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Achieving “Carbon-Neutrality” faster by linking enzymatic carbon capture technology with renewable geothermal energy

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Paper Overview

Saipem and Gruppo Hera cooperation

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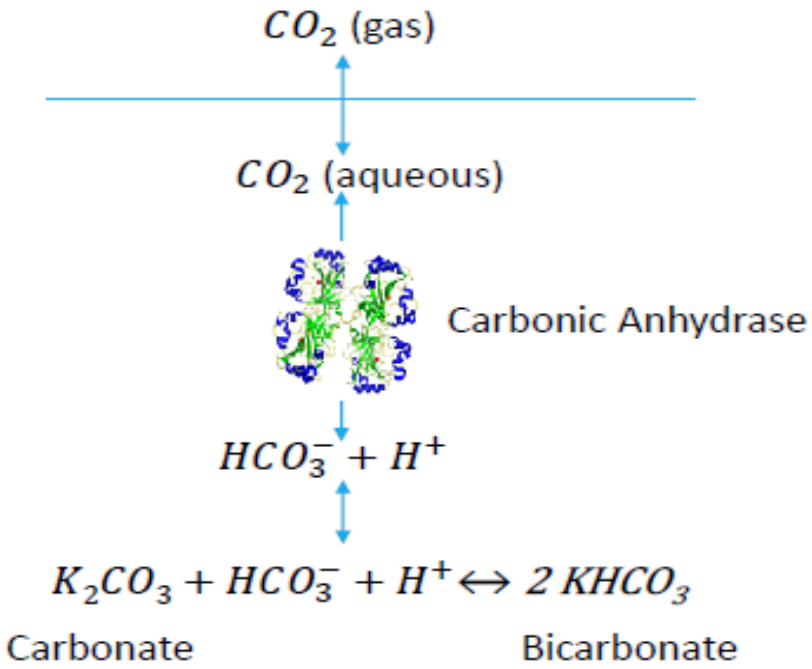
Enzymatic Carbon Capture Technology

Principles of the solvent-based technology



- K_2CO_3 alone is an attractive solvent but is kinetically slow
- Enzyme accelerates the hydration of CO_2 in K_2CO_3

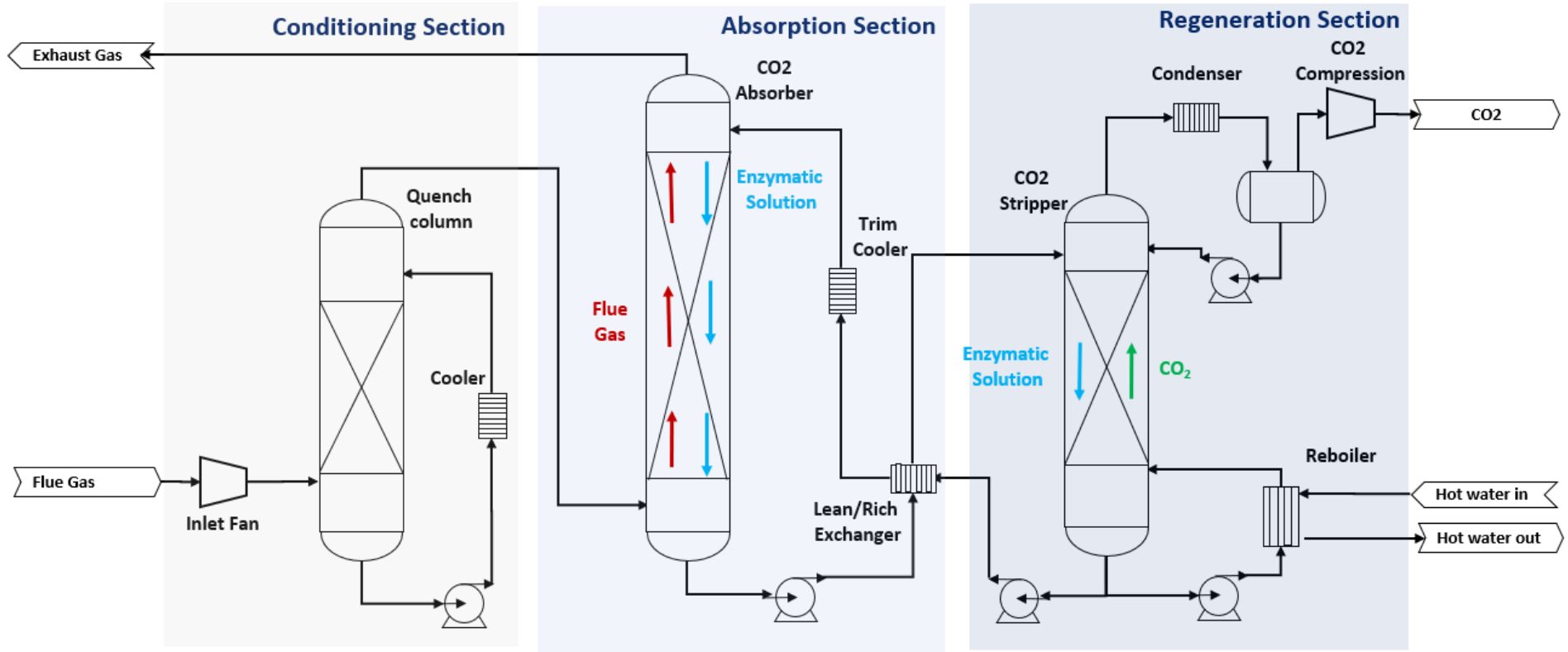
Operating conditions

- Absorption at atmospheric conditions
- Solvent regeneration lower than 85°C

A natural enzyme to enhance the CO_2 capture

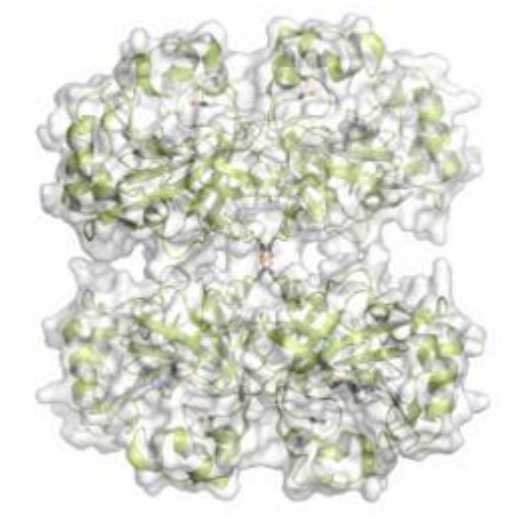
Enzymatic Carbon Capture Technology

Process Flow Diagram



Enzymatic Carbon Capture Technology

Main benefits



Carbonic Anhydrase enzyme

- Non-toxic and environmentally friendly solvent, no risks of aerosol emissions
- Energy consumption using low-grade heat
- Simplified equipment using standard components
- No need of flue-gas compression
- Optimized CAPEX, OPEX and maintenance costs

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Enzymatic Carbon Capture Technology

St. Félicien (Quebec, CA) demo Plant

CO_2 SOLUTIONS BY SAIPEM

- Start-up in 2019
- 30 TPD CO_2 design capacity
- Utilize mill's low-grade waste heat for process
- CO_2 captured from Pulp Mill
- CO_2 routed to a Greenhouse at food-grade for reuse

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Enzymatic Carbon Capture Technology

Solution Industrialization – 200 tpd nominal capacity – Bluenzyme™-200

Plug-and-Play concept

Minimizing the site works and fast module hook-up

Modular design

Compatible with truck transportation

Pre-engaged supply chain to support delivery and de-risk schedule

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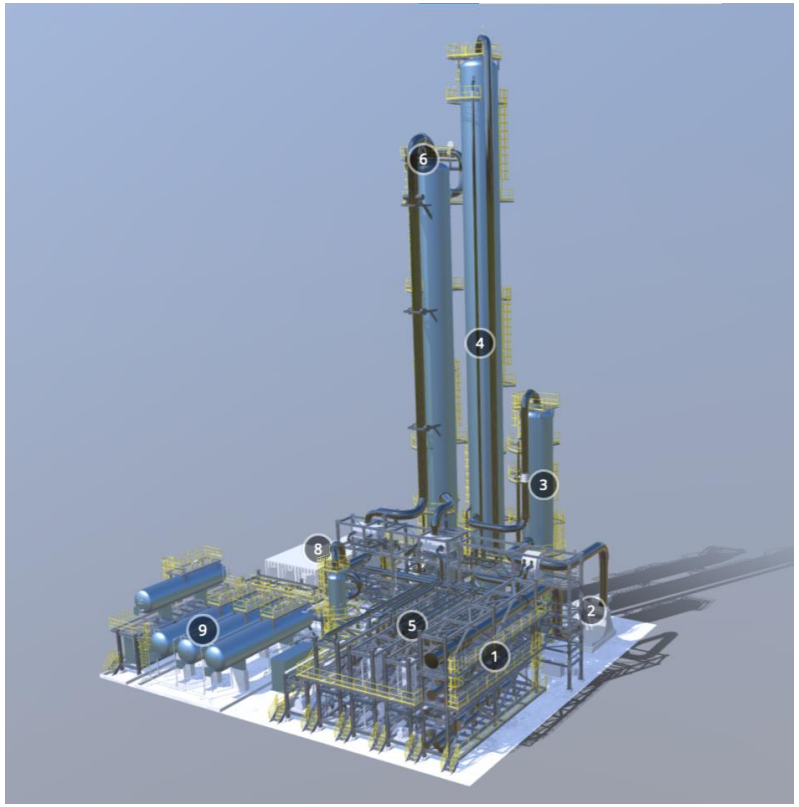
Enzymatic Carbon Capture Technology

Industrialized solution features



1 - INTERCONNECTING MODULE
Ensures the connection with the host plant flue gas and utilities.

2 - FLUE GAS BLOWER
Conveys the flue gas from the emitter.

3 - QUENCH COLUMN
Ensures pre-scrubbing and pre-cooling of flue gas exiting from the emitter.

4 - ABSORBER
The core of CO2 capture ensures a high capture rate (up to 95%) using a non-toxic and non-volatile solvent activated by enzymes.

5 - PLANT MODULES
Allocates equipment, pipes, instruments and cables in truckable-sized structures, easily deliverable to the site.

6 - STRIPPER
Allows Enzymatic Solution to be regenerated using simply hot water rather than steam

7 - CO_2 COMPRESSOR
To deliver the captured CO_2 to its destination.

8 - ELECTRICAL & INSTRUMENTATION CONTAINERS
Optional elements which are required to work in island mode. They are removed when the existing plant systems have some spare room, reducing plant footprint and site impact.

9 - STORAGES
Optional section, to drain the solvent circuit. Replaceable with non-stationary storage, reducing plant footprint and site impact.

"Ready-made" product for a safe and fast-track brownfield installation

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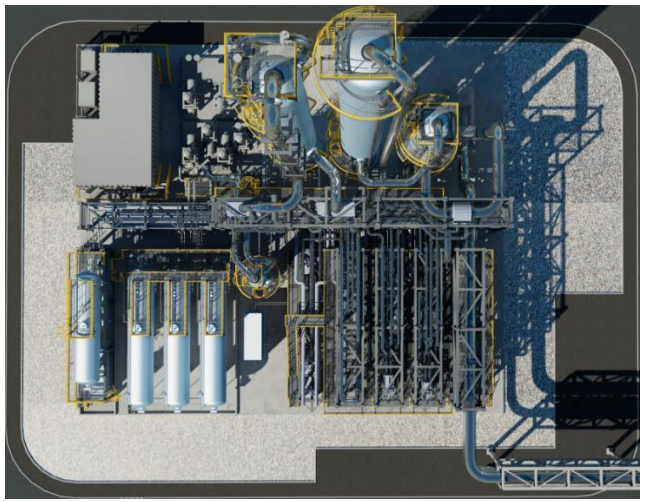
Enzymatic Carbon Capture Technology

A “Ready-made” solution for a safe and fast-track brownfield installation

Layout



Less than 900 m^2 for the main process facilities

Installation

18-month delivery

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Low-Grade Heat Integration

Energy integration solutions accelerate the run towards carbon neutrality

Direct Heat Recovery → Default solution using residual low-grade heat from host plant reducting/avoiding heating costs

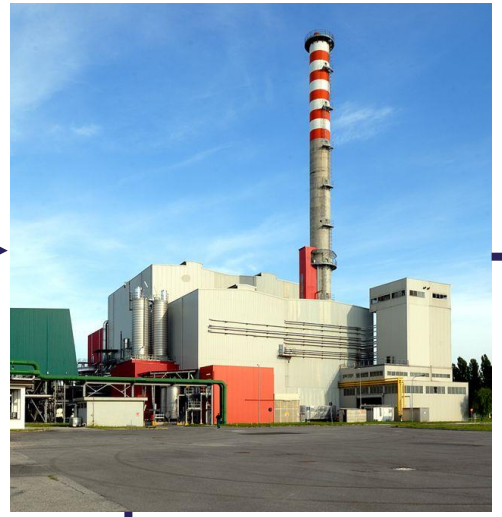
Heat Pumps → The technology is suitable for Standard Heat Pump applications to optimize energy efficiency of Power and District Heating production

Geothermal Energy → The direct utilization of low-grade Geothermal heat supply avoids additional carbon emissions related to the Carbon Capture facilities

WtE application and Synergies with Geothermal energy

WtE Plant Overview and Geothermal source

Waste-to-Energy Plant



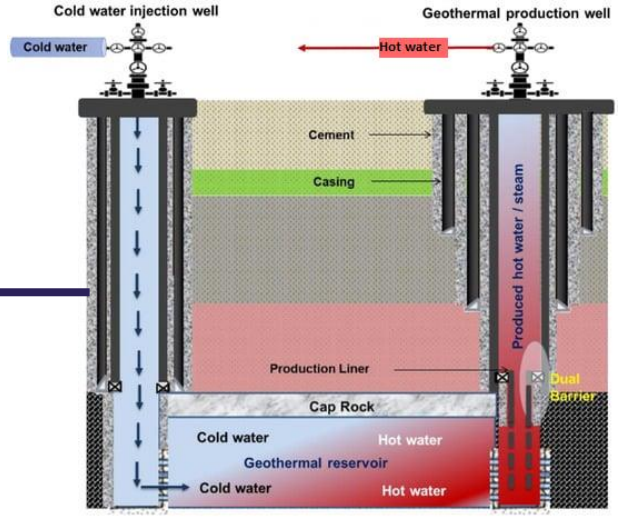
Waste

55% Biomass

45% Fossil

Electric Power to national grid

Geothermal Heat Production



District Heating delivery at 90°C

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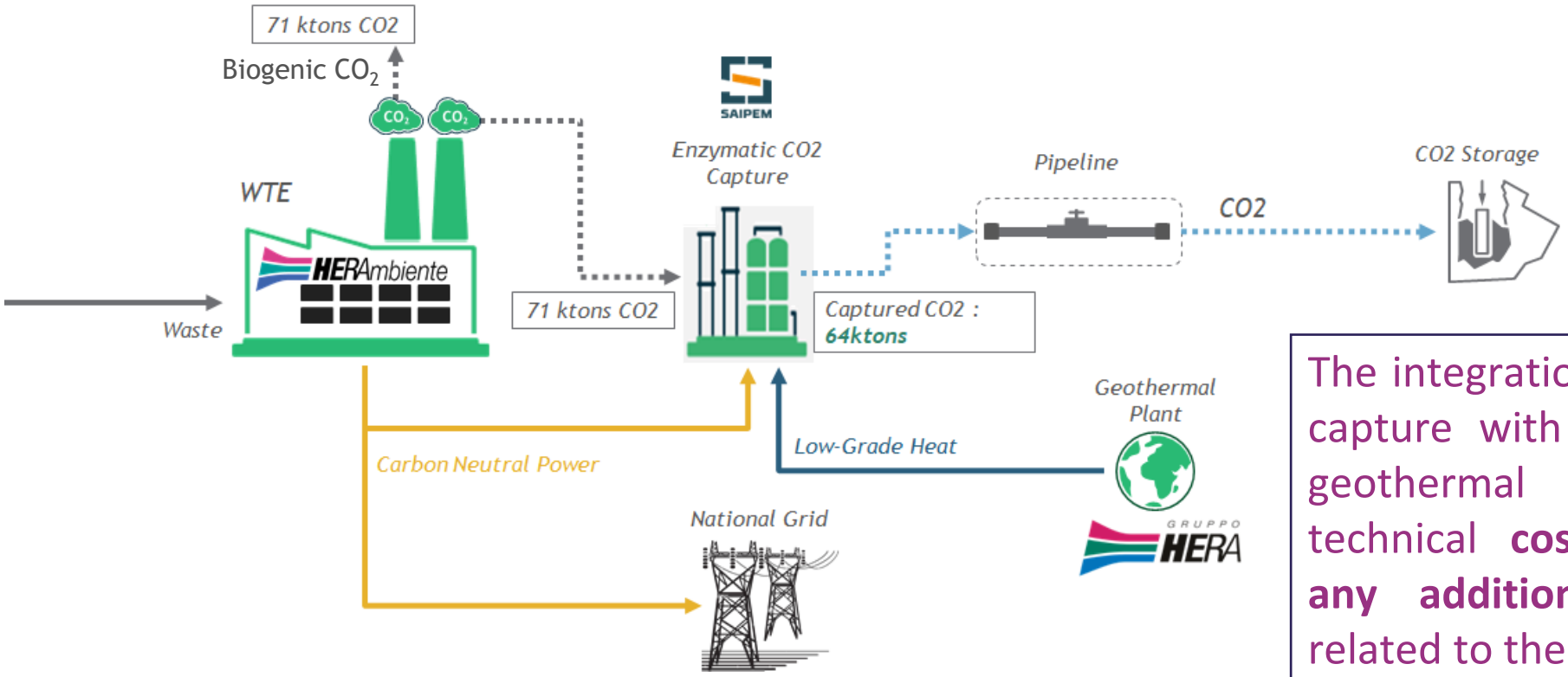
WtE application and Synergies with Geothermal energy

WtE decarbonization Strategy



The integration of enzymatic carbon capture with low-grade renewable geothermal energy results in technical **cost reduction avoiding any additional carbon footprint** related to the capture system.

WtE application and Synergies with Geothermal energy

Conclusions

- **New sustainable aspect for WtE** with removal of the fossil CO_2, improving the social concept of a facility that has no environmental impact;
- The use **non-toxic and non-volatile natural solvent** avoids the handling of the inorganic toxic chemical product, facilitating the permitting process;
- Utilizing **geothermal heat provides benefits for both WtE and district heating** plants, providing a renewable heating source for CO_2 capture and contribute to decarbonise the district heating process;
- The integration of geothermal heat with CO_2 capture **reduces the relevant technical costs without additional carbon footprint.**

Q&A
Thank you

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