This project has received funding from the Research Fund for Coal and Steel under grant agreement No 101150482.

HBI C-flex workshop

Safe H-DRI

Safe transport of DRI from H2-based direct reduction considering quality-related H-DRI reactivity, stability, the efficiency of passivation methods and health and recycling aspects

Valentina Alemanno

Online workshop

February 25th, 2025

Safe H-DRI

AGENDA

1) Introduction
2) Project Objectives
3) Key Activities
4) Current Progress
5) Next Steps
6) Q&A

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Introduction
Project overview

Safe transport of DRI from H_2-based direct reduction considering quality-related H-DRI reactivity, stability, the efficiency of passivation methods and health and recycling aspects

Start date
1.10.2024

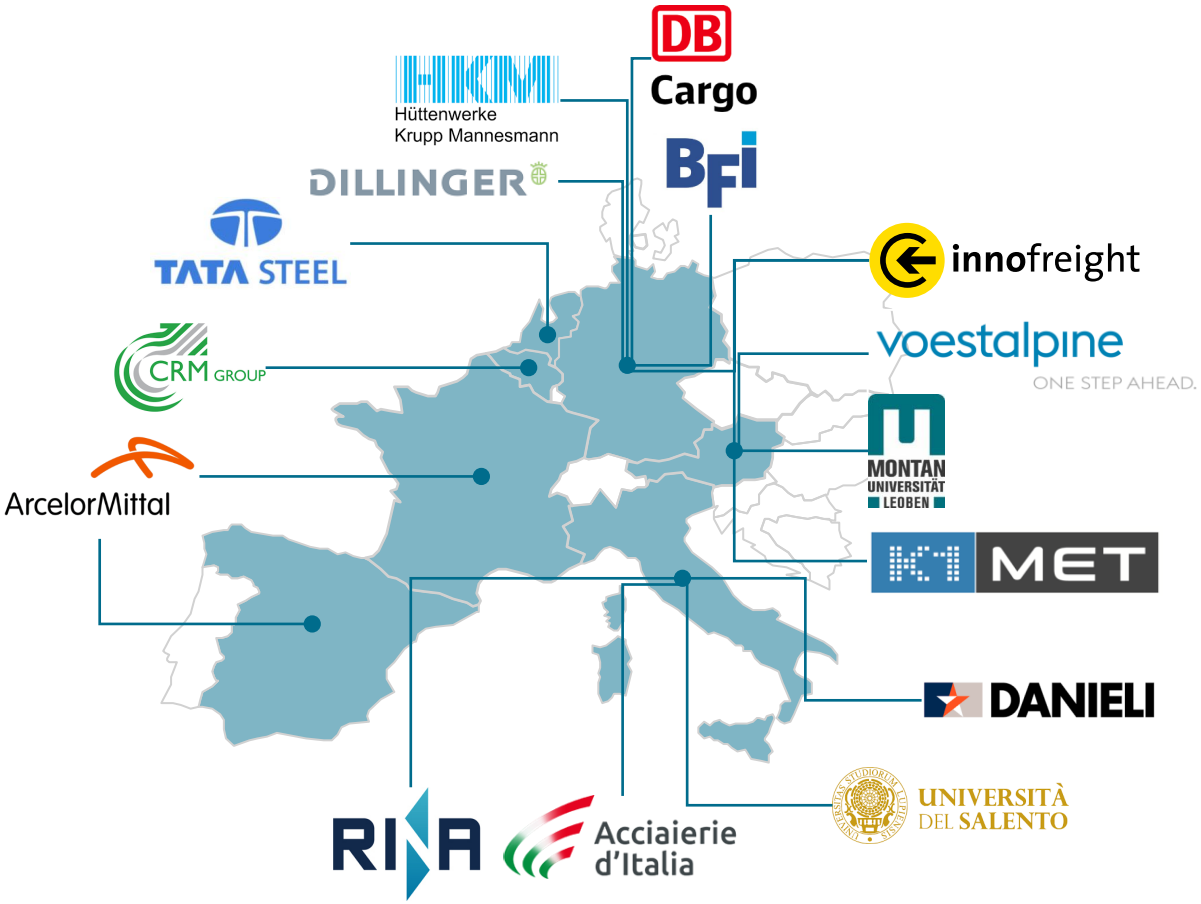
Duration
42 months

➢ Overall objective:

- Development of a safe and standardized logistic chain for H-DRI transport and handling, while ensuring increased sustainability and the use of lower-grade iron ores that are often underutilized

➢ Context:

- Transition toward decarbonization (critical challenge for the European steel industry) with the goal of achieving climate neutrality by 2050.
- Alignment with the European Green Deal and the Clean Steel Partnership: development of breakthrough technologies for low-carbon steel production



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Project objectives

Key objectives

1. **Develop a safe and efficient logistic chain for H-DRI:**
   Design, loading, transport, unloading, and storage tailored to the specific requirements of H-DRI.

2. **Enhance the utilization of lower-grade iron ores:**
   Such as blast furnace-grade pellets and recycled fines, to produce high-quality H-DRI using 100% hydrogen or mixtures hydrogen-ammonia

3. **Understand and mitigate risks of H-DRI reoxidation:**
   Investigate reoxidation behavior under various conditions, like exposure to dry or humid air, saltwater, and temperature variations, to prevent hazards such as self-heating, ignition, and explosions.

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Images sources: web.

Project objectives

Key objectives

4. **Quantify fines and develop recycling solutions:**
   Assess crack formation and fines generation during H-DRI handling and develop strategies for their reuse, reducing material losses.

5. **Standardize transport systems and guidelines:**
   Update existing guidelines and develop innovative standards for H-DRI transport based on the project's findings to ensure safe handling and logistics.

6. **Explore passivation methods to ensure safety:**
   Evaluate and refine passivation techniques (e.g. coatings and treatments) to minimize risks during transport, while preserving metallization and reducing dust generation.

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Images sources: web.

Project objectives
Key goals

- ✓ Decarbonizing the European steel industry
- ✓ Reducing CO_2 emissions
- ✓ Ensuring safety and efficiency throughout the H-DRI value chain
- ✓ Innovative solutions for the increasing demand for H-DRI and its role in achieving a low-carbon, resource-efficient future.

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Project objectives
Overview of H-DRI chain

Safe H-DRI

Varying iron ore qualities

Direct reduction

Pellets, lump ore

H_2, NH_3

H_2-based Direct Reduced Iron (H-DRI)

Reoxidation (H-DRI reactivity)

Varying reoxidation conditions

Sealing cover

Water

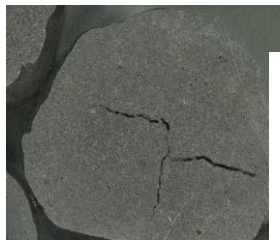
H-DRI sample

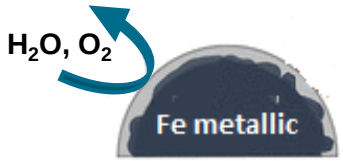
Thermogravimetric analysis (TGA)

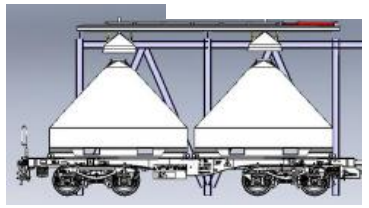
Varying H-DRI quality

Varying passivation methods

Crack formation analysis
H-DRI passivation
Transport system design







Dust & fines

Briquetting

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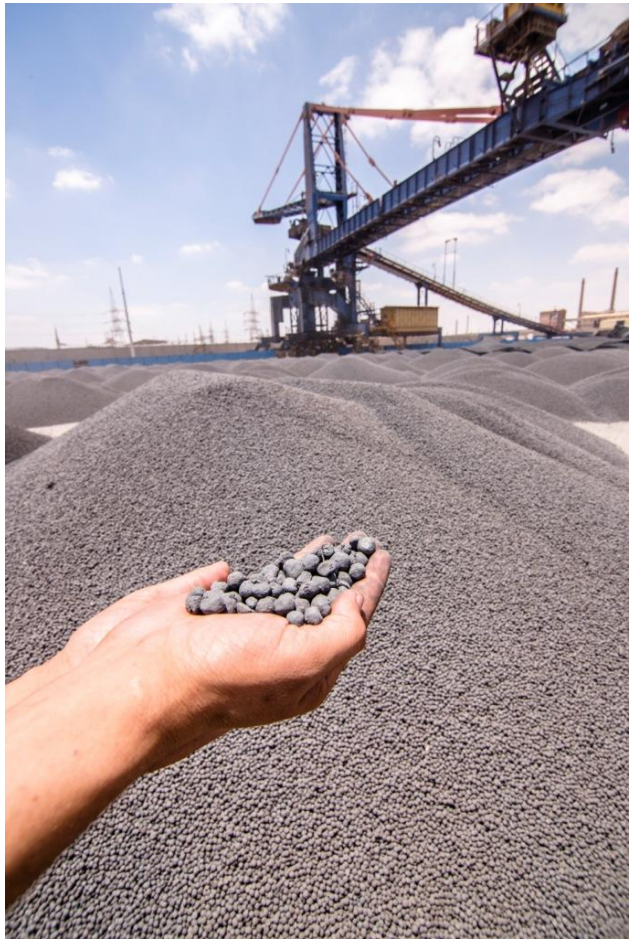
Key activities
Project structure



WP1: Project management and coordination (K1-MET)

WP2: Production of H-DRI with different qualities and reoxidation behavior (MUL-CFM)

WP3: Process analysis and product quality evaluation (ADI)

WP4: Examination of H-DRI stability, risks for dust explosion during handling and H-DRI passivation methods (TATA STEEL)

WP5: Concept for the adaption of the equipment and logistic processes to transport H-DRI and project exploitation (IFSOL)

WP6: Dissemination and communication (RINA-CSM)

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Key activities
Methodology

✓ Assessment of the H-DRI value chain:

- Entire H-DRI process, from raw material selection (low-grade ores) to transport, handling, storage, and reoxidation mitigation
- Expertise from metallurgical, safety, and logistics disciplines to ensure a robust analysis.

✓ Experimental campaigns in controlled and “real” conditions:

- Lab-scale tests to investigate reoxidation, passivation, and fines generation under simulated transport and storage
- Industrial-scale trials, including real-environment tests at seaports and rail transport simulations, to validate results and practical applicability.

✓ Multidisciplinary consortium:

- Close collaboration between industry leaders, research organizations, and logistics providers to have different expertise.
- Partners contribute advanced tools such as climate chambers, reduction furnaces, and computational modeling for detailed analysis.

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Key activities
Methodology

✓ Innovative passivation and handling strategies:

- Passivation techniques, such as coatings or controlled aging, to minimize H-DRI reactivity and improve safety during handling and transport.
- Optimize logistical systems, including container design and transport guidelines, tailored for H-DRI requirements.

✓ Recycling and circular economy solutions:

- Address fines generation by testing strategies for reusing and reintegrating fines into the production process, reducing material losses and supporting zero-waste goals.

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Key activities
Current status

The journey has just begun!

The Safe H-DRI project officially started four months ago, and the consortium is building the foundation for a successful implementation

✓ Initial assessment and planning:

- Comprehensive assessment to define the roadmap for project activities.
- Identified key priorities for experimental campaigns, logistic chain analysis, and stakeholder engagement.

✓ Establishment of communication platforms:

- Website launched! (*https://safe-h-dri.eu/)*
- LinkedIn page created! (*https://www.linkedin.com/company/safe-h-dri-project/)*

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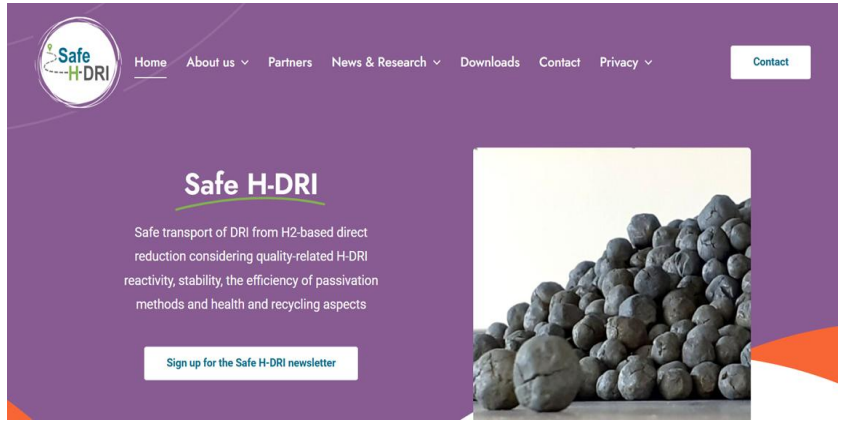
Images sources: web.

Key activities
Current status

❑ What's next?

- Finalize detailed methodologies for experiments and trials.
- Begin experimental set-ups for H-DRI reduction, reoxidation, and transport simulations.
- Organizing meetings and participating at conferences to implement investigations and methodologies.



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Thank you!

valentina.alemanno@rina.org

filippo.cirilli@rina.org

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