SmartMelt

Increase process efficiency for aluminum melting furnaces, by our unique AI-based digital twin

Aluminium melting furnaces face various inefficiencies
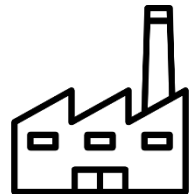
High variability

- Driven by human based decisions
- Difficult to identify drifts

Energy inefficient

- 5% energy efficiency loss caused by 1 door opening
- Typically 700 – 1400 kWh/t consumed for melting, while theoretically 325 kWh/t is needed

Complicated process

- Difficult to standardize and have global guidelines for operators due to numerous potential input variations (e.g., scrap, burner, operational conditions)
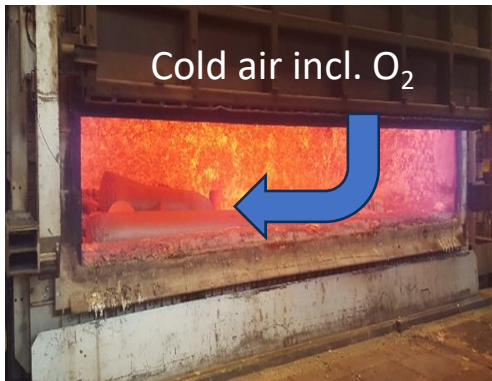
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High variability - Dependence on operator decisions can cause variations and inefficiencies

Example of problems driven by operator decisions

Decision	Unnecessary furnace door opening	Suboptimal timing for operations (e.g., thermocouple insertion, skimming, …)	Delayed loading or melt transfer
Impact	• Metal oxidation • Energy loss	• Temperature overshoots • Inadequate measurement • Process variation	• Energy loss • Process variation

Cold air incl. O_2

Delayed thermocouple insertion causing Excessive temperatures

Delayed melt transfer

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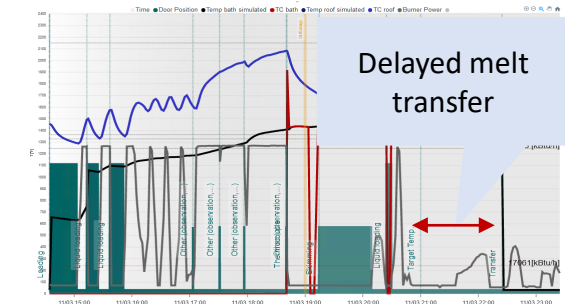
SmartMelt has achieved ~10% process efficiency after +100'000 h of service at 12 furnaces
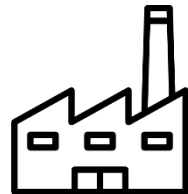
~10% productivity increase

- Proposes optimal next steps to the operator, reducing variability
- Provides visibility on process deviations, enabling continuous improvements

~10% energy savings and CO_2 emission

- Reduces unnecessary manipulations (e.g., door opening)
- Avoids unnecessary waiting time by predicting end of cycle

12 furnaces equipped so far

- Our installed base, spreads across EU and US on furnace sizes ranging from 24t to 110t capacity
- Operating since 2019, we have developed a deep experience

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In few seconds, SmartMelt builds/updates the digital twin, one step ahead of the operator

Physical asset,
4-5 hours cycle length

Digital Twin,
Predicts the full cycle in a few seconds

Data

Insights & recommendations
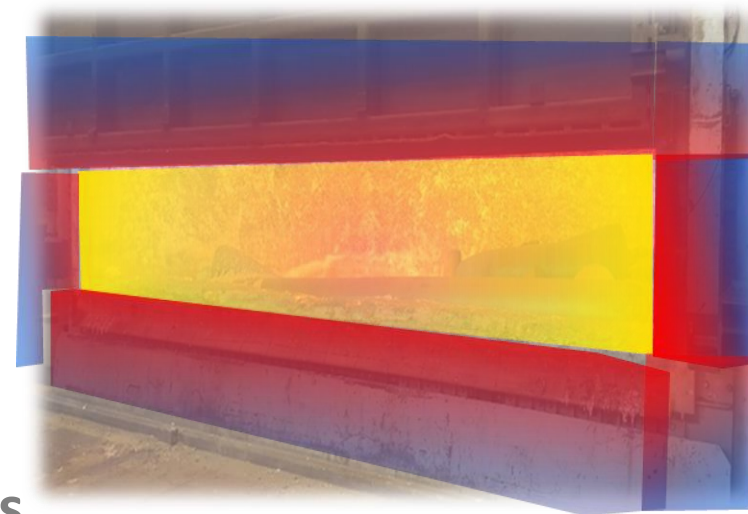
Like a GPS, SmartMelt guides the operator throughout the process

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How SmartMelt works and what it brings to your business

1 **Intuitive and easy to use dashboard**
- guides the operator on optimal process steps, and their timing
- tracks KPIs, enabling benchmarking across different plants and furnaces

2 **Reduce variability by minimizing human impact**

3 **Simplify reporting for added visibility while supporting continuous improvements**
- facilitates communication across organization
- Helps root cause analysis and generates insights for continuous improvement
- Supports identification of process inefficiencies and development of best practices

4 **Rapid implementation and return on investment**
- Flexible modular design simplifies implementation
- Rapid return on investment thanks to low CAPEX and OPEX

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1. Intuitive dashboard, with KPIs

Graphical process overview
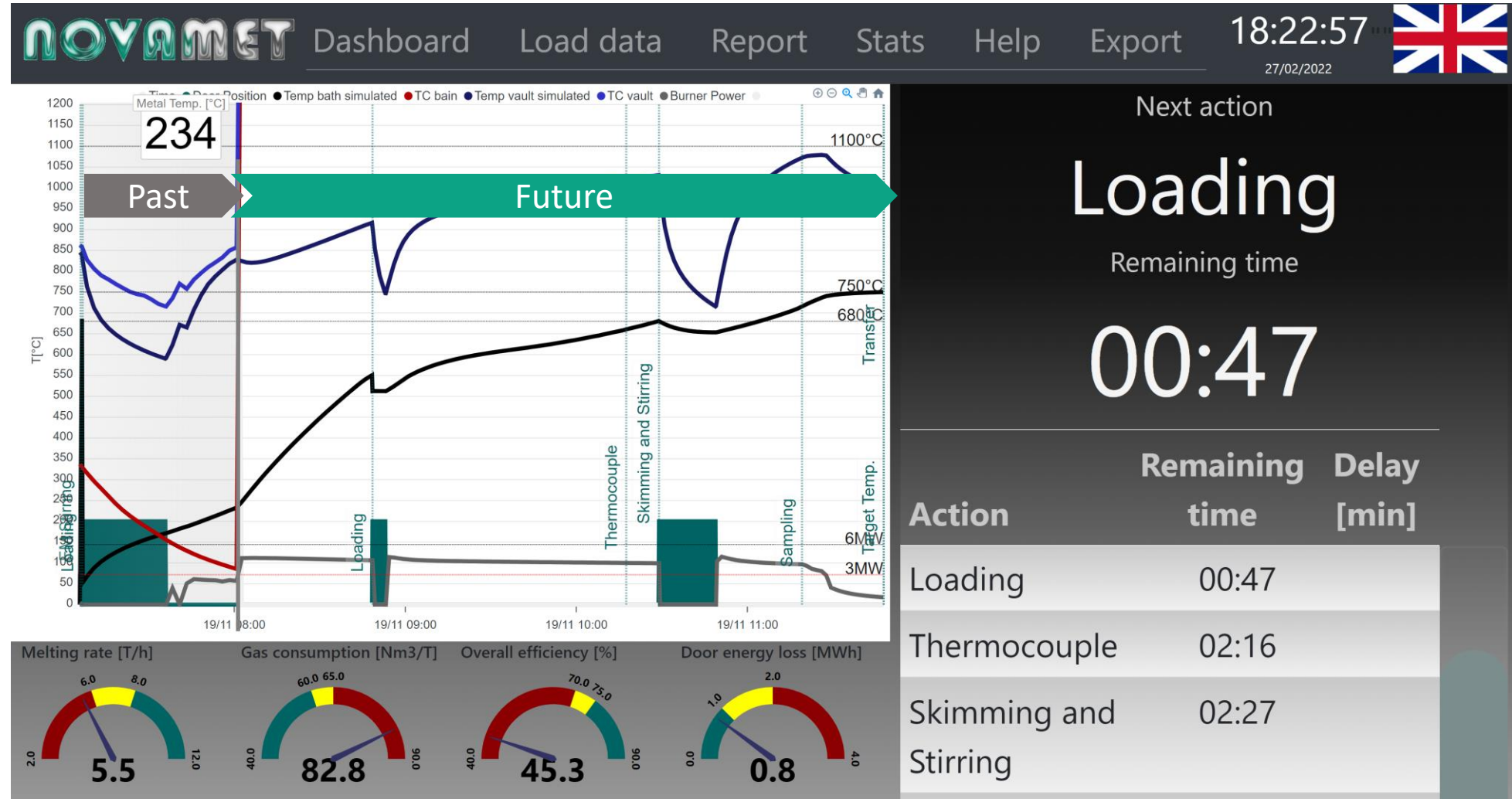
KPI view

Recommendations:
What to do, and when to do

2. SmartMelt helps to reduce variability by limiting human-based impact

Example of SmartMelt impact on gas consumption variability

Gas consumption variability (%)

No SmartMelt

With SmartMelt

Variation range (%)

Cycle number
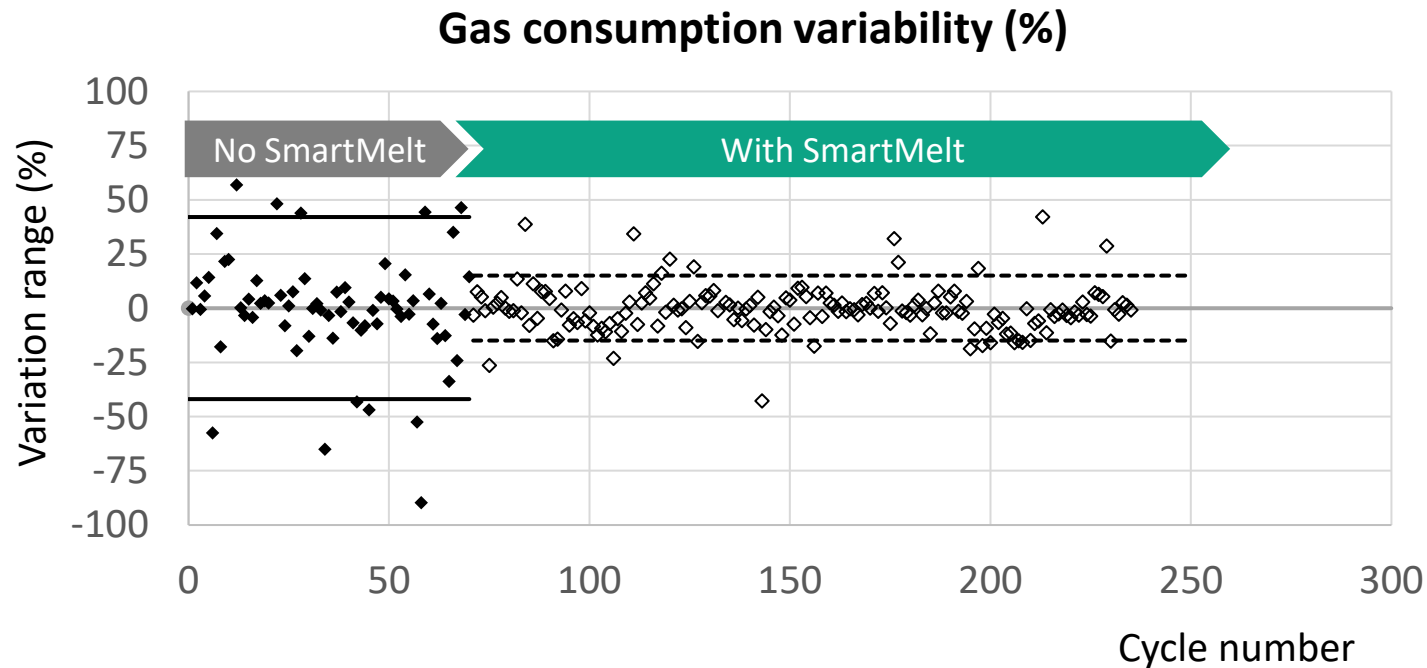
- ✓ **Reduction in variability Cycle-to-Cycle**
- ✓ **Transparency on Performance**
- ✓ **Augmented Operational Intelligence**

Note: this graphs shows % of variability. The average values are not absolute. Consider first an improvement of 10% reduction of average energy consumption before and after implementing SmartMelt.

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3. Simplefied reporting facilitates insight generation to drive continuous improvement

Example of SmartMelt reporting and predictions
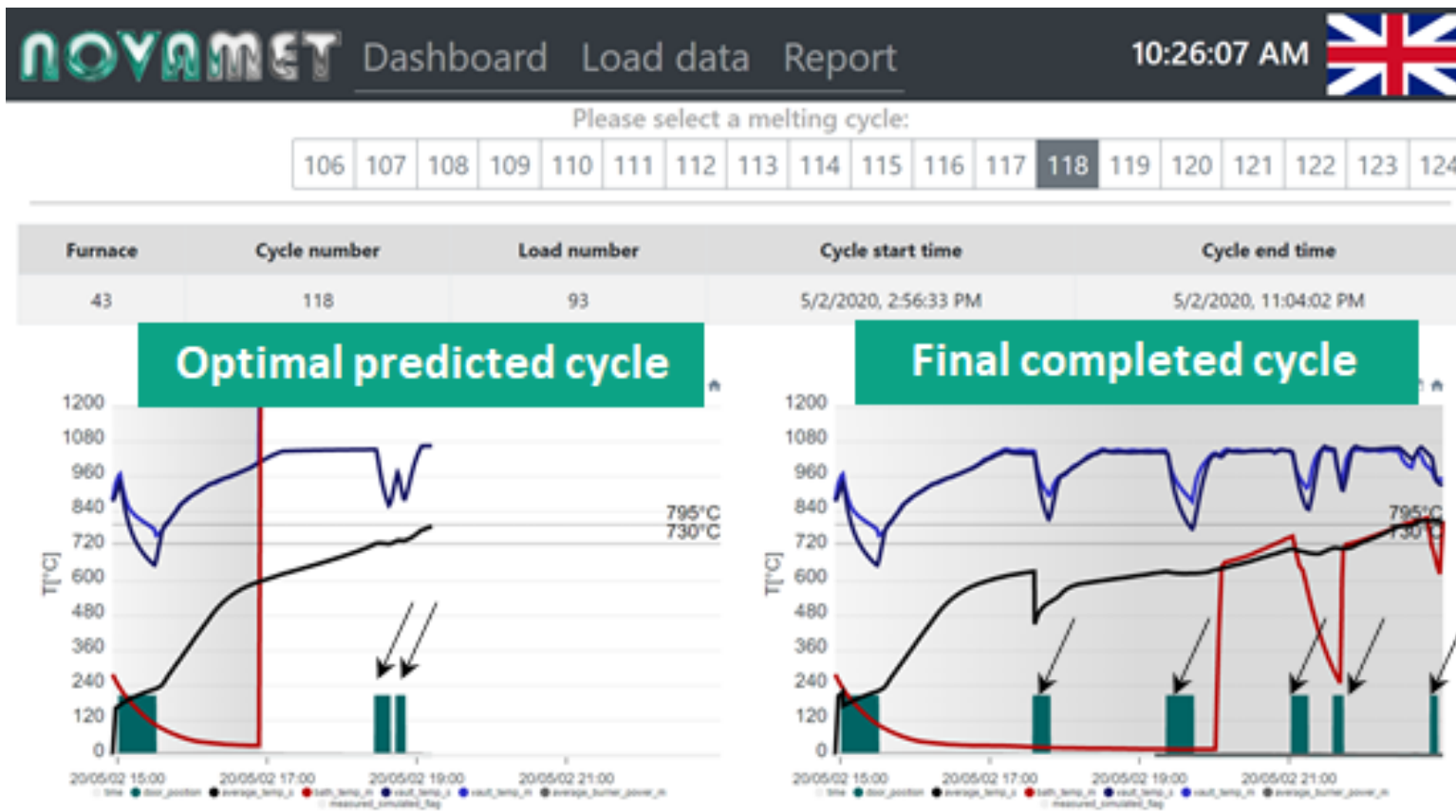
- ✓ **High accuracy predictions**

- ✓ **On-site and remote evaluation of precedent cycles**

- ✓ **Generation of historical data-base of cycles performance**

- ✓ **Potential for specific improvement actions**

Example of process inefficiencies
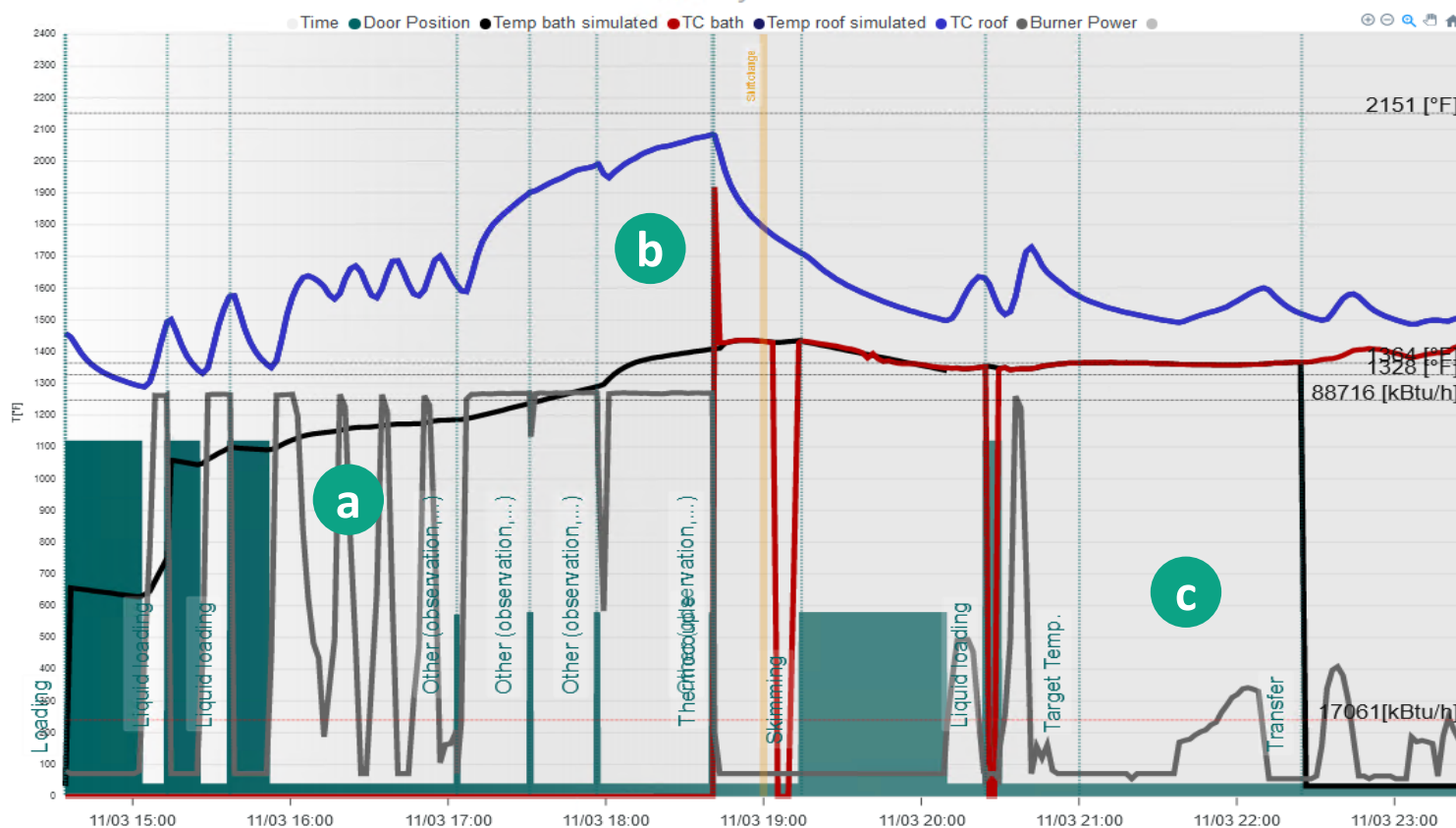
Problems detected

a. Burner power oscillation extending melting time

b. Delay in thermocouple insertion causing temperature overshoot

c. Delayed melt transfer causing energy losses

4. Rapid implementation of our unique solution, developed during 5 years of indus. collaborations

Rapid installation and training

- First installation could be realized in 2 months and around 2 weeks for the following furnaces
- Operators can be trained under 1h

Continuous support to sustain the impact

- Intuitive Human Machine Interface (HMI) facilitates transformation
- We reinforce the implementation via long term support and coaching to take the most of SmartMelt in the long term

Rapid return on investment

- Low CAPEX and OPEX
- Energy savings
- Variability reduction
- Simplified and standardized reporting to streamline daily operations

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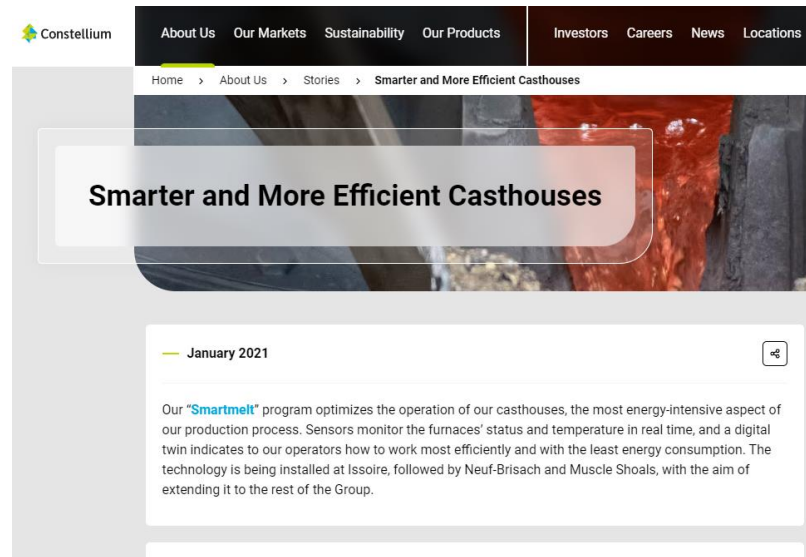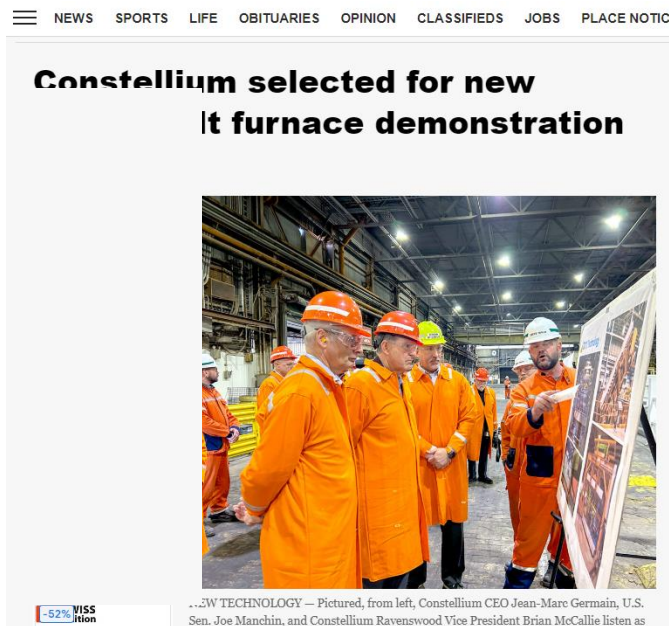
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SmartMelt in the news

Example news articles

Constellium selected for new
..lt furnace demonstration

..EW TECHNOLOGY — Pictured, from left, Constellium CEO Jean-Marc Germain, U.S.
Sen. Joe Manchin, and Constellium Ravenswood Vice President Brian McCallie listen as

Constellium

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Smarter and More Efficient Casthouses

— January 2021

Our "Smartmelt" program optimizes the operation of our casthouses, the most energy-intensive aspect of
our production process. Sensors monitor the furnaces' status and temperature in real time, and a digital
twin indicates to our operators how to work most efficiently and with the least energy consumption. The
technology is being installed at Issoire, followed by Neuf-Brisach and Muscle Shoals, with the aim of
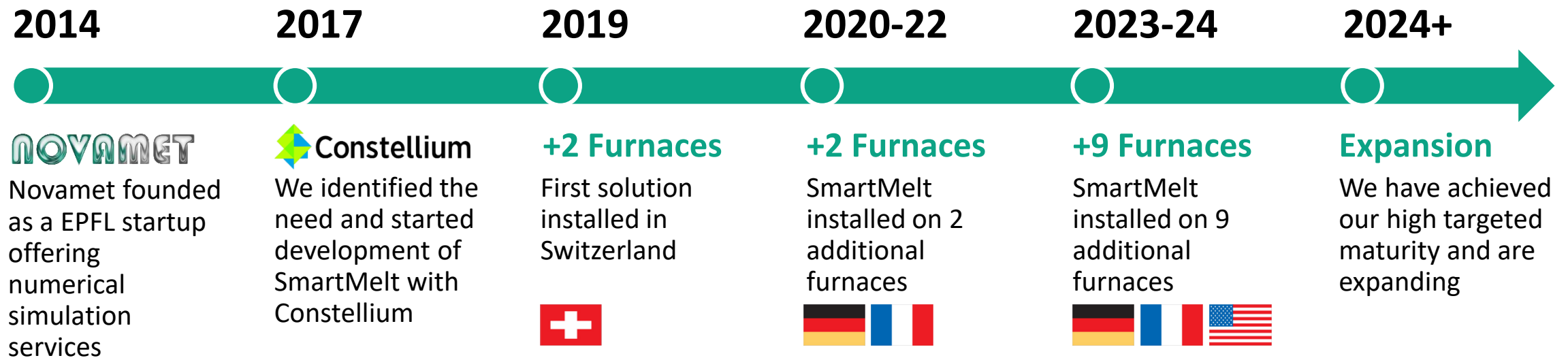extending it to the rest of the Group.

Example testimonials

"since February 2019, SmartMelt is running very smoothly at our Chippis plant. It is helping us to achieve safer loading practices, energy consumption reduction and overall more efficient melting cycles. We are eager to implement it in other casthouses of the group!"

Marc Bertherat, Casting Technical Assistance Manager

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We have been growing and maturing Smart melt since 2017

Development timeline

2014	**2017**	**2019**	**2020-22**	**2023-24**	**2024+**
NOVAMET	Constellium	**+2 Furnaces**	**+2 Furnaces**	**+9 Furnaces**	**Expansion**
Novamet founded as a EPFL startup offering numerical simulation services	We identified the need and started development of SmartMelt with Constellium	First solution installed in Switzerland	SmartMelt installed on 2 additional furnaces	SmartMelt installed on 9 additional furnaces	We have achieved our high targeted maturity and are expanding

We have successfully raised about 2MCHF of fundings

EPFL   Aim higher — EUROSTARS APPLICATION FORM   Schweizerische Eidgenossenschaft / Confédération suisse / Confederazione Svizzera / Confederaziun svizra — Swiss Confederation — Innosuisse – Swiss Innovation Agency   HORIZON 2020

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