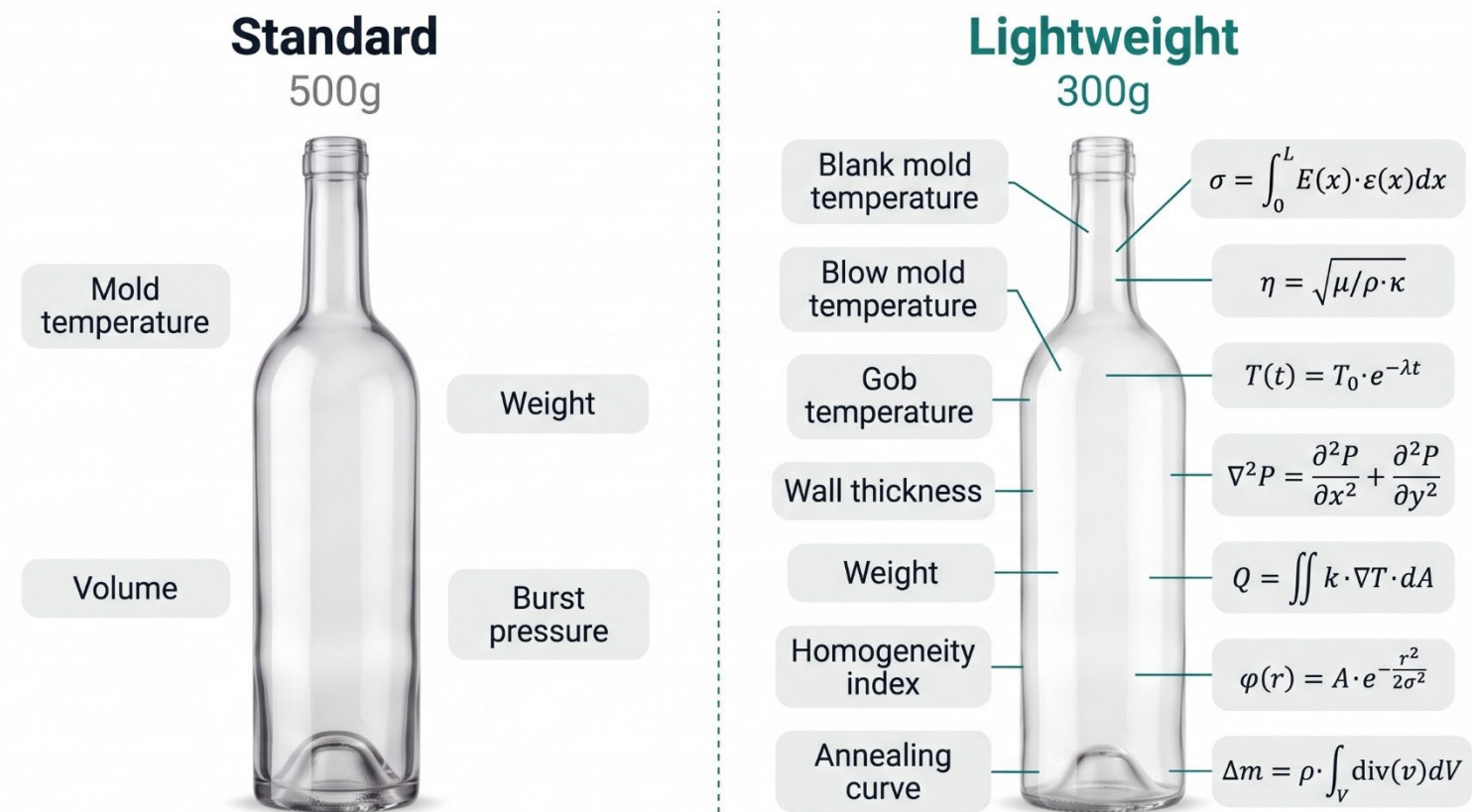
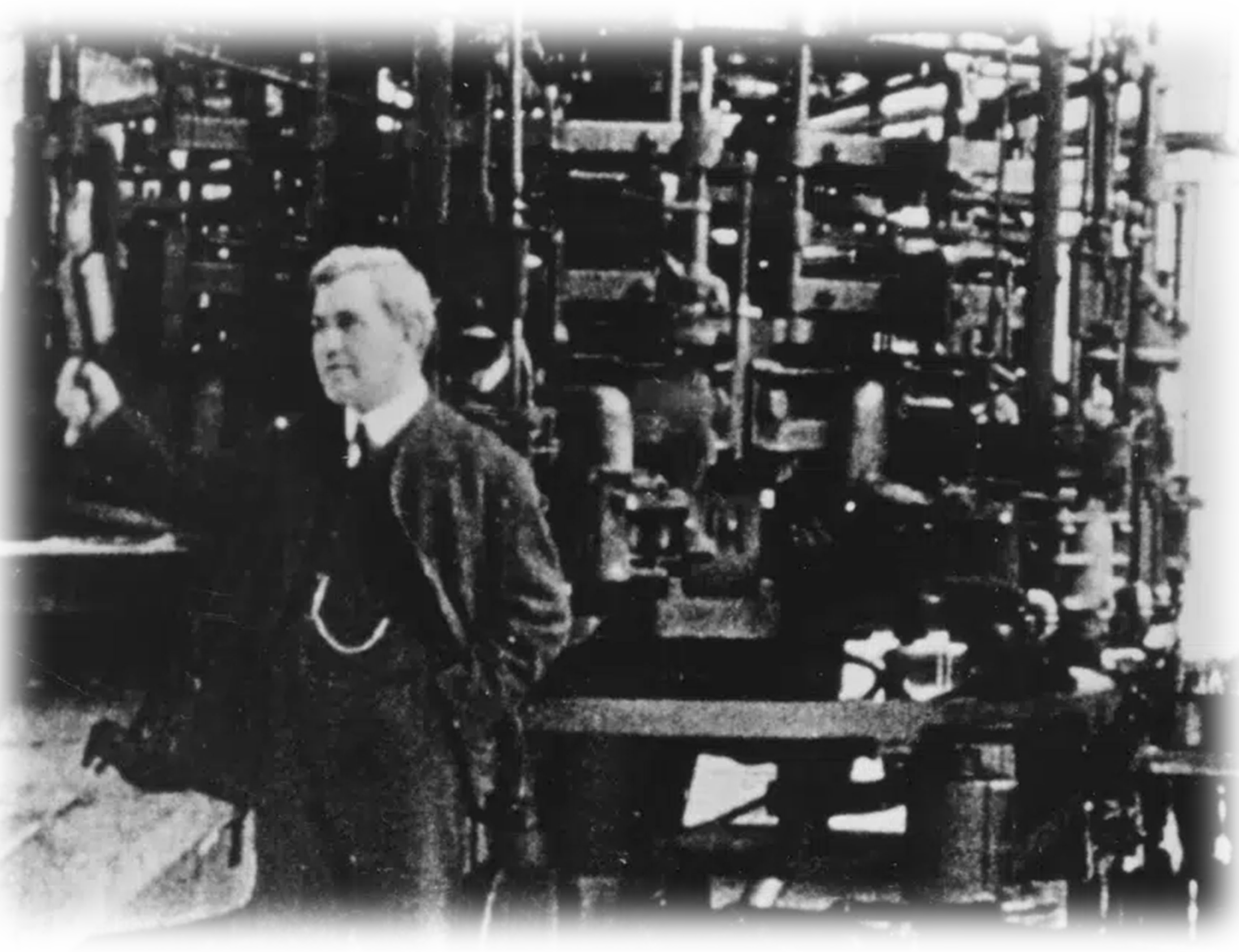




Closing the Loop: Thermal Control for Stable Lightweight Glass Production

Once Upon a Time



1904, Toledo:

Michael Owens patents a machine that automatically manufactures glass bottles.

***120 years later, the core challenge remains:
Controlled heat extraction without defect***

Why we started

*Crucial factor but low
process management*



No Real-Time Measurements

No live data

Higher risk of **defects**

Delayed detection

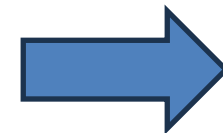


High Dependence on Expertise

No **consistency** between shifts

Subjective decisions

Dependence on expertise



Inconsistent Repeatability

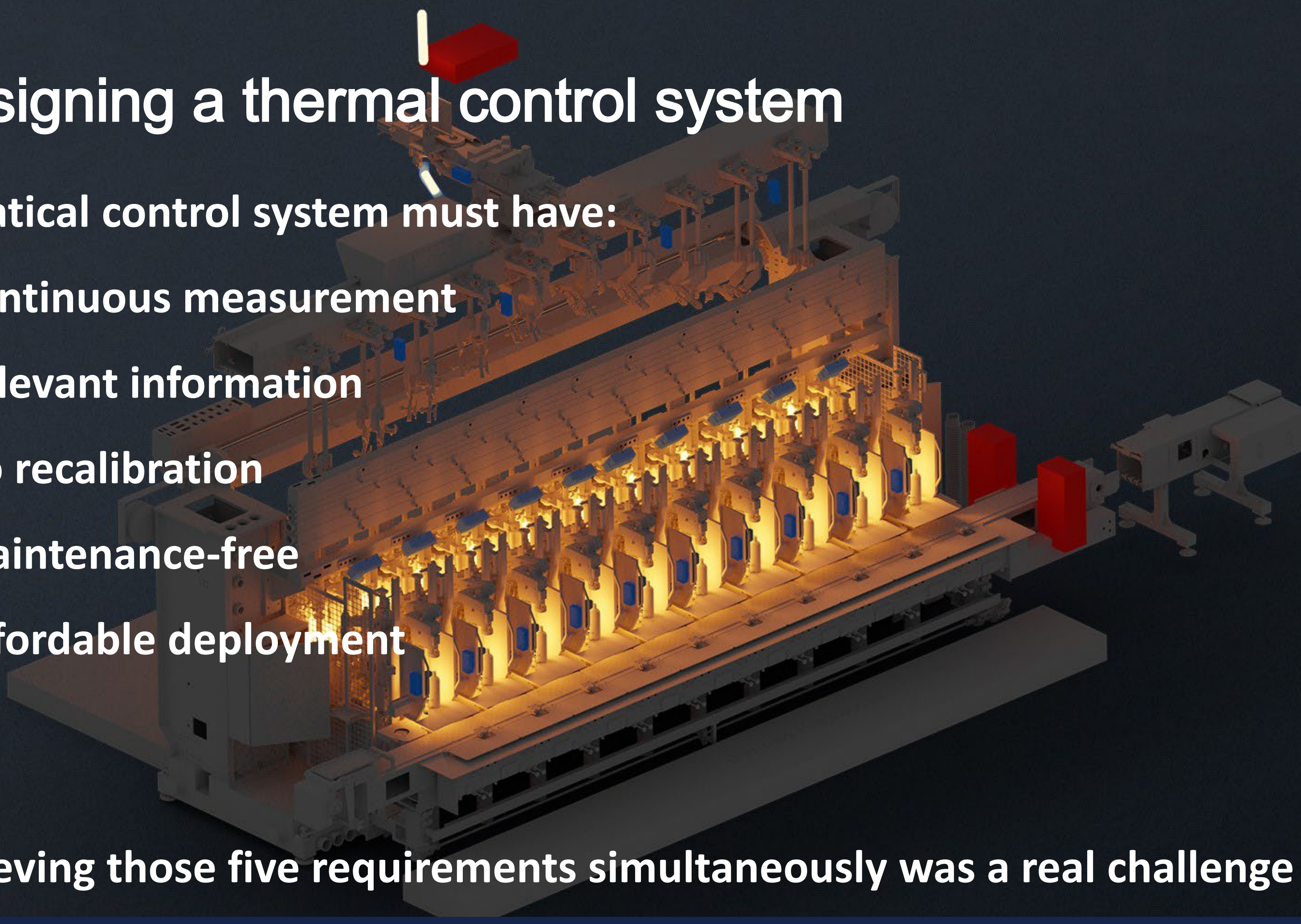
Process **drift**

Variations over time

Loss of **productivity**



Designing a thermal control system

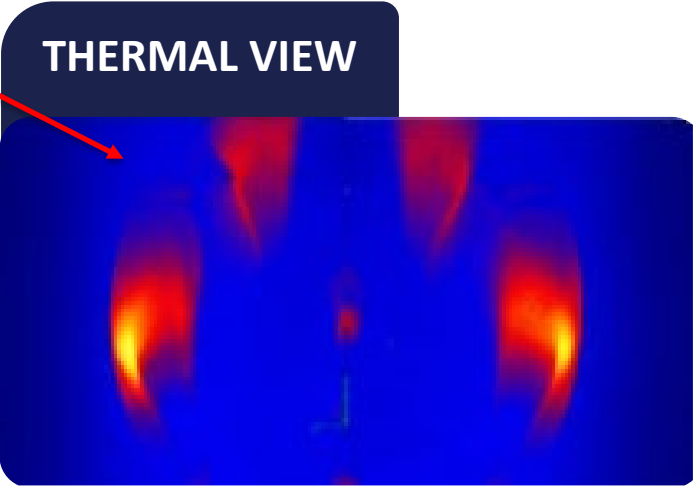
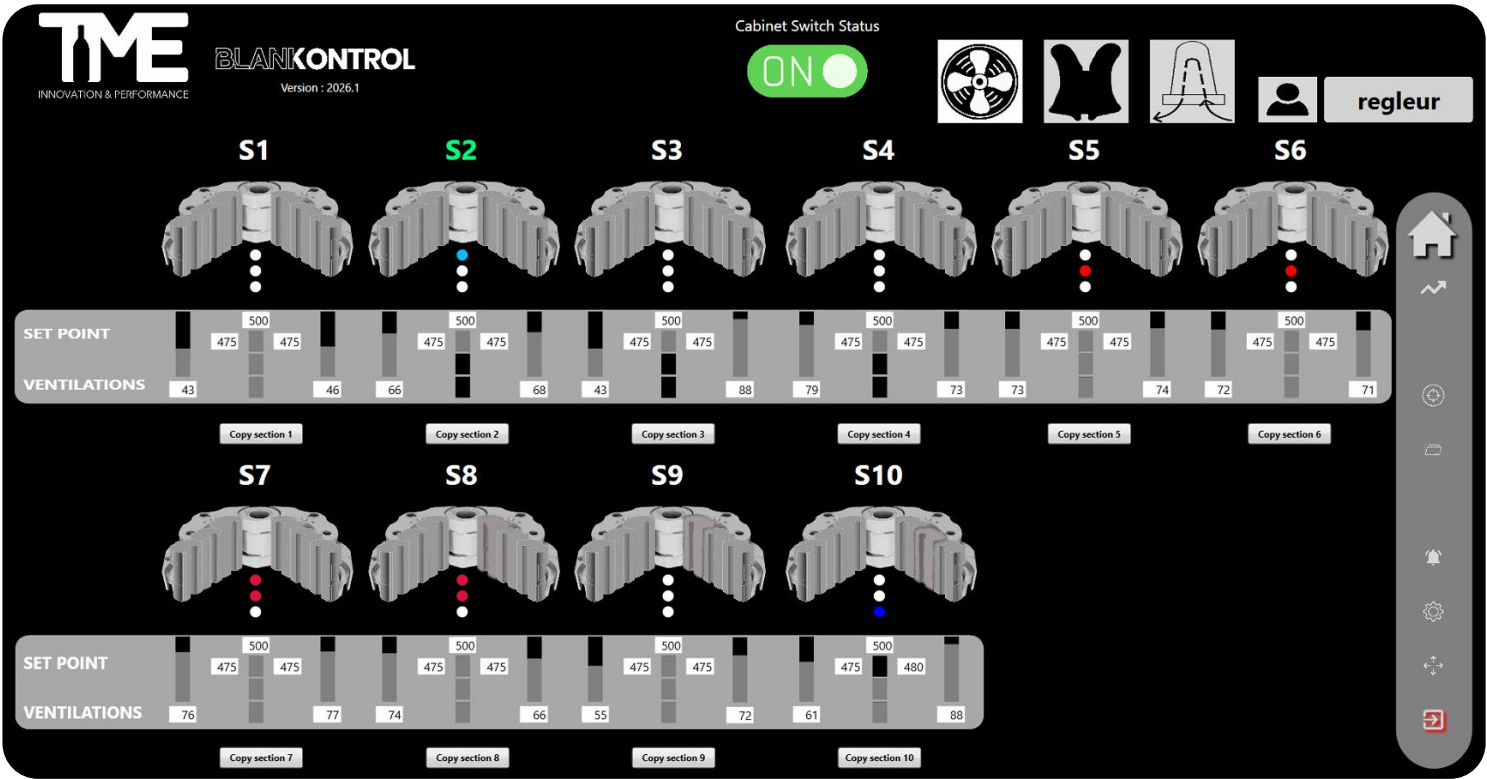
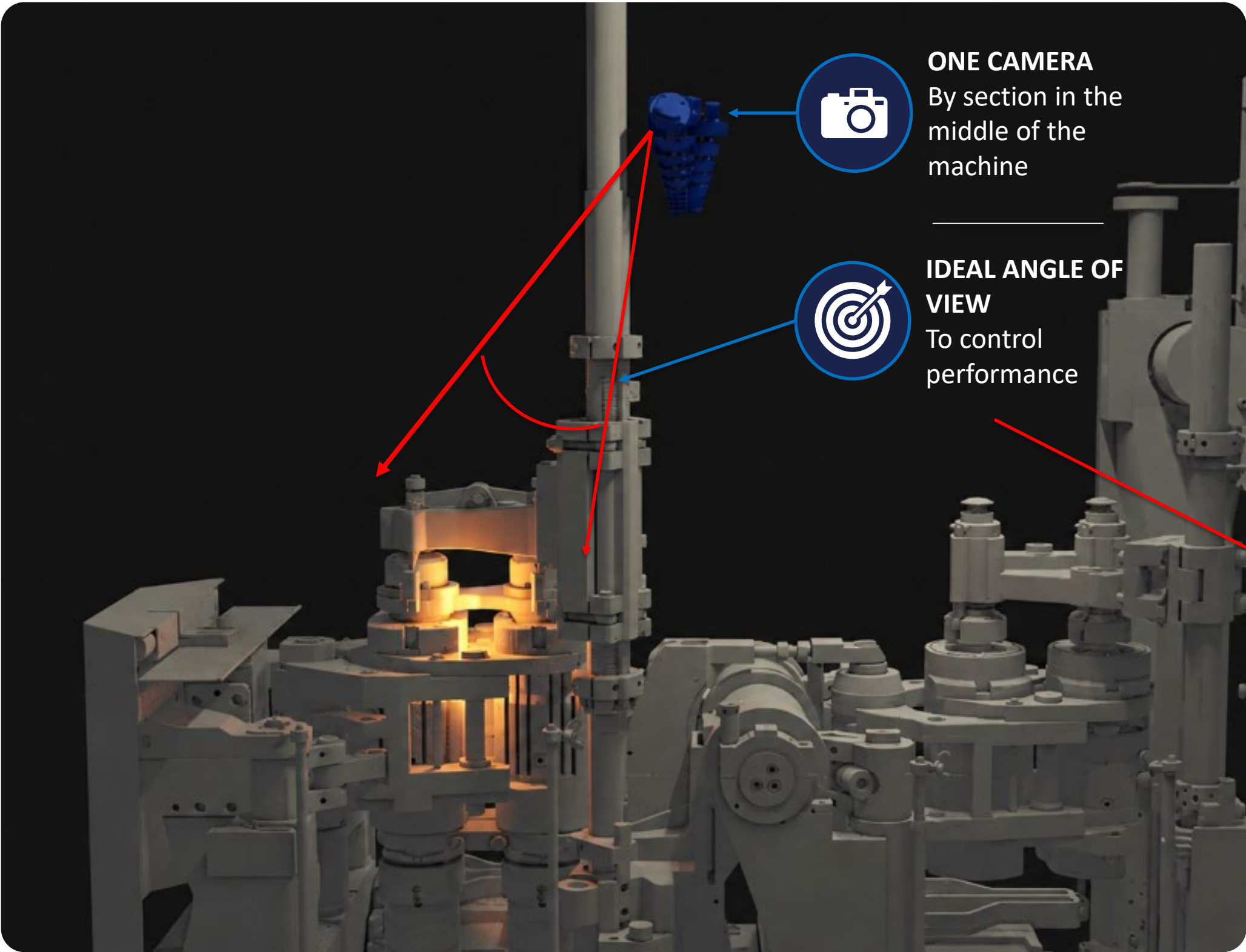
A detailed 3D CAD model of a thermal control system. The model shows a complex arrangement of heat exchangers, pipes, and structural supports. The heat exchangers are highlighted with a warm orange glow, indicating heat transfer. Several red rectangular blocks are placed at various points in the system, likely representing heat sources or sinks. The entire assembly is mounted on a base structure.

A practical control system must have:

- ✓ Continuous measurement
- ✓ Relevant information
- ✓ No recalibration
- ✓ Maintenance-free
- ✓ Affordable deployment

Achieving those five requirements simultaneously was a real challenge

The system



We see the inside inner surface with a proven accuracy of +/- 2°C

*Parallel and radial Molds opening.
SG/DG/TG – All kinds of cooling*

Key technical characteristics



Maintenance - free
No lens
contamination



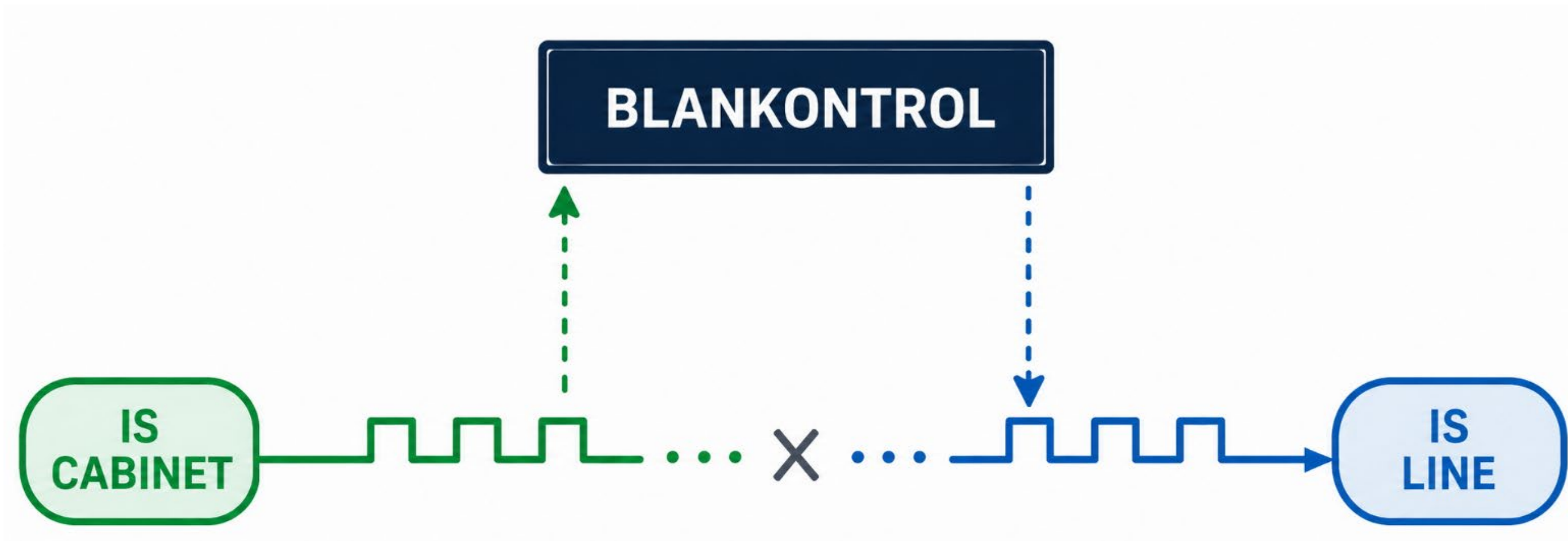
**No recalibration
needed**



Affordable system
ROI < 1 year



Key technical characteristics



Automatic
regulation



Any timer
Any brand

Proven in industrial production

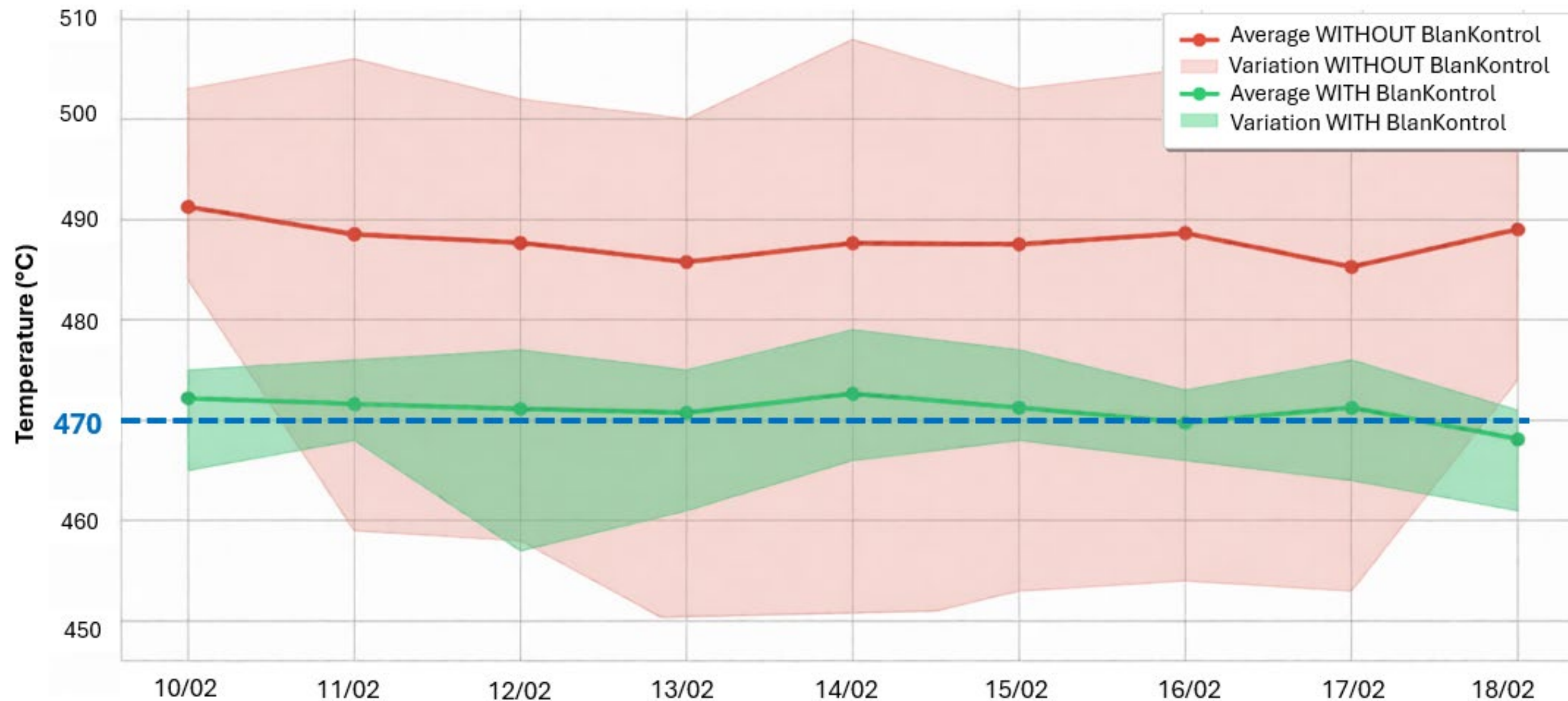


✓
11 / 14 recuring customers

	2023	2024	2025	2026	2027
Total Customer	1	2	8	14	~20
Recurring Customer			3	6	11
Total Installed	1	3	20	44	70+

Stability results

- (sampling period: 9 days // Setpoint : 470°C)



TIGHT DISPERSION

Temperatures maintained within a narrow range around the setpoint



MORE UNIFORM TEMPERATURE

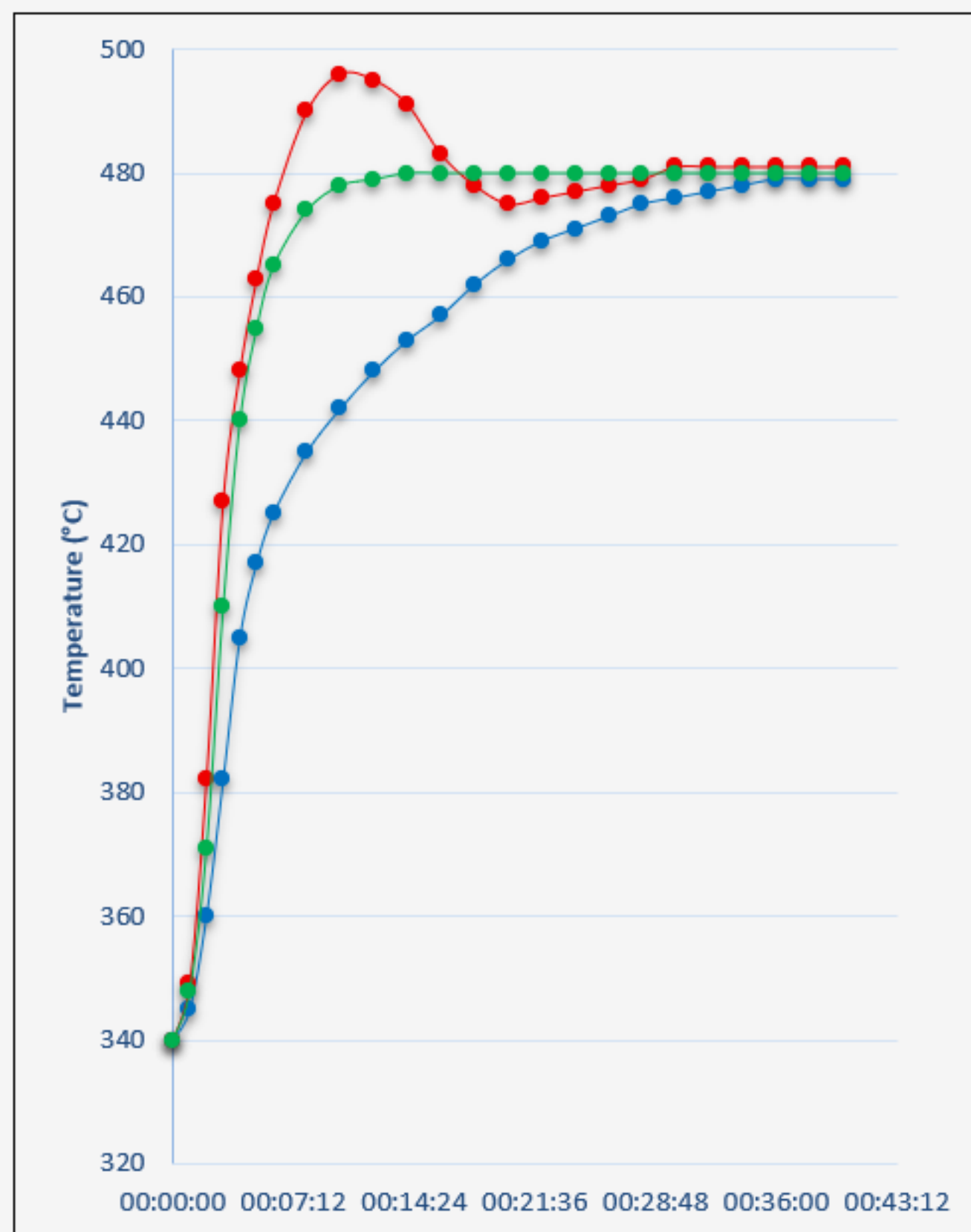
All sections behave consistently over time



BETTER REPEATABILITY

Stable thermal behaviour for a more predictable process

Operational Impact

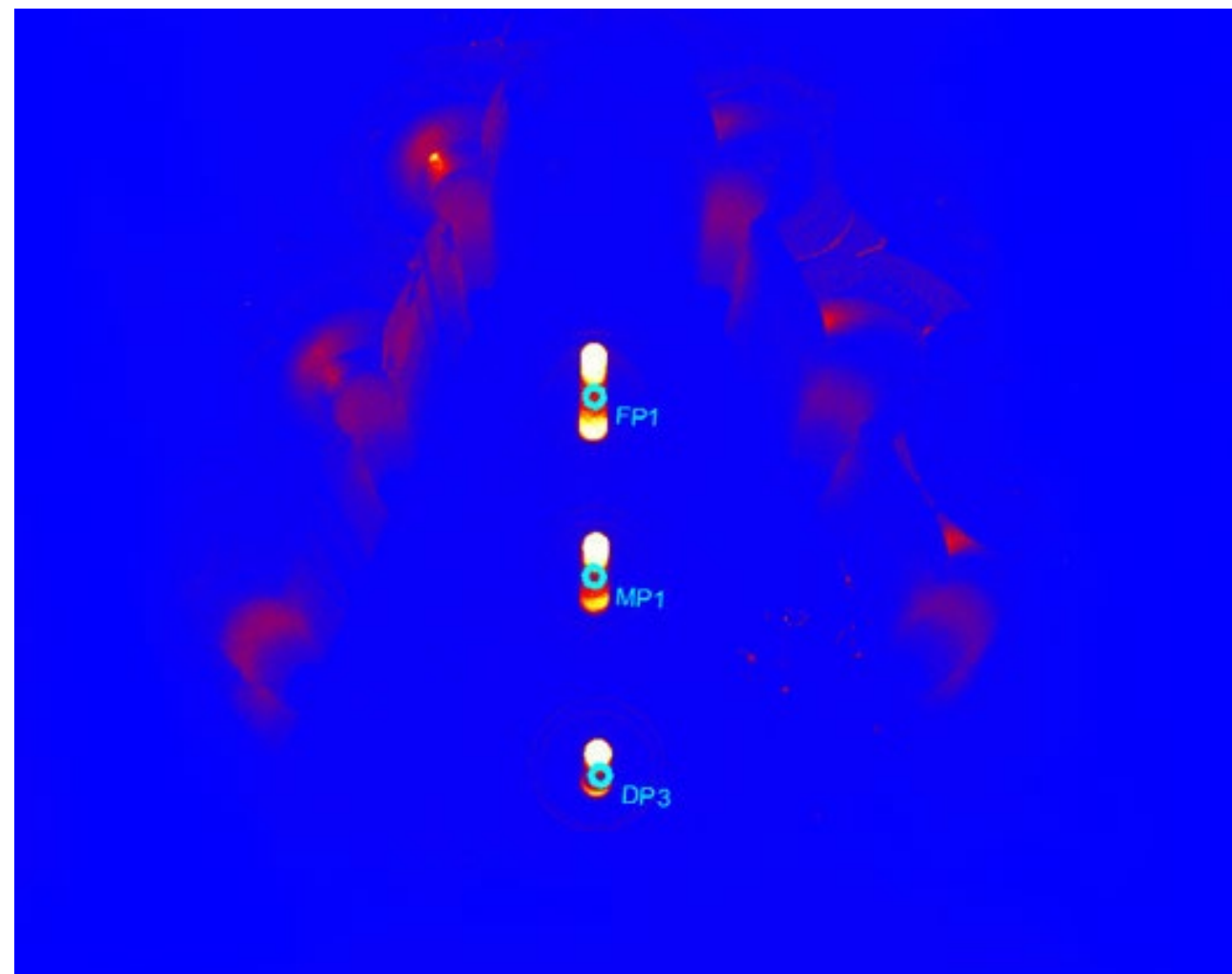


BRINGS BETTER OPERATIONS
Temperature is stabilized; cruise control is on

- ✱ Qui cker warm up of the section
- ✱ No overshoots
- ✱ Extends mold lifetime by 50%
- ✱ Free up the glassmakers to focus on higher - value improvements

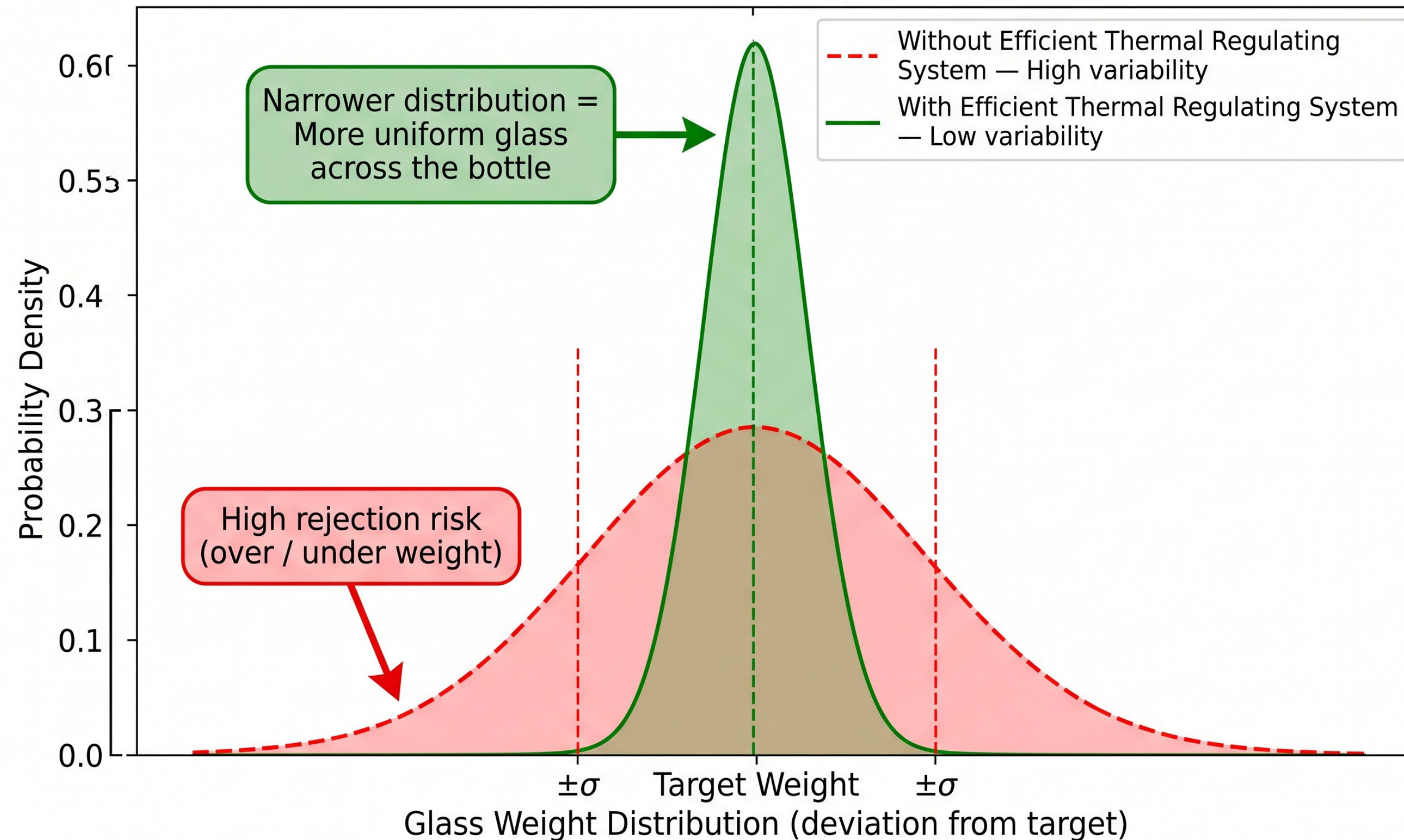
Quality Assurance

Certify to the end customer that no spikes from plungers were packed



Unexpected: enable safe lightweighting

Glass Distribution of a Bottle – Impact of an Efficient Thermal Regulating System



Why Lightweight?

Customer's view

- Fewer emissions
- Less fuel used
- Cost savings

KPI **-15 to -25%**
(Cost savings)



500g

↓ **-40%**



300g

Glass Company's view

→ **Higher Margin ↑**

→ **More Market Share ↑**

Iso-Tonnage Advantage

+66%

Revenue

Results

Mastering the temperature to get even distribution: Datasheet from a customer

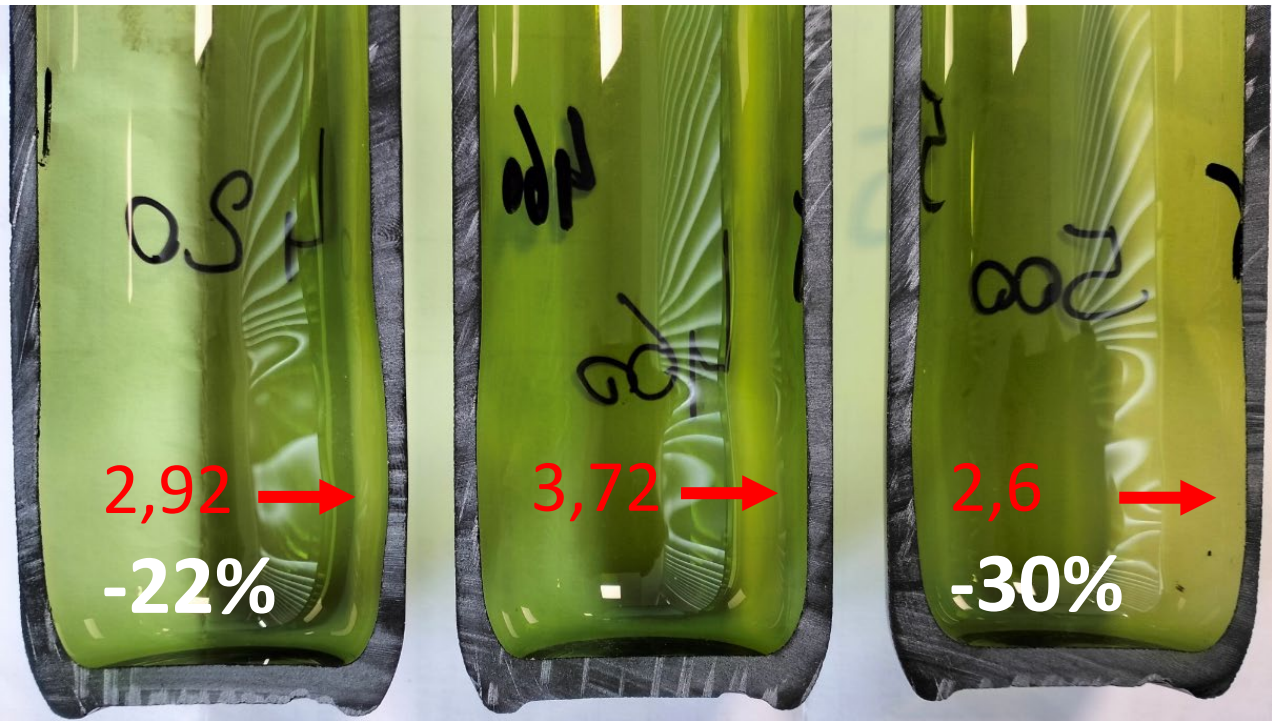
Blankontrol		Plan Expérience
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Répartition verre

Ref

- Sect 4 AVEC régulation

T° Ebaucheur	Gauche	Droite
Initial	460°	460°
1 ^{er} essai	420°	460°
2 ^{ième} essai	500°	460°



1^{er} essai
420°

Initial
460°

2^{ième} essai
500°

Conclusion

More stability brings more process control.



More process control leads to greater performance.



**Lightweighting is a decisive path to make glass
a more competitive packaging material.**



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