

HEAT CIRCULARITY







Funded by the European Union Emissions Trading System Innovation Fund

1 Thermodynamics: Entropy SECOND LAW OF THERMODYNAMICS

The total entropy of an isolated system always increases over time, or remains constant in ideal cases where the system is in a steady state or undergoing a reversible process

1 Thermodynamics: Entropy









 $E = \dot{Q}$ $Max Eff = \frac{\dot{Q}_H - \dot{Q}_C}{\dot{Q}_H} = \frac{T_H - T_C}{T_H} = 1 - \frac{T_C}{T_H}$

2 Technological Pathways LOW TEMPERATURE HEAT RECOVERY- INTRO



BASE CASE OF WASTE HEAT AVAILABLE IN PROCESS UNITS

- Total Heat process units: **15 MWt** (@ rejection temp: 70°C).
- 2 67% of this heat has a quality between **90-110°C**, where theoretical maximum thermal efficiency is around **20%**.
- 3 Extrapolating this potential to all Repsol refineries (Solomon CWT weighted) and the EU refining system total heat amounts to 25 GWt.
- Recovering 900MWt has an estimated reduction potential of 7,5M tCO₂/year (vs natural gas combustion).





TOTAL HEAT (KW) BY TEMPERATURE



3 Low Temperature Heat Recovery HEAT RECOVERY ROUTES

REPJOL

Heat balance comparison of the most promising technologies with a reference waste heat stream



5

3 Low Temperature Heat Recovery HEAT RECOVERY ROUTES

From a electrification perspective, the heat pump is also the best pathway due to the excannge rate between heat and electricity



4 European project HIGHLIGHTS





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Coordinator and process owner



Rotating equipment and thermodynamic designs.



Heat exchangers design and construction and system integration in the production process.







DEMONSTRATION OF A HIGH TEMPERATURE HEAT PUMP, UPGRADING 3 MW OF HEAT FROM 100 TO 150°C.



8

REPJOL

4 EUROPEAN PROJECT Partner capabilities



Rotating equipment and thermodynamic designs.



rpm

Low rpm.



Magnetic transmission.



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Direct drive.

Easy-

connect.

RANK[®]

Service.

<î;



Zero

leaks.

operation



Heat exchangers design and constructive **EPFOL** and system integration in the production process.







Funded by the European Union **Emissions Trading System** Innovation Fund



INNOVATION FUND Driving clean innovative technologies towards the market





First call for projects in 2020



up to 2030 in EU's climate neutral future

Energy

storage



Avoid emissions and boost competitiveness

SUPPORTING INNOVATION IN:



Energy intensive

industries



Renewables



Carbon capture, use and storage



EU Emissions Trading System (EU ETS)

The EU ETS is the cornerstone of the EU's policy to combat climate change and its key tool for reducing greenhousegas emissions costeffectively. It is the world's first major carbon market and remains the biggest one.

5 Upscaling & Path forward





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Main drivers



REDUCED PROCESS UNIT ENERGY CONSUMPTION



EXPANDED OPERATIONAL RANGE AND PROCESS FLEXIBILIZATION



MAXIMISED CO₂ EMISSIONS REDUCTION WITH A MINIMISED LEVELIZED COST OF CO₂ ABATEMENT









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put forward in the REPowerEU Plan, increasing of the competitiveness and resilience of the

European process industry.



of energy.

12

