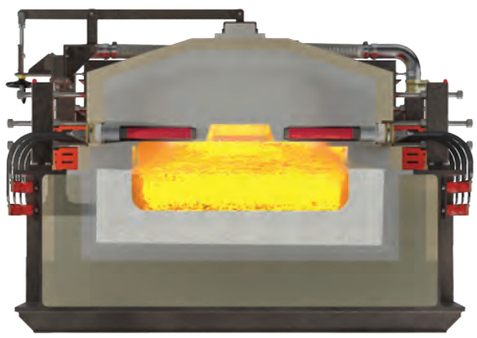
This arrangement protects the radiant elements from chemical attack and eliminates the risk of fragments entering the molten glass.

- Complete Isolation: the design isolates heating elements from direct exposure to glass vapours, drastically reducing chemical corrosion and extending the service life.
- Zero Contamination: enclosure within refractory channels ensures zero risk of material falling into the glass melt.
- Electrical Safety: direct contact between energized elements and molten glass is entirely eliminated.

The Glass Service electric forehearths with embedded radiant elements can have two different arrangements, with only one element and with two independent elements in the left and right sides of the channel.

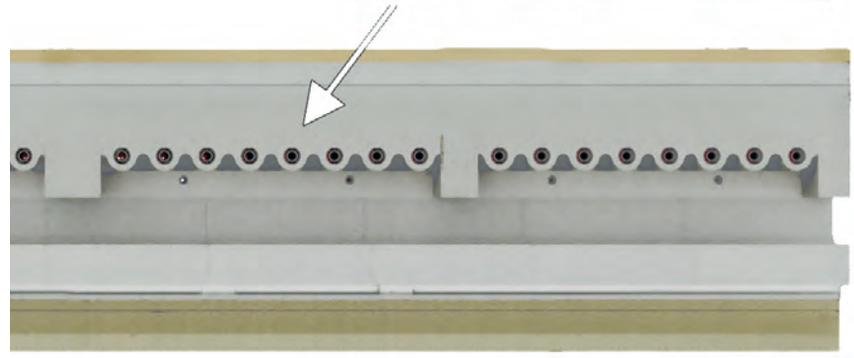


HEATING



HEATING & COOLING

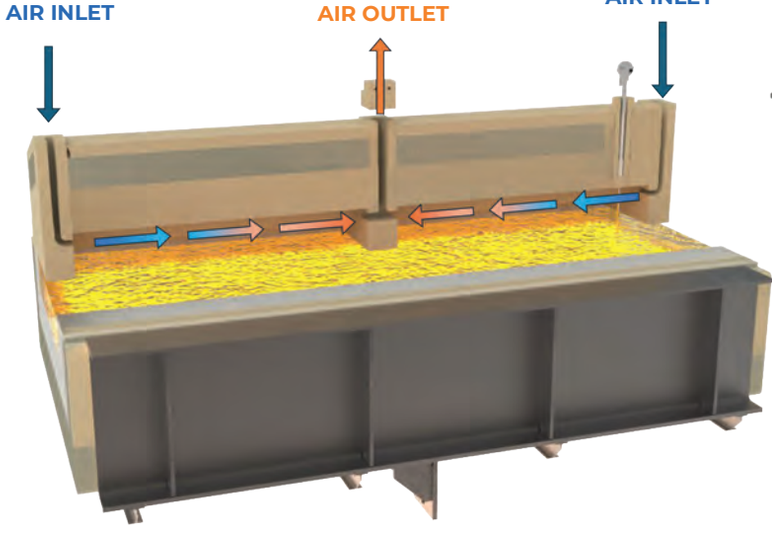
In both cases, as shown in the following picture of the longitudinal section, the resistance tubes are placed inside specific block holes.

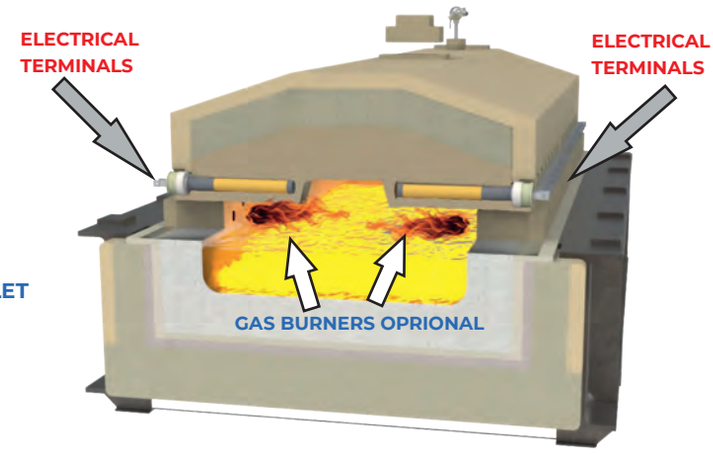


ADVANCED ATMOSPHERIC & THERMAL MANAGEMENT

Advanced versions of the system incorporate independently controlled left and right heating circuits, central cooling channels, and optional auxiliary burners.
Independent radiant elements for the left and right sides compensate temperature asymmetries. The radiant elements are housed in separate refractory chambers and connected through lateral electrical terminals, providing easier access for inspection and replacement. Electrical power is regulated through thyristor-based controls according to the required glass temperature and operating conditions.

For amber, green and other reduced glasses the system can maintain an oxidizing atmosphere around the radiant elements and a reducing atmosphere in contact with the molten glass.

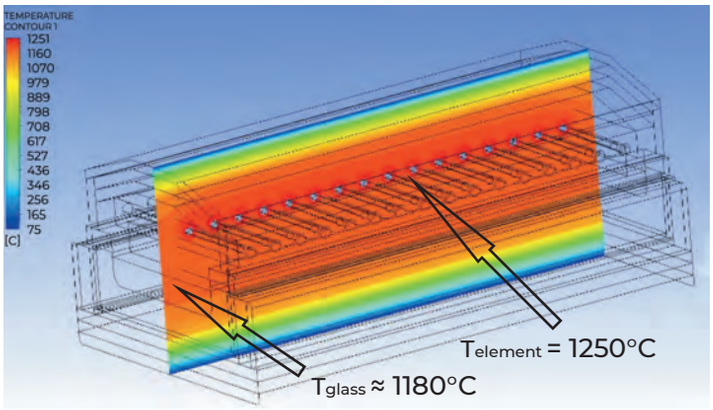


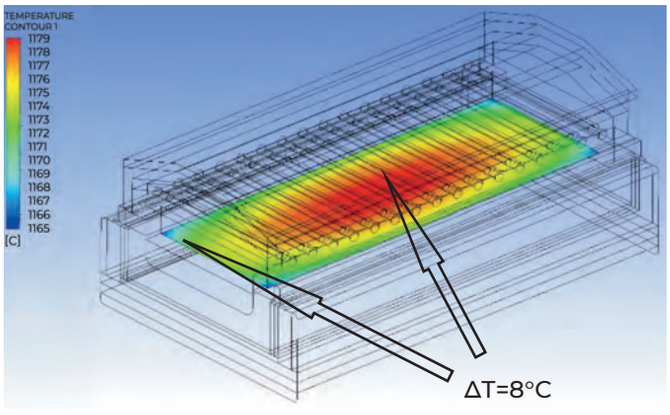


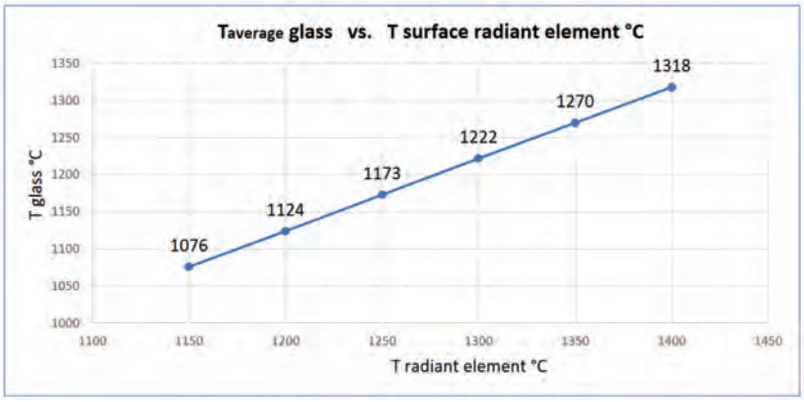
Central cooling channel: improves the cooling efficiency of the structure and the consequent thermal homogeneity.

Numerical simulations using finite-element and CFD techniques confirm nearly linear relationships between element and glass temperatures, displaying only minor variations across the glass surface and exceptional thermal homogeneity

CFD analsys on a standard zone (L=2820 mm) → evalutate the power and the heat loss





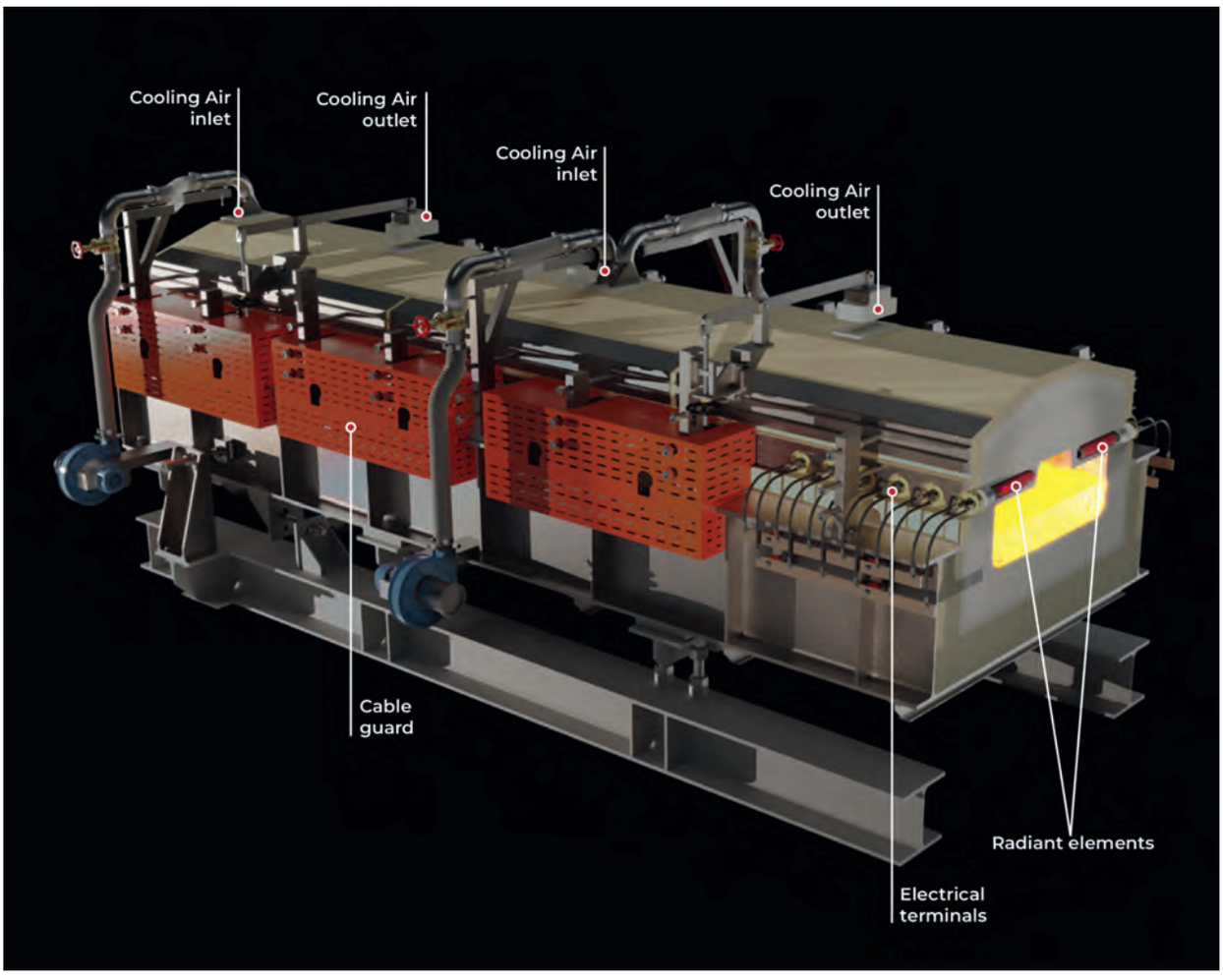


KEY BENEFITS & PERFORMANCE EVALUATION

- Extended Durability: Protection from corrosive vapours significantly increases element lifespan.
- Process Flexibility: Fully compatible with demanding glass compositions (including reduced-glass applications requiring specific atmospheric controls).
- Enhanced Safety: Elimination of direct contact risks and compliance with stringent industrial safety standards.
- Zero direct emissions: contributes directly to plant decarbonization targets when coupled with renewable electricity sources, CO2 emissions are totally eliminated.

ELECTRING HEATING VS AIR/GAS HEATING

The following chart shows the energy comparison between air/gas heating and electric.

Forehearth K36 , L=2820 mm	Air/gas heating	Indirect radiant elements
Installed power	25·Nm³/h of gas·(250·kW)	70·kW
Approximate steady-state power consumption & Efficiency	ENERGY EFFICIENCY: 30% / 90%	POWER CONSUMPTION: 125 kW / 24 kW
Approximate steady-state CO_2 emissions	220 Ton/year CO_2 (Gas System)	0 Ton/year CO_2 (Electric System)

Higher Efficiency Up to 90% | Lower Consumption Up to 80% reduction | Zero Emissions Electric System | Sustainable Solution for a cleaner future