

Enhancing slag valorisation: from advanced modelling techniques to decision-making tools

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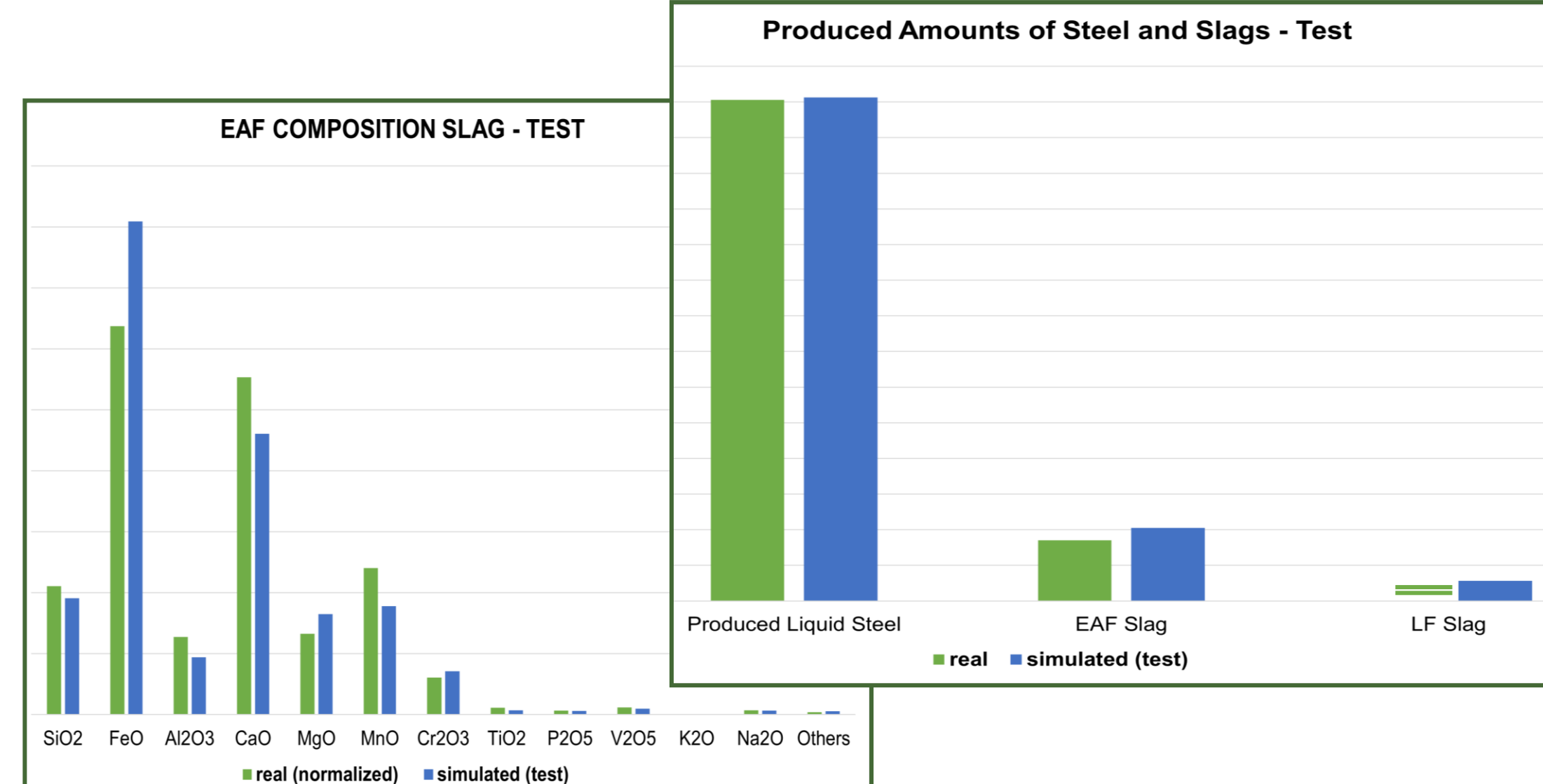
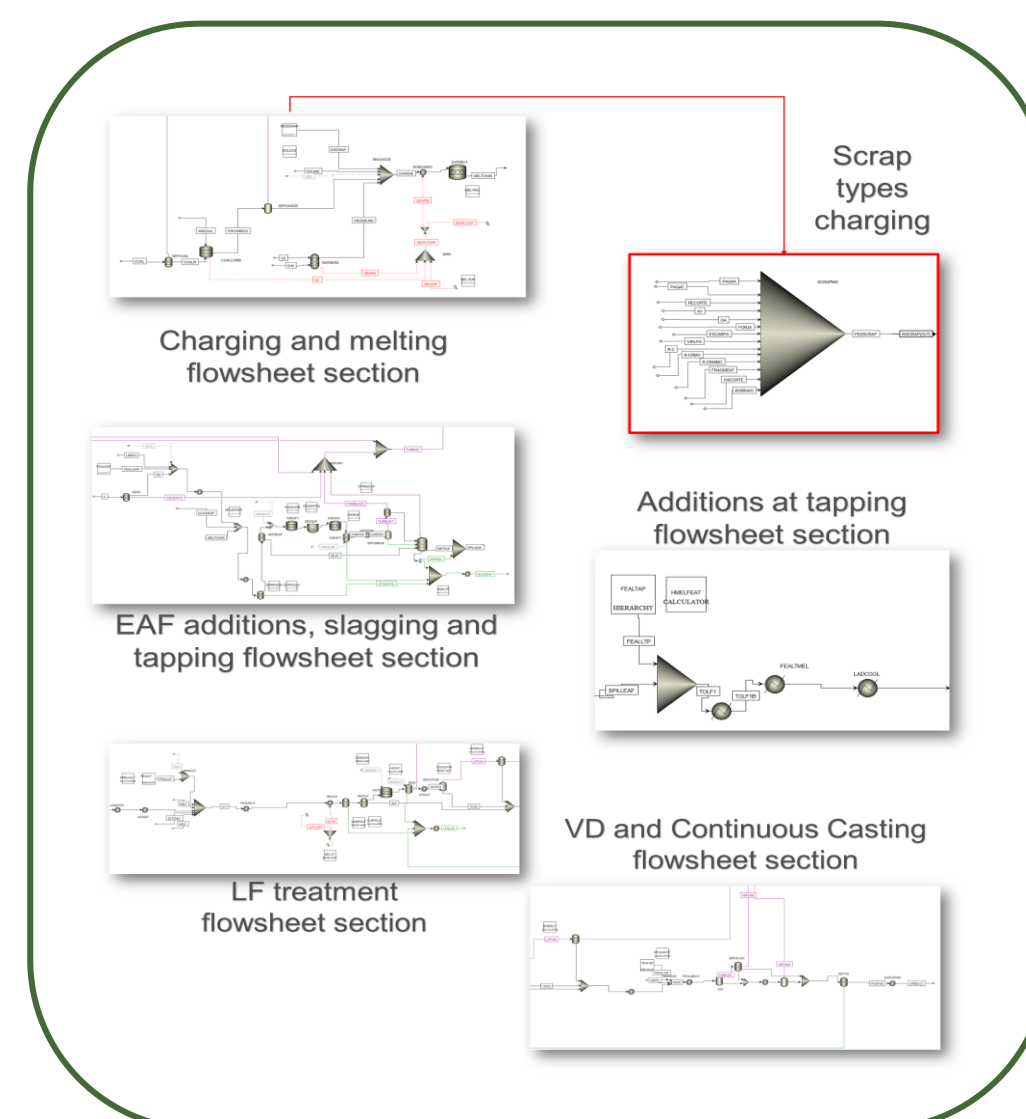
Introduction

The project **iSlag** aims at optimising the valorisation of slag produced by electric steelworks, avoiding wasting valuable products, improving the circularity of the sector and implementing Industrial Symbiosis solutions. The main goal is to identify best practices and select the optimal way to reuse and recycle the slag through the development of digital tools starting from the forecasting of the slag amount and characteristics.

Flowsheet model

The model reproduces all the different steps and phenomena involved in the whole electric steelmaking route.

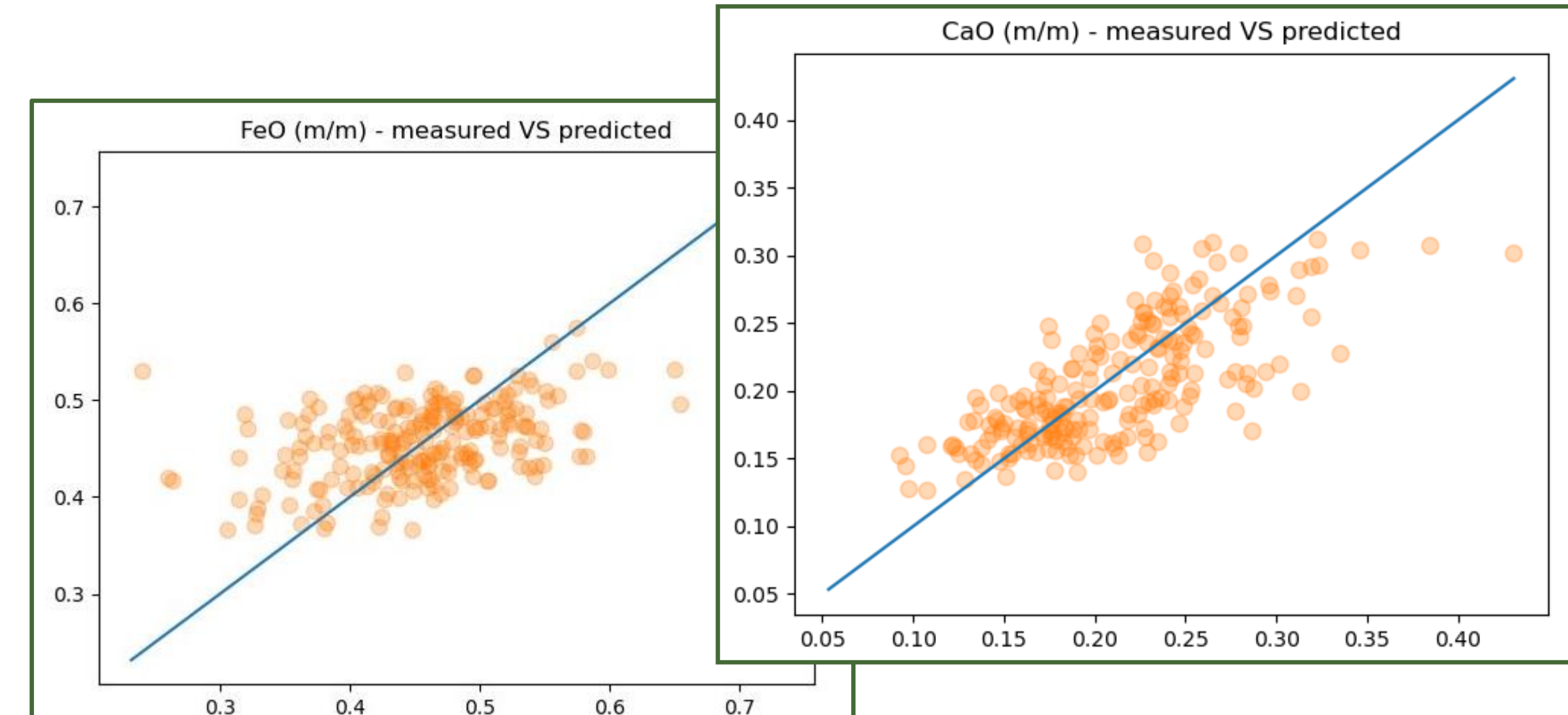
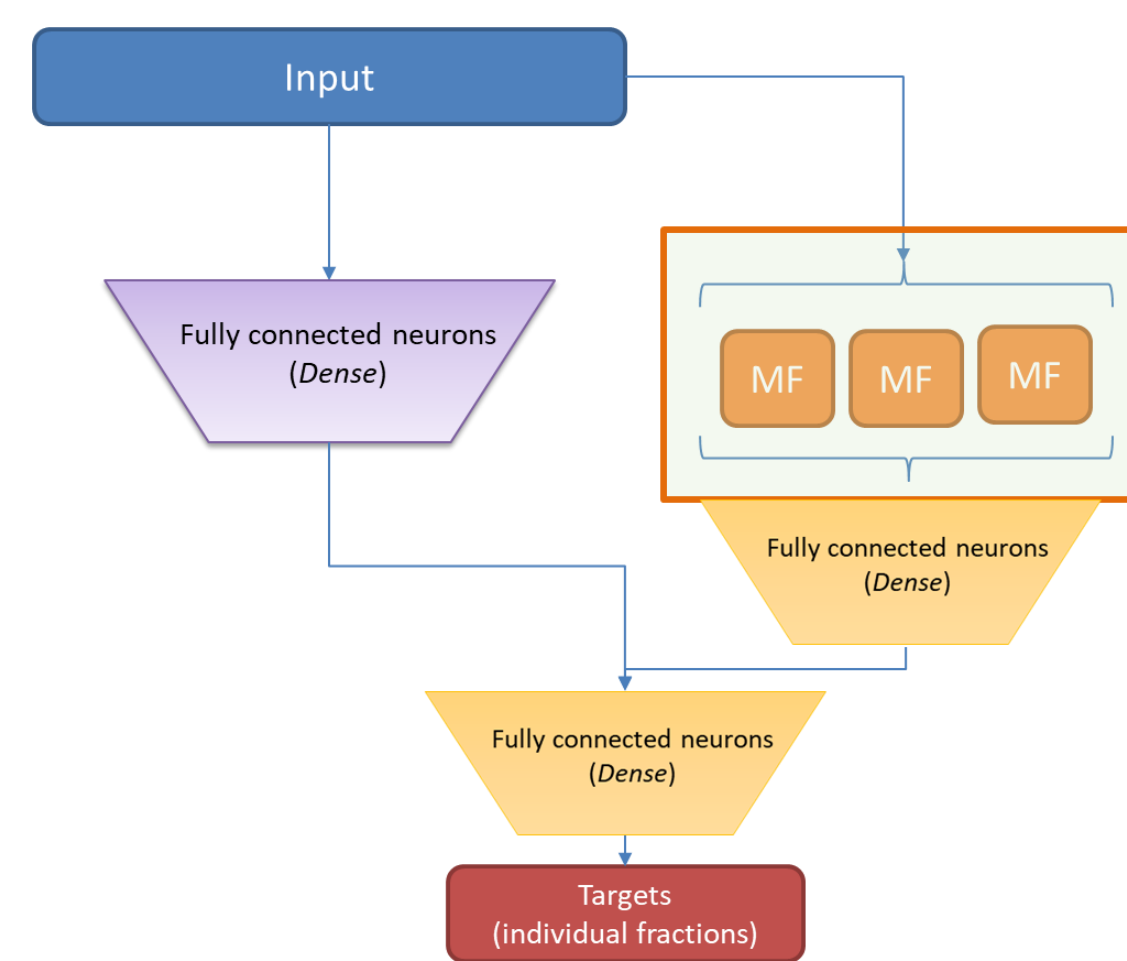
- **Estimating** the amount and chemical composition of slags and liquid metal.
- **Monitoring** the energy consumption and CO₂ emissions.
- **Scenario Analysis** for different and/or unusual operative conditions.
- Supporting the **classification** of potential recycling paths.



HYbridNet - Physics Informed Neural Network

A **hybrid model** was developed combining the physical model within a Deep Neural network architecture. It uses real process data and physical model outcomes.

- **Prediction** of slag amount and chemical composition.
- Useful for **real-time decision-making**.
- HybridNet is optimized by using experimental data.

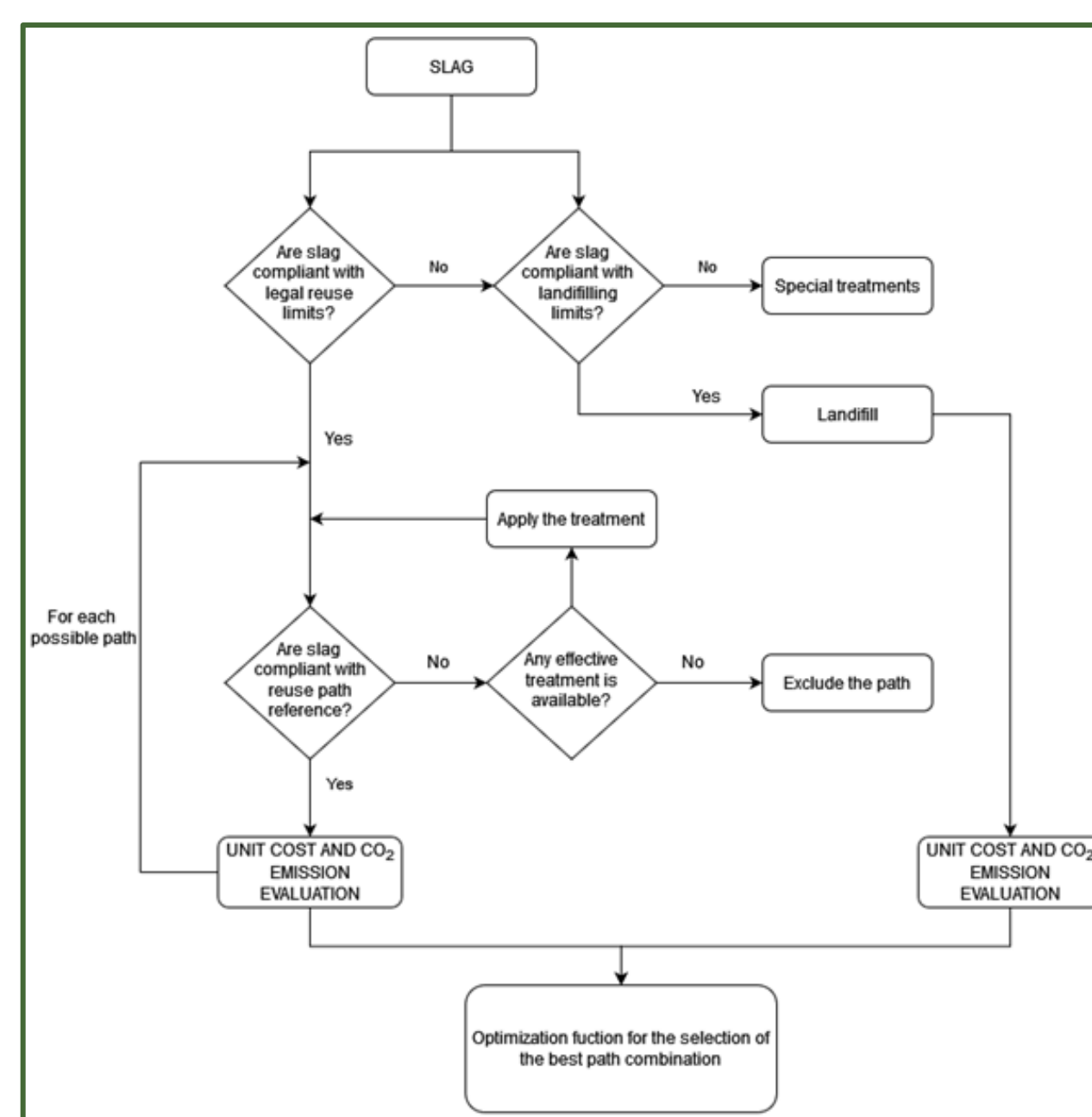


Decision Support System - iSlagDSS

The main purpose is to provide users with a support tool to select the best combination of the **possible recycle/reuse paths** for slag.

- **Costs and CO₂**: slag storage, transportation, treatments, and revenues for slag selling.
- **Legal limits** for reuse and landfilling are automatically managed. The **requirements for each possible path** are considered.
- Other specific parameters, function of the specific plant location could be inserted by the users through a Graphical User Interface.
- Tested for Italy and Germany.

The **optimization strategy minimizes costs and CO₂ emissions**.



Italy Case Study

Path	Active	Cost	CO2
path Agg armoustone	0	0	0
path Agg concrete	0.6666667	-0.003	0.011424
path Agg construction	0.3333333	-0.008	0.001424
path Agg mortar	0	0	0
path Agg railroad	0	0	0
path Agg road	0	-0.003	0.011424
path Internal reuse	0	0	0
path Landfill	0	0.012	0.00178

Path	Active	Cost	CO2
path Agg concrete	0.5	-0.008	0.00178
path Landfill	0	0.102	0.001424
path SWS 1	0	0	0
path SWS 2	0.5	-0.004	0.000712

Germany Case Study

Conclusions

The presented digital tools contribute to decrease the amount of landfilled slag and increase revenues from slag valorization through the estimation and forecasting of the slag properties. They provide practical support to workers in finding the best valorization paths for slag, promoting Circular Economy and Industrial Symbiosis solutions.

Acknowledgment

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