

**ESTEP 2025 Annual Event**

28-30 October 2025  
Udine (ITALY)

How decarbonisation, digitisation  
and circular solutions forge the  
sustainable European steel future?



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# **HYBRID AI APPROACH**

## **Yield Improvement and Blend Optimization in DRI-EAF Steelmaking**



**DIGIMET**



**DANIELI AUTOMATION**



**UNIVERSITÀ  
DEGLI STUDI  
DI UDINE**  
HIC SUNT FUTURA

# Methodology



## Challenges & Approach

### Challenge:

Every 1% yield loss increases energy and CO<sub>2</sub> footprint

### Dataset:

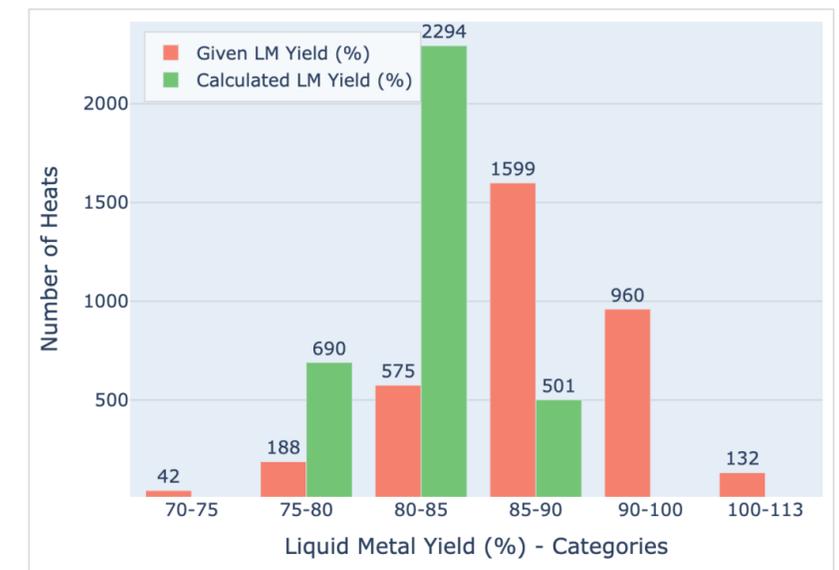
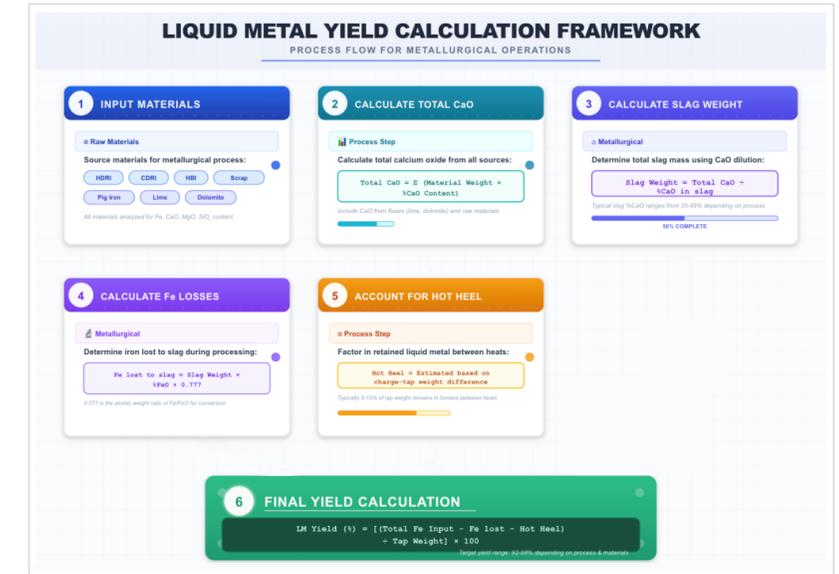
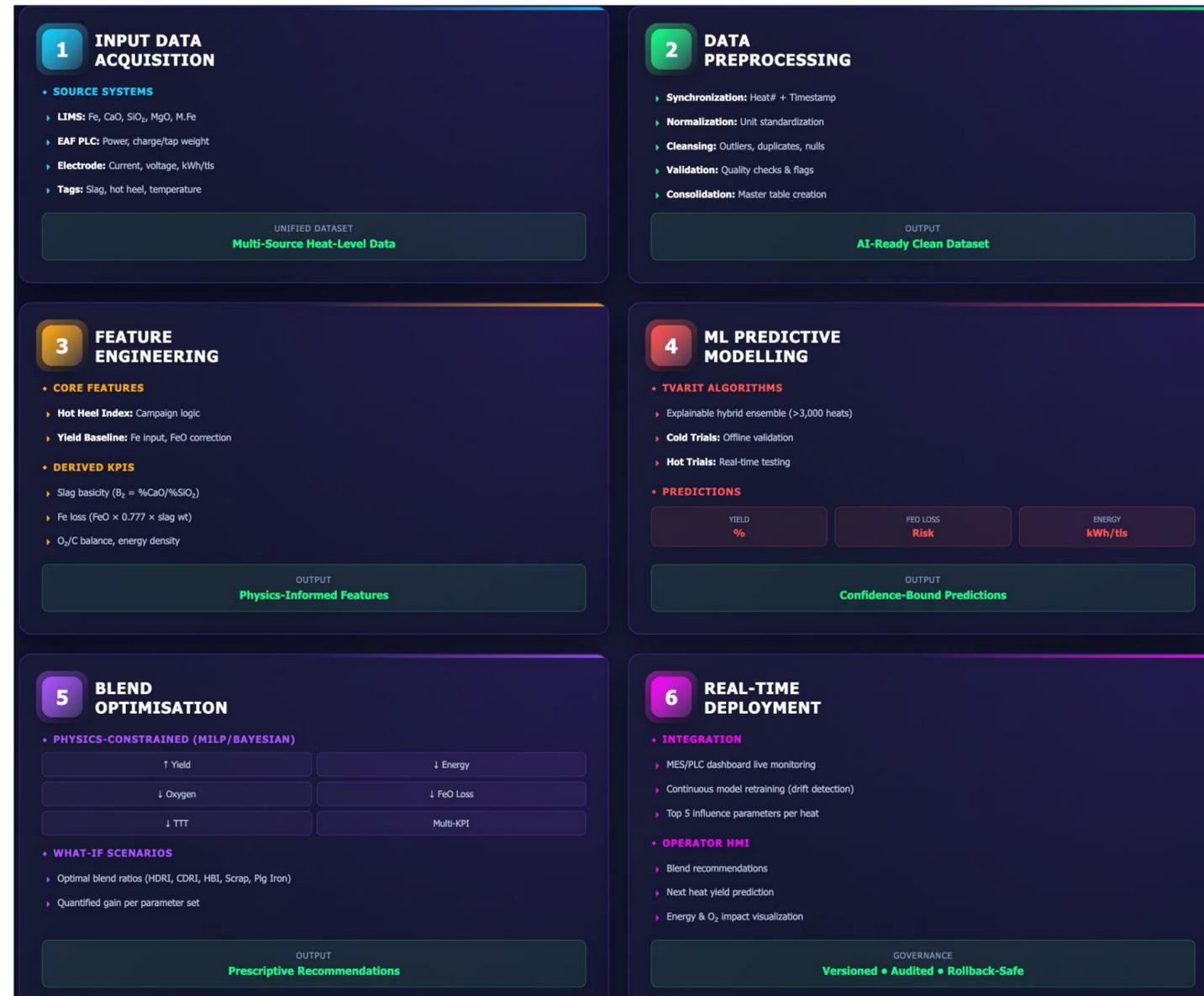
3,500+ heats

### Baseline:

Thermodynamics-based corrected yield (accounts for FeO losses, slag chemistry, hot heel)

### Hybrid AI:

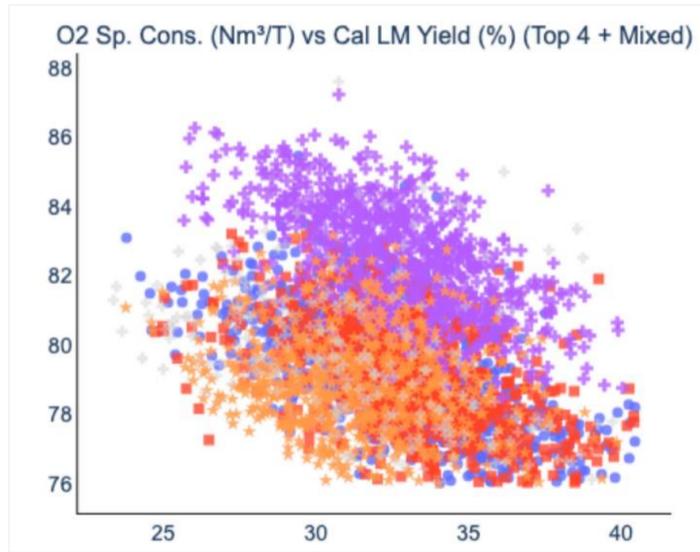
Combines metallurgical rules + ML-driven pattern recognition



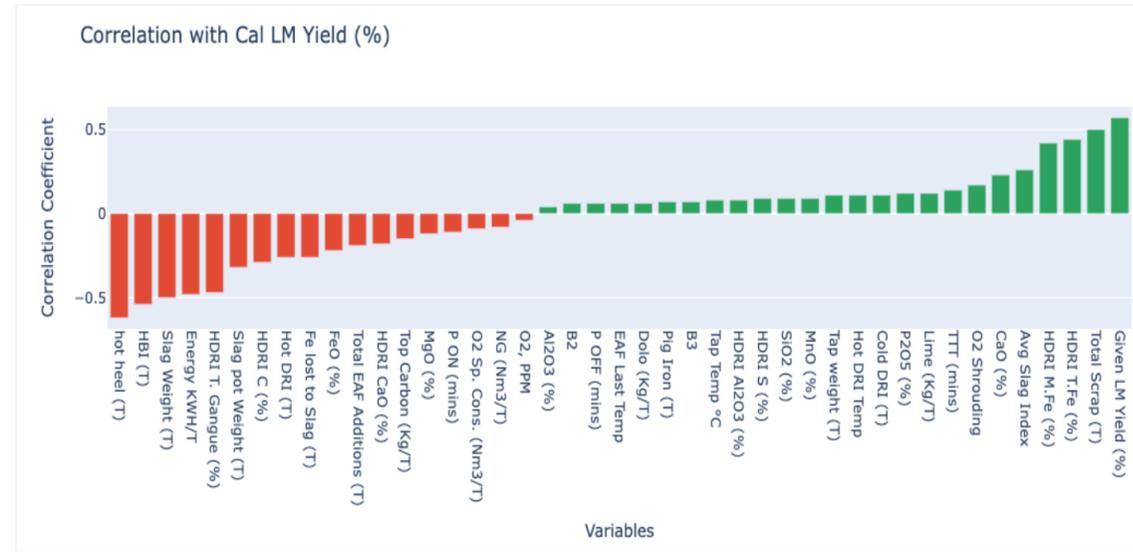
# Key Findings & Results



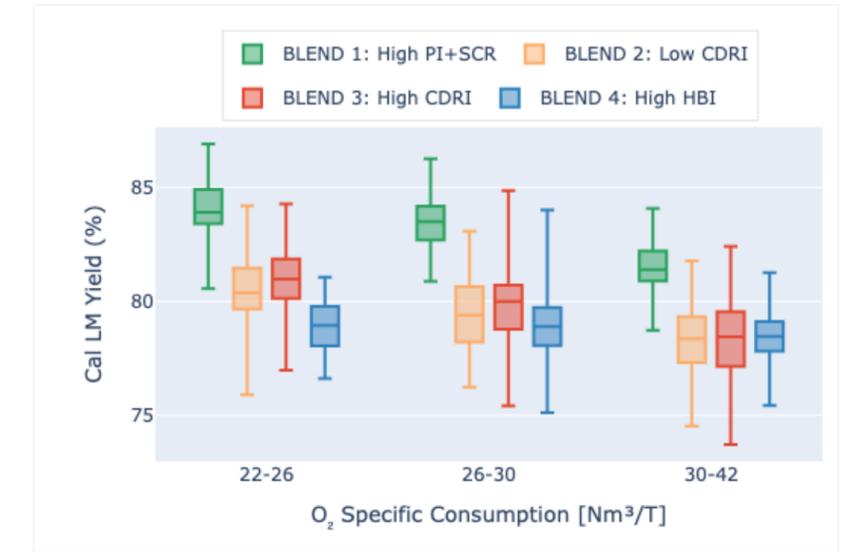
## Understanding Operating Practice



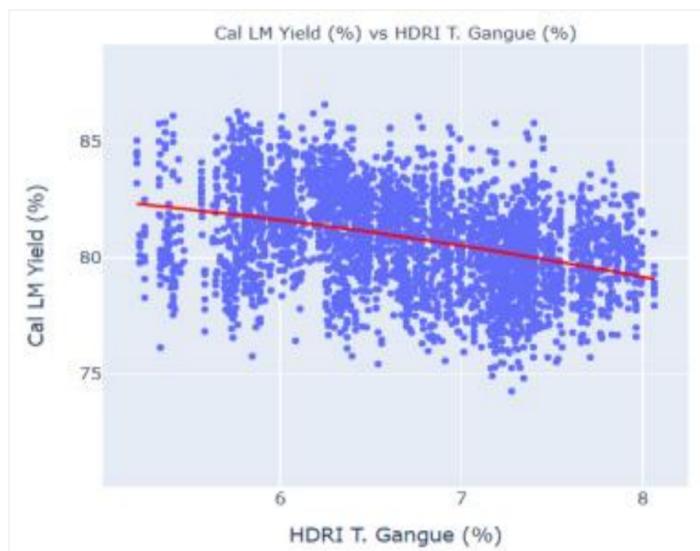
## Understanding and Validation of Correlation



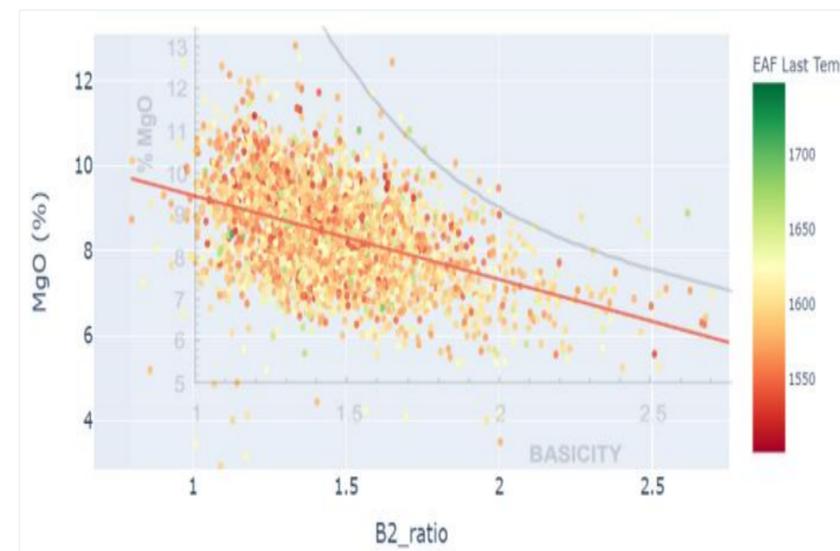
## Balancing Metallic yield and Optimum Blend Mix



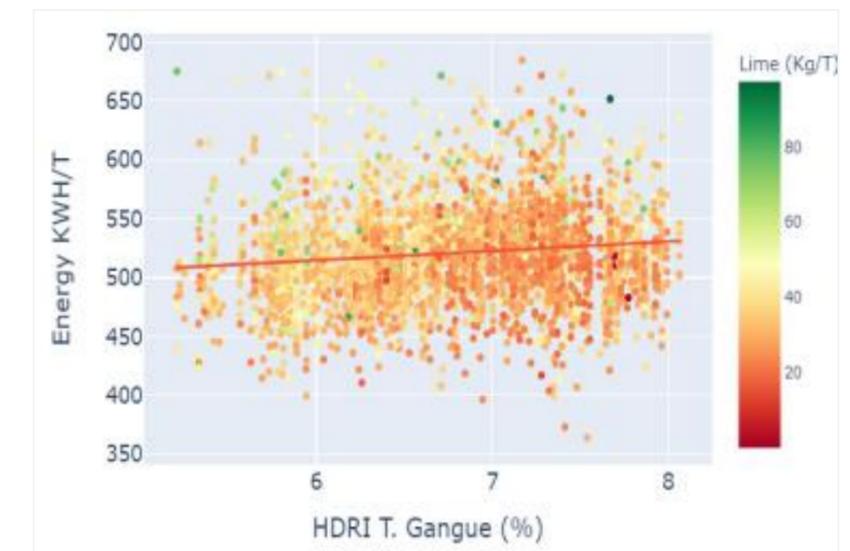
## Quantifying Effect of Raw Material Quality on Metallic Yield



## Addressing Refractory Life



## Effect of Raw Material Quality on Energy Consumption



# Impact & Implementation



## Key Performance Improvements

### Yield Gain: +0.5-1.0%

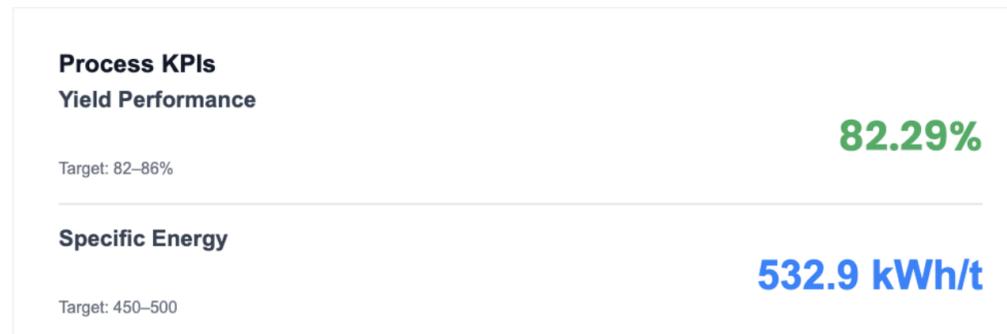
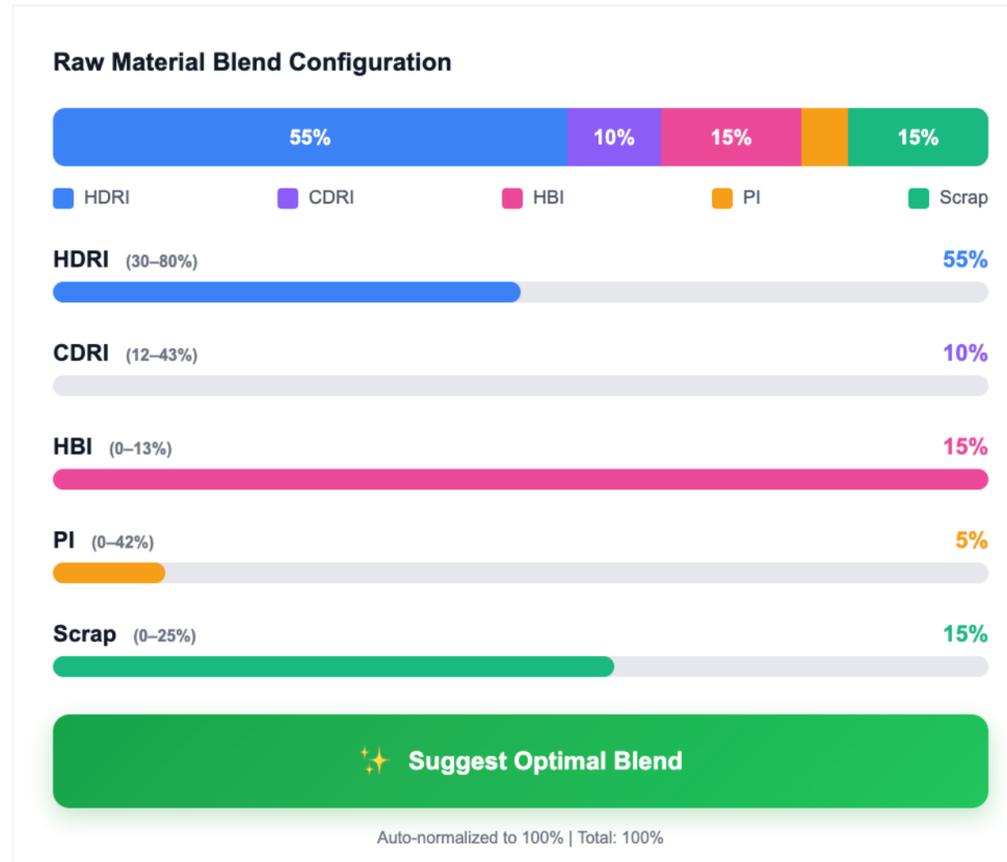
5-10 kg less Fe loss per ton of liquid steel

### Energy Savings: 15-25kWh/tls

Significant reduction in specific energy consumption

### Optimal Operating Ranges:

- ▶ O<sub>2</sub>: 26-33 Nm<sup>3</sup>/T
- ▶ C: 10-14 kg/T
- ▶ HDRI M.Fe > 84%, Gangue < 7%



# MANY THANKS!



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