

ESTEP 2025 Annual Event

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Udine (ITALY)

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

Giuseppe Giacomini
Acciaierie Bertoli Safau S.p.A.
Chief Sustainability Officer



CUSTARD

carbon **C**apture and **U**se
at a **S**teel plant with an
Advanced solution to
Reach **D**ecarbonisation



DIGIMET



DANIEMI AUTOMATION



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



Funded by the European Union
Emissions Trading System
Innovation Fund

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Overview

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THE CUSTARD PROJECT FRAMEWORK: TECHNOLOGY AND PRODUCT

DECARBONIZATION OF ALL SECTORS IS COMPULSORY ACCORDING TO THE EU GREEN DEAL AND A FUNDAMENTAL RETHINKING AND RESHAPING OF PEOPLE AND INDUSTRIES' WAY OF OPERATING IS URGENT.

In the Steel sector the decarbonization can be reached through the following measures:

- Electrification of processes using electric energy coming from local renewable energy sources;
- Green hydrogen production (preferentially at plant) to substitute fossil fuels in heat treatment processes;
- Adoption of waste wood and waste plastics instead of fossil fuels (coal in particular);
- Carbon Capture and Use (CCU, to produce hydrocarbons or other value-added products);
- Carbon Capture and Export (CCE, where CO₂ travels on ships for its further geological storage or through pipelines for further industrial applications).

CUSTARD AIMS AT THE DECARBONISATION OF THE STEEL SECTOR THROUGH AN INNOVATIVE CCU SOLUTION THAT FORESEES TO FIX CO₂ INTO A VALUE-ADDED PRODUCT (NACO₂H₃) WITH A HIGH MARKET POTENTIAL AT EU AND EXTRA-EU LEVEL



MAIN PROJECT PARTNERS

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The CUSTARD project and investment is promoted by **two Italian companies, leader players in the steel sector:**

- **ACCIAIERIE BERTOLI SAFAU SpA (ABS)**
- **DANIELI OFFICINE MECCANICHE & C. SpA (D&C)**

D&C, a joint stock company listed on Italian Stock Exchange, it's the parent company of Danieli Group that in 1995 acquired ABS.

The project participated to INNOVATION FUND and achieved a grant of 4,15M€ from EU to award the innovative technology and the contribution to decarbonization of hard to abate sectors.

Danieli
Group

Danieli
Plantmaking



ABS
Steelmaking



ABS produces special steels and is the beating heart of the **Steelmaking Division** of Danieli Group. With a steelmaking expertise gained in over 200 years of history, **ABS plays a worldwide leadership role in the steel industry**, and it is one of the few EU Companies that shows an almost complete integrated process, since at the same industrial site we can find steel production from ferrous scrap and cast iron up to the manufacturing of steel products for widest sectors of industry.

D&C is **among the world's top three manufacturers of plants and machines for the metals industry**, offering plants that produce steel without using coal and with very low CO₂ emissions. D&C uses its own technologies to manufacture and install competitive machines and plants all over the world, supplying both single units and turnkey plants. D&C's current range of products includes machines, plants and processes for all the production cycles of steel and non-ferrous metals.

Commercial
partner

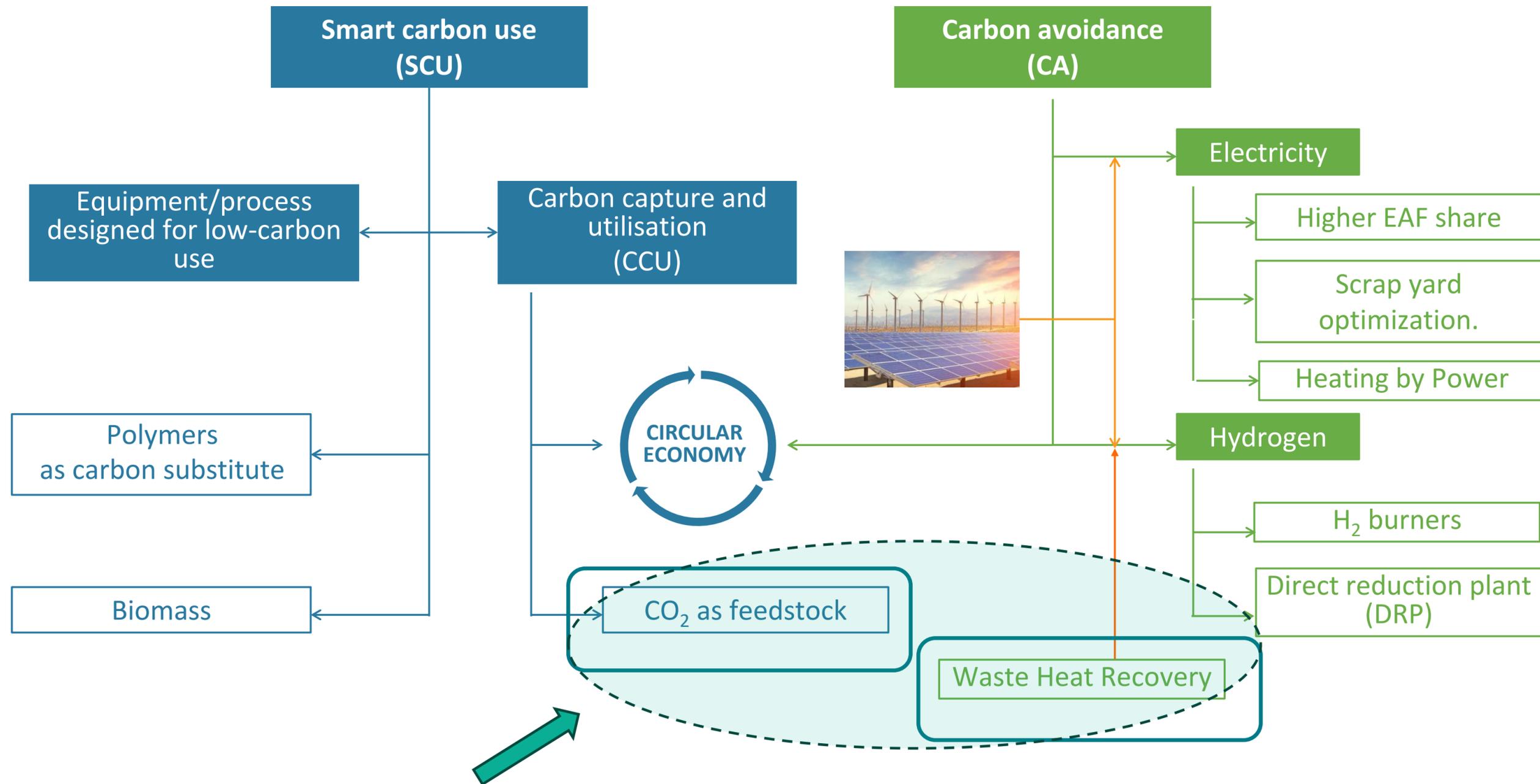


CGC - Caffaro Green Chemicals Srl part of **Caffaro Industrie SpA**. With over 70,000 tons of basic and fine chemicals manufactured and marketed annually Caffaro Industrie S.p.A. stands out as an industrial player of growing importance in all geographical areas with a strong industrial vocation.

CGC, with its research, development, and operational support production activities at its Torviscosa (UD) plant, aims to produce and market basic and fine chemical products that are increasingly less closely linked to the petroleum supply chain.



DECARBONIZATION ACTION LINES IDENTIFIED BY DANIELI GROUP



CUSTARD FALLS WITHIN THE DECARBONIZATION ACTION LINES OF DANIELI GROUP: THE PROJECT TARGETS TO THE **DECARBONIZATION OF ABOUT 50% OF WIRE ROD PRODUCTION ON YEARLY BASE**, THROUGH A LOW COST AND EFFICIENT SOLUTION THAT EXPLOITS CARBON CAPTURE AND UTILIZATION (CCU) TECHNOLOGY AND WASTE HEAT RECOVERY.



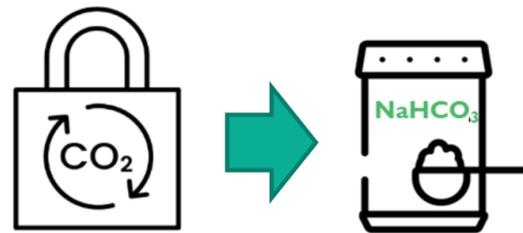
CUSTARD PROJECT KEY FIGURES

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The CUSTARD project will introduce the first application of **Carbon Capture and Utilisation (CCU) technology** within a steel plant that foresees CO₂ capture and its **use at plant** as reactant with caustic soda (NaOH) to produce sodium bicarbonate, a high value-added chemical compound useful for a wide portfolio of industrial applications.

Carbon Capture from flue gases followed by CO₂ utilisation in baking soda production is not a new solution in the industrial sector but **no applications of CO₂ capture for baking soda production are at present related to the Steel sector.**



GHG EMISSIONS AVOIDANCE
-13.000 tCO₂/year

(about 50% of CO₂ will be captured by the flue gases of wire rod rolling mill reheating furnace)

Key figures



NaHCO₃ PRODUCTION
+23.000 t/year

(caustic soda supplied by CGC, process managed by ABS, product marketed by CGC)



CUSTARD CCU DIAGRAM FLOW

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Sodium bicarbonate is currently produced in large volumes using the Solvay process, which uses sodium chloride and calcium carbonate as raw materials, along with fossil-based carbon dioxide for the calcination of the carbonate. The classic Solvay process ultimately produces sodium ash, also creating calcium chloride as a byproduct.

The process used by CUSTARD was developed over a century ago; the availability of electrolytic caustic soda now makes it possible to produce sodium bicarbonate according to the reaction:



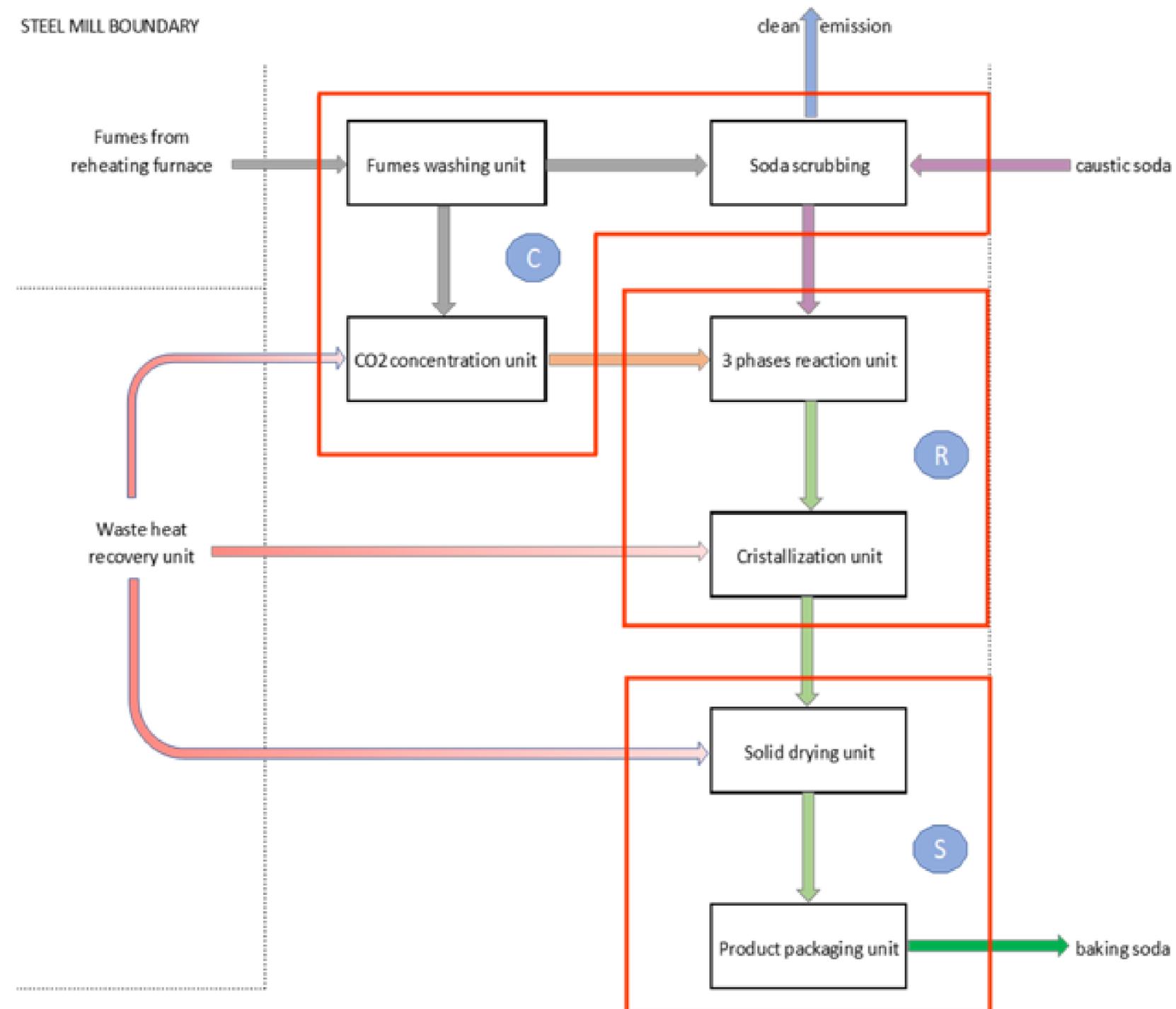
The CO₂, captured from the exhaust gases of ABS reheating furnace, reacts with caustic soda supplied by a project partner, Caffaro Green Chemical (CGC), which will also market the final product.

A pilot plant was built at Serichim chemical production site of Torviscosa, Udine. The tests have been carried with parameters designed and checked with CGC.

The plant consists of the following three groups of units:

- Carbon Capture and Soda Scrubber Unit (C)
- Reactor Unit (R)
- Solids Treatment Unit (S)

The schematic plant layout, with the subunits contained in C, R, and S, is shown in the figure with also steelworks perimeters, since the CO₂ required for sodium bicarbonate production is captured from its flue gases.

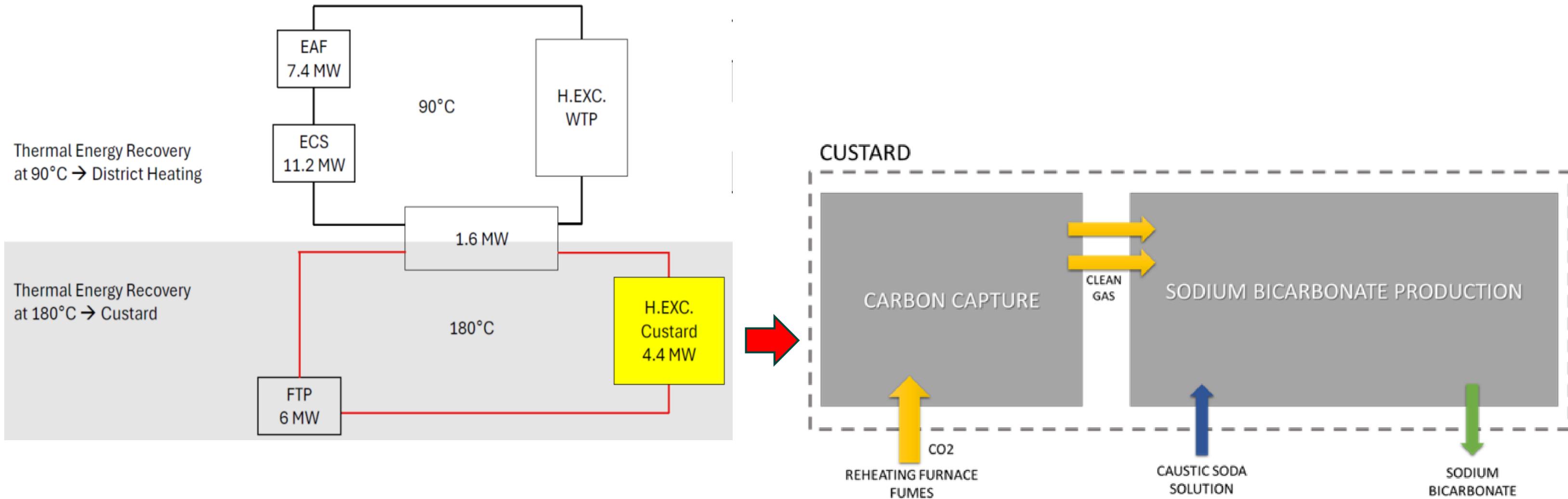




WASTE HEAT RECOVERY FROM DIGITAL GREEN PLANT

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THE HEAT THAT CUSTARD NEEDS FOR ITS PROCESS IS GENERATED AND RECOVERED IN THE DIGITAL GREEN PLANT, NEXT BIG INVESTMENT OF ABS (FEB 2026-DEC 2027), THIS NEW INSTALLATION WILL PRODUCE UP TO 730.000 T/YEAR OF LIQUID STEEL WITH THE MOST ADVANCED AND DIGITALIZED TECHNOLOGIES AND WILL CONTRIBUTE TO DECARBONISATION OF CARGNACCO (UD) SITE. THE HEAT EXCHANGERS WILL RECOVER 4,4 THERMAL MW AT 180°C DEDICATED TO CUSTARD. OTHER CONSISTENT QUANTITY OF WASTE HEAT (PART AT 180°C AND MOSTLY AT 90°C) WILL BE DESTINATED TO UDINE DISTRICT HEATING.



SUMMARY OF CUSTARD FEATURES

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NO BY-PRODUCTS PRODUCTION



HIGH QUALITY OF THE FINAL PRODUCT (FOOD-
GRADE)



NO HAZARDOUS CHEMICALS ARE FORESEEN



NO SAFETY ISSUES LIKE CCU SOLUTIONS THAT
FOSTER BIOFUELS PRODUCTION



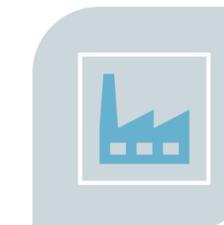
THE TECHNOLOGY IS **EASILY UP-AND-DOWN
SCALABLE**



SINGLE **COMPONENTS** ADOPTED **ALREADY
CHARACTERIZED** BY PROVEN AND EFFICIENT
TECHNOLOGIES THAT DO NOT PRESENT CRITICAL
ASPECTS AT INTERFACES FOR THEIR INTEGRATION



HIGH-COST EFFICIENCY (IN TERMS OF COST OF CO₂
ABATEMENT, EXPRESSED IN €/T)



THE TECHNOLOGY CAN DECARBONIZE EVEN FLUE
GASES OF **OTHER ENERGY INTENSIVE INDUSTRIES
UNDER ETS AND CARBON TAXES**



CONCLUSIONS

CUSTARD offers cross-sectoral breakthrough innovation to decarbonize hard-to-abate industries while sustainably producing a high value-added chemical good.

By adopting the CUSTARD technology, hard-to-abate industries will have the possibility to decarbonize their processes and at the same time generate value through the production and direct commercialization of sodium bicarbonate.

The new production of this chemical will not compromise the environmental sustainability of the process since it will be done following a production route that is environmentally and economically competitive with respect to the widely adopted Solvay process, considered the reference method for sodium bicarbonate production at international level.

Ultimately, the CUSTARD solution will represent a unique opportunity for adopters since it will allow them to meet decarbonization goals and at the same time exploit new business opportunities represented by the possibility to commercialize a new product with high market potential.



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THANK YOU FOR ATTENTION

QUESTIONS & ANSWERS



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