Ref. Ares(2025)502767 - 22/01/2025

Requirements & KPIs

D5.1

HURRICANE

M13 – Jan 2025

Funded by the European Union

HURRICANE is funded under the call HORIZON-CL4-2023-TWIN-TRANSITION-01-37 within Horizon Europe, the European Union's framework programme for research and innovation (grant agreement no.:10113849)

Document Information

Project Title	Sector-coupling hub for circular use of thermal and industrial waste		
Acronym	HURRICANE		
Grant agreement no.	101138494		
Topic ID	HORIZON-CL4-2023-TWIN-TRANSITION-01-37		
EU Contribution	€ 19.090.973,75		
Coordinating entity	ArcelorMittal Belgium		
Start date	01 Jan 2024	End date	31 Dec 2028
Deliverable	D5.1	WP	5
Deliverable type	R — Document, report	Dissemination level	PU-Public
Lead beneficiary	Universita Politecnica Delle Marche - UPM		
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Contributions from	All partners		

Change Records

Document Revision History			
Issue date	Version	Author/reviewer	Comments
23.02.2024	0.1	J. Bauwens/ H. Prabhakara	
16.07.2024	0.2	All partners	
10.01.2025	0.3	All partners	

Project Summary

Within HURRICANE a sector-coupling circular hub centred around the ArcelorMittal Ghent site will be created. We will target efficient resource management together with the recovery and utilization of squandered industrial waste heat and water. Together with ArcelorMittal Ghent's ongoing initiatives, this will lead to a reduction of energy, water and raw materials by at least 20%. Thanks to the ongoing projects taking place within and around the Ghent site, the site is already well connected to many other industries like waste suppliers, chemical producers (ethanol offtake & H2 waste gas), renewable power producers, and wastewater treatment. It has become a multi-sectoral hub leading to efficient implementation of industrial symbiosis concepts. The Ghent site has a significant amount of recyclable energy, material and water that allows this symbiosis. These aspects are not only from the steel making processes, but also from other operations taking place in the mentioned "multi-sectoral" hub. This hub can be further enhanced with the integration of waste heat with its ongoing initiatives. Our solution aims at developing and demonstrating novel heat recovery (heat exchanger) and upgrading (heat pumps) solutions from selected operations and then coupling it with the internal and external off takers by means of a heat grid. With digital tools, aspects like broadening the district heating network, and adapting the heat demand profile of the buildings to better match the intermittent of the waste heat, can be optimized. Finally, an integrated software tool for circular hubs that combines the different tools and data produced at the different operations will be developed and validated. Through two virtual demonstrations and circular hubs blueprint the replication potential will be proven. The consortium is formed by 11 partners from 4 different countries, including 4 research organizations, 1 large End User, 2 SMEs, 3 civil organizations and 1 linked 3rd party.

Acknowledgement: HURRICANE – Sector-coupling hub for circular use of thermal and industrial waste (grant agreement number: 101138494) is funded under the call HORIZON-CL4-2023-TWIN-TRANSITION-01-37 within Horizon Europe, the European Union's framework programme for research and innovation.

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Executive Summary

This Key performance indicator (KPI) document is an editable document where the partners of the consortium can update the document based on the existing, newly generated data/information from the research and demonstration activities. The document is broadly divided into project KPIs and KPIs related to individual solutions. First version of this document D5.1 will be submitted as a deliverable. The report will be updated every 6 months. This document will serve as the benchmark for evaluating the findings from the project. During the demonstration campaigns the partners will evaluate the full system key performance indicators and compare it against the project objectives. This document will be adapted one last time at the end of the project as an unalterable version will be prepared as a deliverable. The HURRICANE website will also be a leading information resource for the project. (Home - Hurricane (hurricane-hub.eu)).

2 General KPI's of the Project

Entry		Unit	Target
2.1 Operational KPI's			
Capacity of the heat Grid		MW_{th}	>8
Waste Heat Load available		MW_{th}	>20
External Heat Demand		MWh/year	To be determined
Utilized waste heat		MWh/year	To be determined
% of heat used by internal off-takers		%	To be determined
% of heat used by external off-takers		%	To be determined
Potential Natural gas consumption avoided for external users		MWh/year	>6,500
Potential light Fuel Oil (Mazout) consumption avoided		MWh/year	>2,000
Potential Fuel consumption (Steam/ Blast furnace gas) avoided		MWh/year	>10,000
Reduce Water consumption		m^3/year	30,000
% of District heating capacity reached			To be determined
2.2 Environmental KPI's			
Global warming		kg CO_2 eq.	To be defined after closer study of the process
Acidification		kg SO_2 eq.	To be defined after closer study of the process
Photo-oxidant formation		kg ethylene eq.	To be defined after closer study of the process
Human toxicity		1,4-dichlorobenzene eq.	To be defined after closer study of the process
Freshwater aquatic ecotoxicity		1,4-dichlorobenzene eq.	To be defined after closer study of the process
Eutrophication		kg PO_4 eq.	To be defined after closer study of the process
Avoided CO_2 emissions		ton CO_2/year	>30,000
2.3 Economical KPI's			
NPV of the hub			=0 (breakeven)

3 Specific KPI's

3.1 Heat exchangers – Coil hot strip mill

Entry		Unit	Target
Coil Hot strip mill --% heat recovered from the coil compared to the theoretical maximum (theoretical maximum is related the difference in temperature between the initial coil temperature and the return temperature of the district heating network)			
Heat Available (1 coil)		MWh	Delta T 100°C: 0.27 MWh Delta T 200°C: 0.55 MWh Delta T 300°C: 0.82 MWh Delta T 400°C: 1.09 MWh Delta T 500°C: 1.36 MWh

Expected heat recovery with a delta T of 300°C		kWh	245 kWh (0.88 GJ) at 30% recovery
Design Heat Capacity of HE		MW_{th}	To be determined
Max Temp		°C	600 °C
Min Temp		°C	65 °C or 338.15 K (depending on heat design capacity)
Pressure drops		bar	1 (preliminary)
Thermal effectiveness		%	To be determined
heat recovered per coil		kW_{th}	To be determined

3.2 Heat exchangers – Tunnel hot strip mill

Entry		Unit	Target
Tunnel hot strip mill ---% heat recovered from the coil compared to the theoretical maximum (theoretical maximum is related the difference in temperature between the initial coil temperature and the return temperature of the district heating network)			
Heat Available when 30 coils pass in the tunnel (for 25000 coils/year)		(MW)	0.07 MW (only radiation captured, with a radiation efficiency of 70% and an absorbance efficiency of 30%).
Delta T		°C	130 °C (600°C to 470°C)
Expected heat recovery for one coil in the tunnel with a delta T of 130 °C (only radiation)		kWh	4 kWh (0.014 GJ) only radiation
Design Heat Capacity of HE		MW_{th}	To be determined
Max Operating Temp		°C	600 (Temp of Hot Coil)
Min. Operating Temp		°C	65 (depending on heat design capacity)
Pressure drops		bar	1 (preliminary)
Thermal effectiveness		%	To be determined
Actual heat recovered		MW_{th}/ton	To be determined

3.3 Heat exchangers - Walking beam furnace hot strip mill

Entry		Unit	Target
Walking beam furnace hot strip mill			
Heat Available		MW_{th}	>10
Delta T		°C	5 - 20 (80°C to 75-60°C)
Expected heat recovery		MW_{th}	>8
Max Operating Temp		°C	81
Min. Operating Temp		°C	75
Pressure drops primary side		bar	Max 0.2
Thermal effectiveness		%	>95

3.4 Heat pump

Entry		Unit	Target
Heat Pump			
Thermal power output		kW	Above 3000 kW_{th}
Water Output temperature		°C	Above 120°C at the Condenser outlet
Coefficient of performance		-	Above 3.5

3.5 Software tools

Entry		Unit	Target
EMB3R Software Platform (PDMFC)			
Accuracy		%	To be defined
Reliability		%	To be defined
Predictability		%	To be defined
Repeatability		%	To be defined
Simulation timeframe		min	<15

Entry		Unit	Target
STORM District Energy Controller Accuracy of the waste heat forecaster compared to the monitored waste heat			
Mean Absolute Error		MW	To be defined after closer study of the process and DH network
Mean Percentage Error		%	To be defined after closer study of the process and DH network
Mean Absolute Percentage Error		%	To be defined after closer study of the process and DH network

Entry		Unit	Target
Design tool for district heating networks (Pathopt) --Capex reduction with dynamic design approach compared to a static design approach.			
CAPEX Reduction of District Heating Network extension		%	To be defined after closer study of the process and DH network
Increase Revenue for District heating Network extension		%	To be defined after closer study of the process and DH network

3.6 Operation heat grid

Entry		Unit	Target
Performance KPIs			
Capacity users Phase 1		MWth	>8
Flow max		m^3/h	500
Max pressure		Bar	6
Temperature supply		°C	69.5
Temperature return		°C	50-60 (depending on season)

3.7 Socio-Economic Performance

Entry		Unit	Target
Performance KPIs			
Stakeholders reached		No.	> 100
Participants at each workshop		No.	> 20
Interviews conducted		No.	30-50
Gamification tested during workshops		No.	4

3.8 Dissemination

Entry		Unit	Target
Visits (social media, website)		No.	>25.000 site visits
B2B		No.	>30
Scientific publications		No.	>10 publications
Mobile application users continued engagement		% of initial users	>50