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Y MEDIO AMBIENTE

# ekoSTEGUNA

ekoeraginkortasunaren osteguna | jueves de ecoeficiencia



## **HYPER- DEEPSCRAP Proiektua: txatarra ferrikoen sailkapen aurreratua labe elektrikorako**

**Project HYPER- DEEPSCRAP:  
Advanced classifier for ferrous scrap  
material as EAF main raw material**

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# ArcelorMittal

## Smarter steels for people and planet



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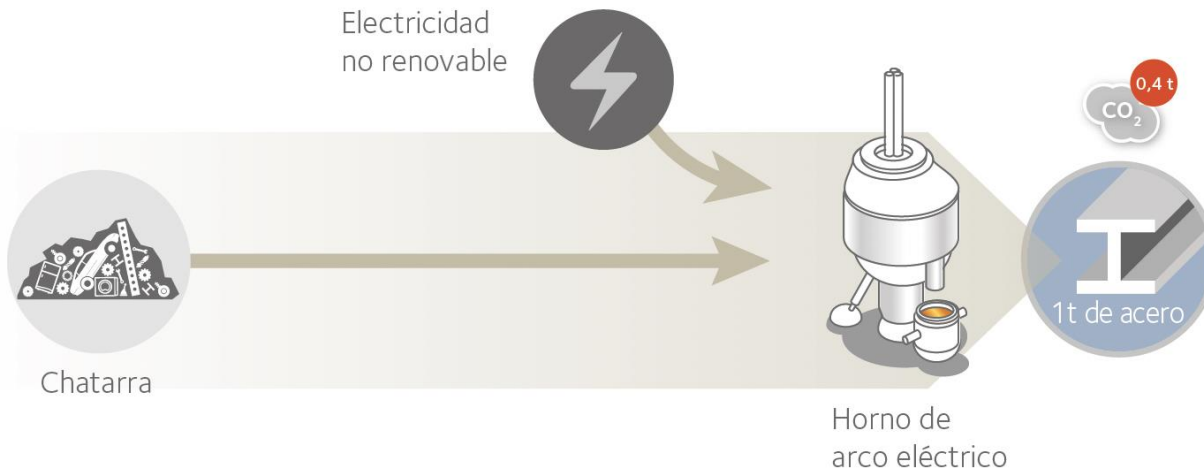
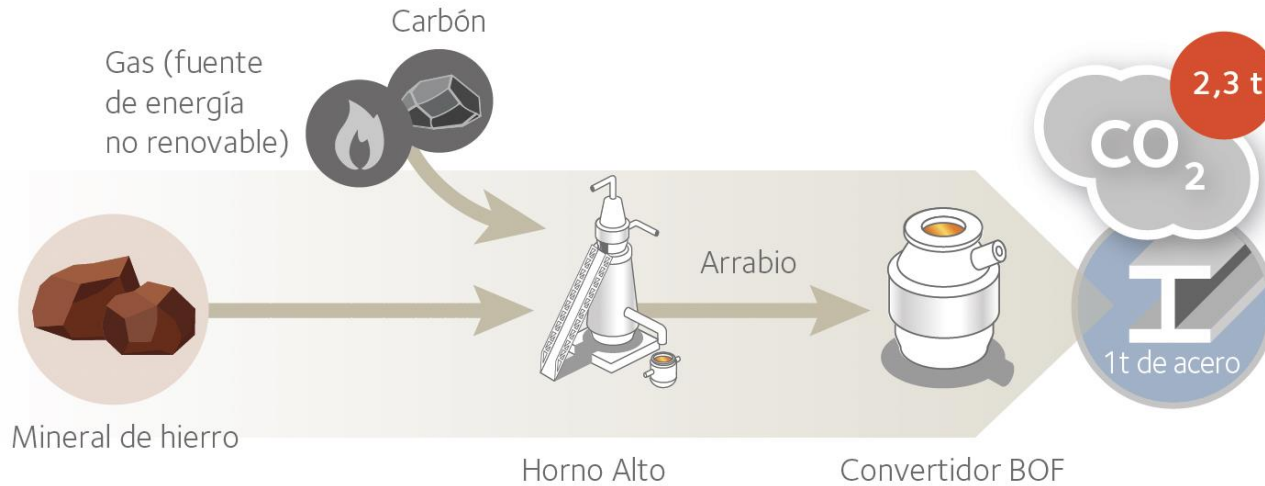
- The world's leading steel and mining company, with around **168,000** employees in more than 60 countries.
- Leader in all major global steel markets, including Automotive, Construction, Household appliances and Packaging, with leading R&D and technology.
- Primary steelmaking facilities in **18** countries expose the company to all major markets, from emerging to mature.
- A major producer of steel in the EU, North and South America, Africa and in the CIS region, and a growing presence in Asia, namely in China and India.
- One of the world's largest producers of iron ore and metallurgical coal strategically positioned to serve our network of steel plants and the external global market.



# RELEVANCE OF INNOVATION IN METAL FOR THE COMPANY'S STRATEGY



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*For 1 ton of Liquid Steel*

500 kg	Coke
350 kg	Cal
2250 kg	Iron ore
-----	
850 kg	Hot Metal
230 kg	Mixed scraps
6 kg	Iron ore
60 kg	Lime
20 kg	Dolomite
54 Nm3	Oxygen

*For 1 ton of Liquid Steel*

513 kg	Mixed scraps
423 kg	Iron ore
64 kg	Lime

# RELEVANCE OF INNOVATION IN METAL FOR THE COMPANY'S STRATEGY



The World is facing up a serious challenge regarding CO<sub>2</sub> footprint...



In Europe, around **70%** of the steel is produced **by integrated route**.

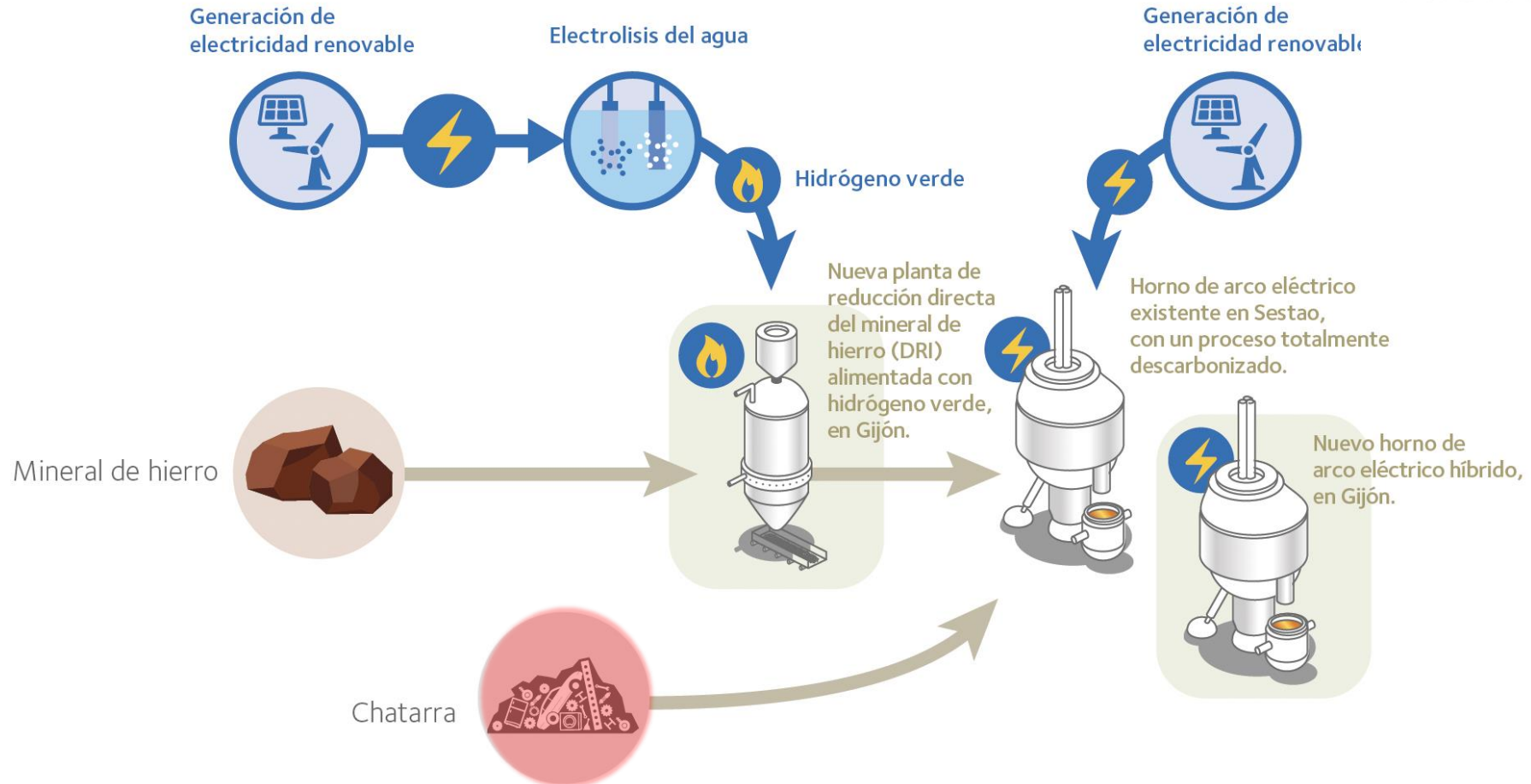
Clearly, Steelmaking industrial process needs to keep on working in **reducing its impact on environment**

**Steel is the most recycled material in the world**

**Scrap is part of the solutions to solve this environmental challenge**



# RELEVANCE OF INNOVATION IN METAL FOR THE COMPANY'S STRATEGY

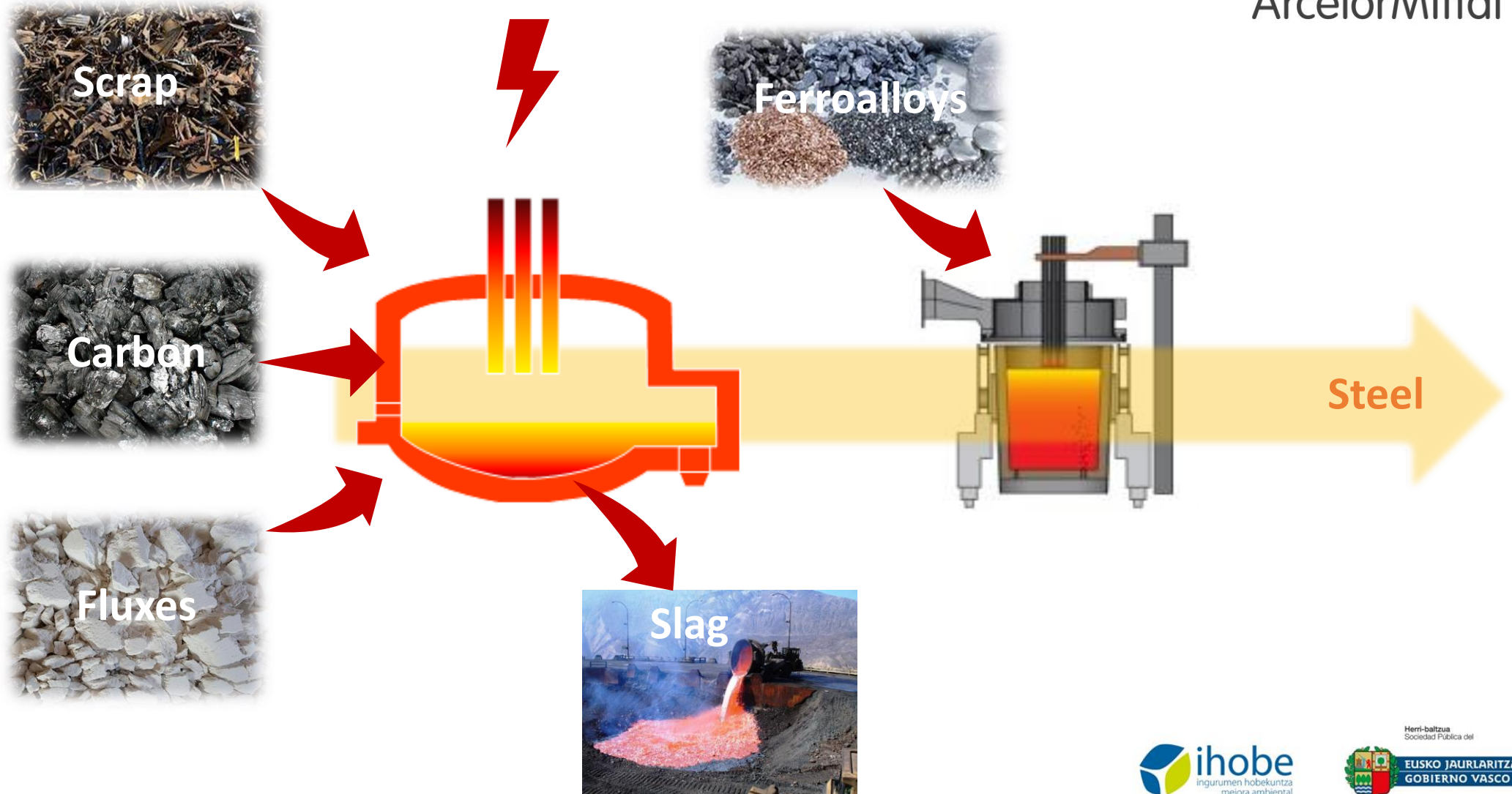


**Global Project to reduce CO2 emissions generated by ArcelorMittal in Spain by 50% by 2025**

# PROJECT MOTIVATION



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# PROJECT MOTIVATION



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The main problem with Ferrous scrap is that not all is scrap!

Non Ferrous metals



Dirt



Coatings / paintings

Non metallic materials



Rust



# PROJECT MOTIVATION



Nowadays, various scrap preparation and upgrading techniques exist and scrap yards use them to obtain good qualities of the different scrap types.

In ArcelorMittal, several steelmaking plants are installing “**Scrap Cleaning Machine**” for material upgrade.

However, ...

- Scrap is a **very complex material**, and the upgrading strategy varies from one type to other.
- Also, a new problem arise; we will generate and unknown **residues**

\* ArcelorMittal Olaberria



\* ArcelorMittal Dunkerque

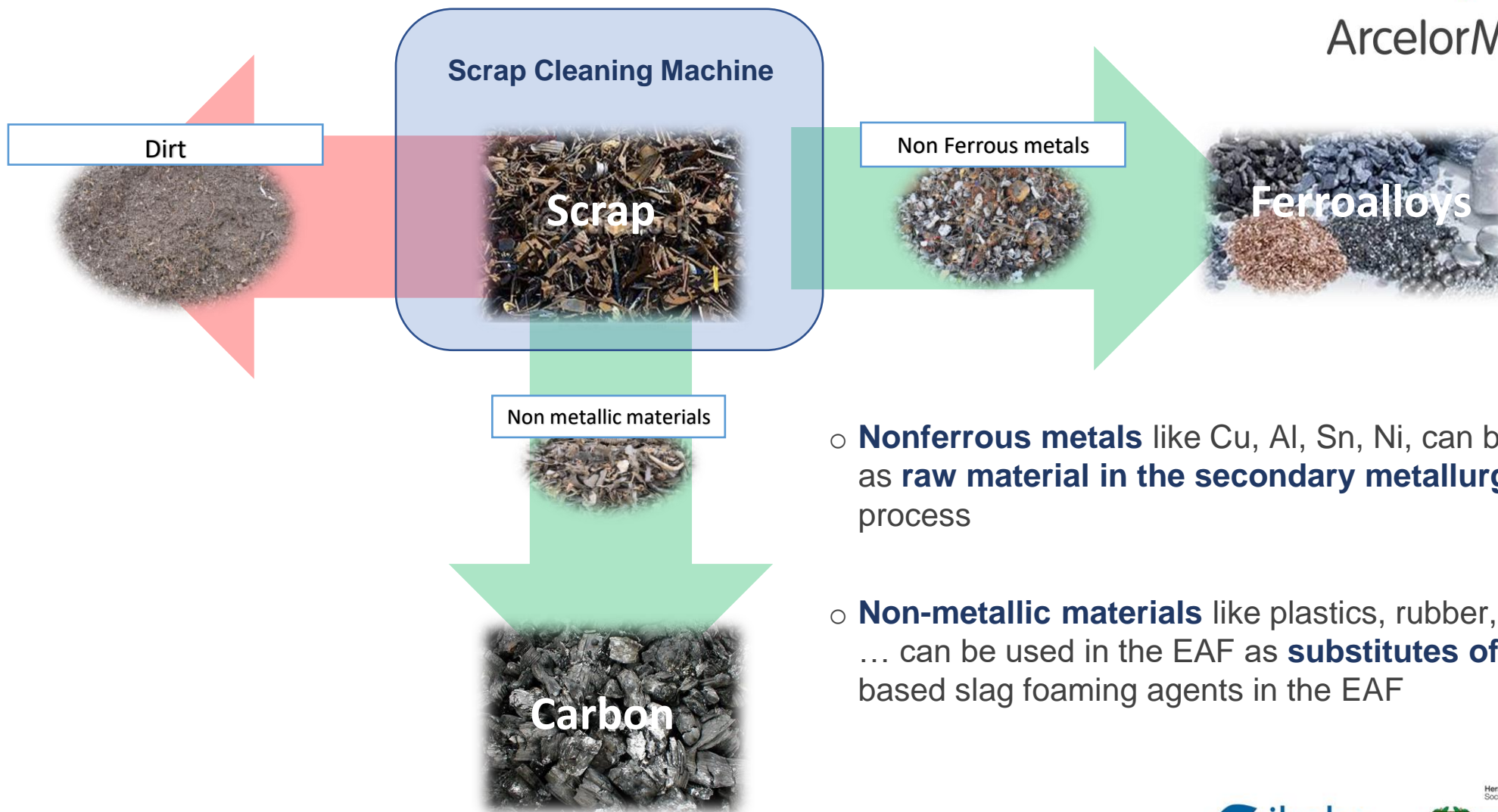


How to deal with this new challenge?

# PROJECT MOTIVATION



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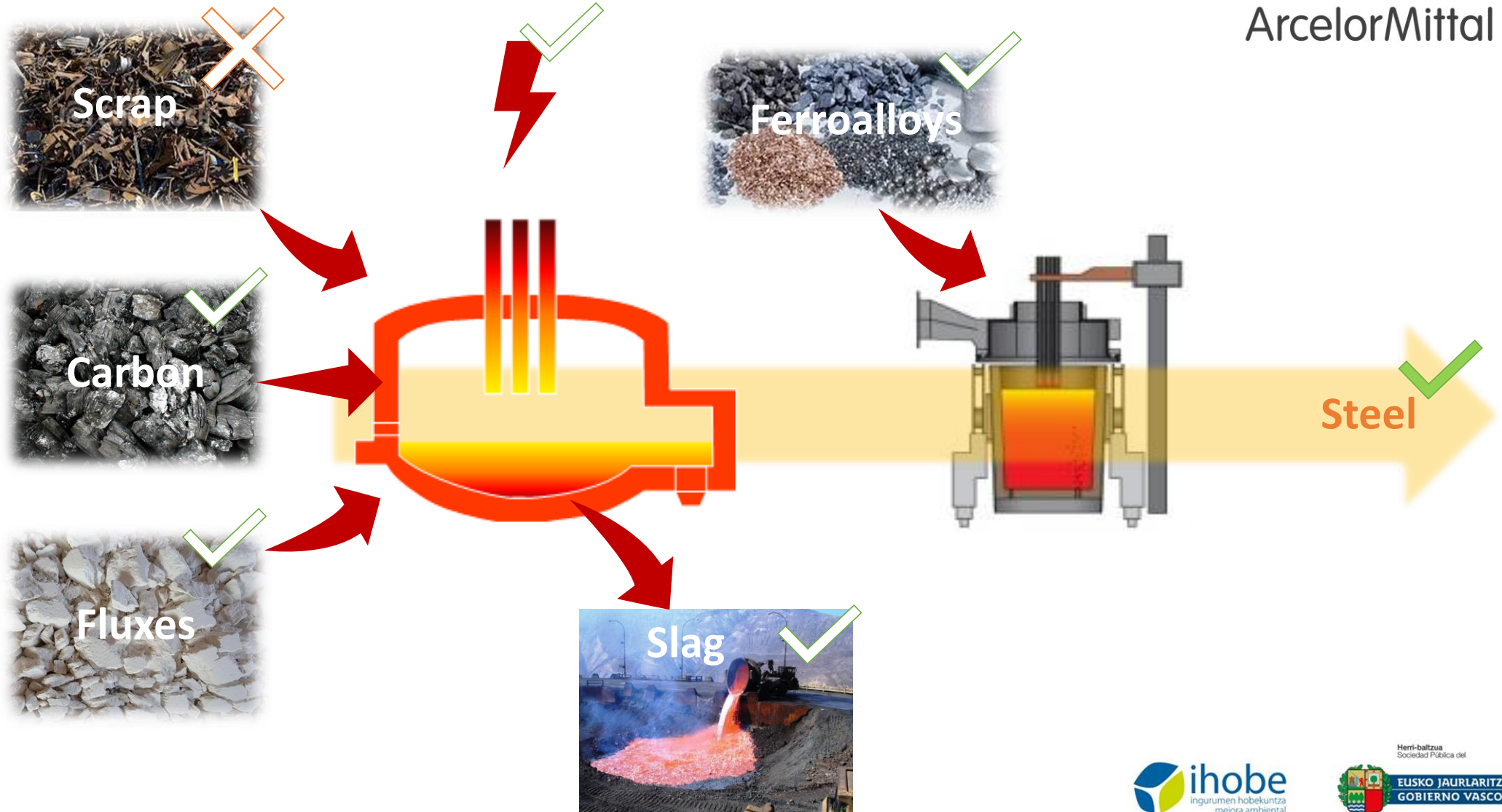


- **Nonferrous metals** like Cu, Al, Sn, Ni, can be used as **raw material in the secondary metallurgy process**
- **Non-metallic materials** like plastics, rubber, wood, ... can be used in the EAF as **substitutes of C** based slag foaming agents in the EAF

# PROJECT OBJECTIVE



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# PROJECT OBJECTIVE



**HyperDeepScrap Project focused on investigating efficient alternatives to facilitate an increase in obsolete scrap consumption in steelmaking**



Structure of the project:

- Analysis of the ability to improve the quality of obsolete scrap under current treatment schemes
- Analysis of the nature of EAF residues generated in the ferrous scrap cleaning process
- **Development of an automatic classifier for recovery materials contained in ferrous scrap for industrial process conditions**

Module 1  
Homogenisation

Module 2  
Separation

Module 3  
Characterisation

# OBTAINED RESULTS



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## Example in Module 3 for scrap characterization:

A new material classifier combining HybridSN 2D-3D DL architecture with Hyperspectral imaging for measuring the cleaning efficiency of conventional scrap cleaning machines

### 1- Laboratory set up

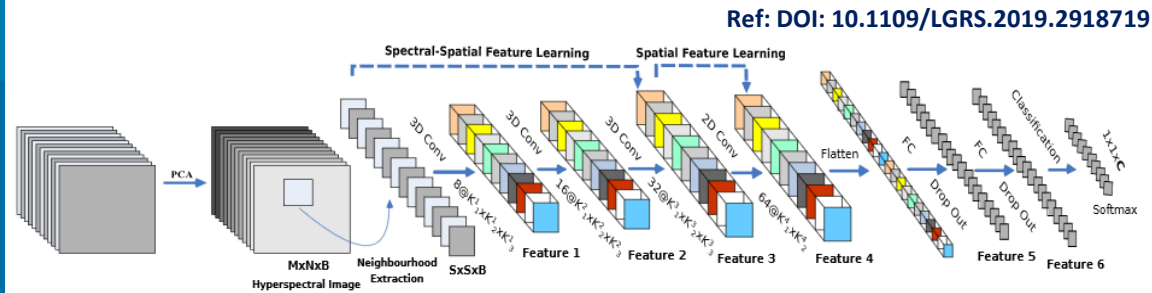
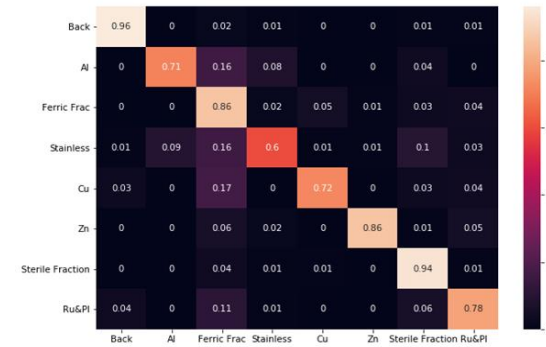


Fig. 1: Proposed HybridSpectralNet (HybridSN) Model which integrates 3D and 2D convolutions for hyperspectral image (HSI) classification.

### 2- Model development

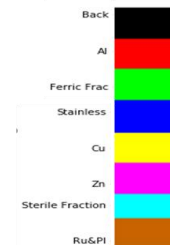
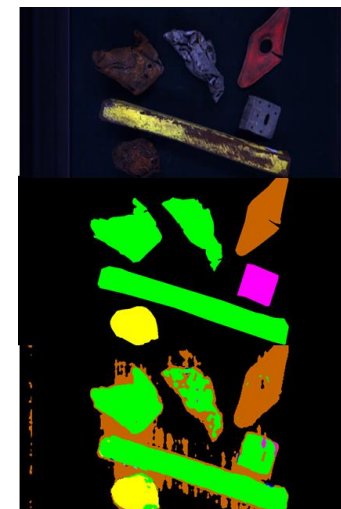


### 3- Industrial validation

Scrap metal cleaning machine in Dunkirk



### Hyperspectral cameras system



# CONCLUSION



**For an efficient management of steelmaking operations, close quality control of scrap is a must**

## **However:**

- **The Ferrous Scrap is probably the most complex raw material in industry**
- **The quality of scrap is expected to get worse in the coming years**
- **There will be a lack of High-quality ferrous materials motivated by the transition BF-BOF to EAF**

## **How to answer steelmakers needs?**

- **Different scientific disciplines need to be merged for getting useful results; Process knowledge, material science, spectroscopy technologies, machine vision, logistics, AI, chemical analytics, Digital solutions, ... and **We cannot do it alone****

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LOGO BIEN VISIBLE DE EMPRESA