Techno-economic viability of different Power to Gas integration configurations in a BF-BOF iron and steel plant.

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CONTEXT AND OBJECTIVES

The production of synthetic methane (SNG) from **green H2** produced by electrolysis is a Power-to-Gas (PtG) technology [1]:

$$CO_2 + 4H_2 \leftrightarrow CH_4 + 2H_2O$$

This gas is consumed in the steel industry, producing CO2 emissions that are reused to produce more SNG [2]. Water is also recycled in the electrolyser, closing the carbon and water cycles.

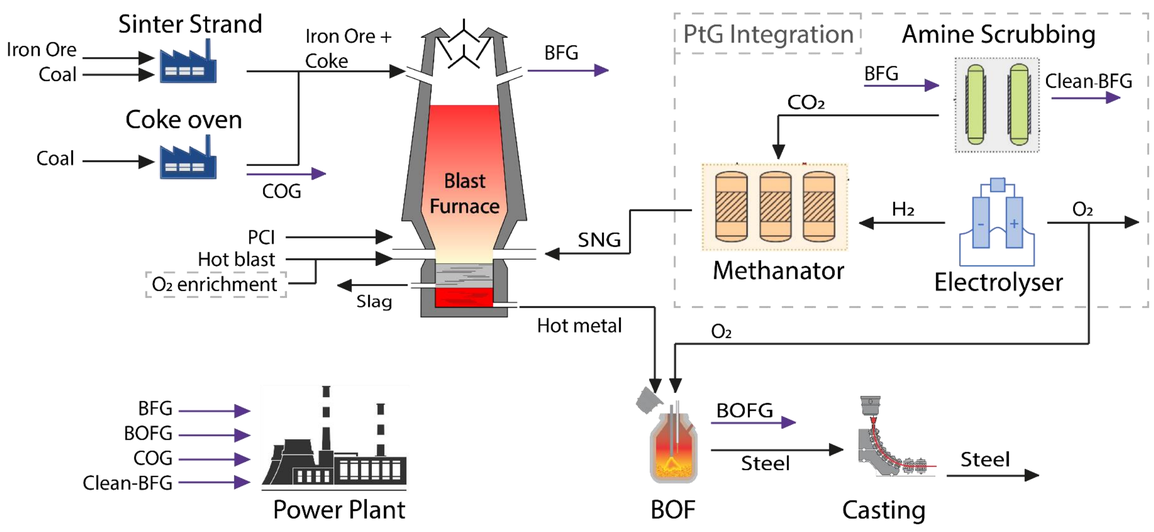
OBJECTIVES

- Study the concept of PtG integration in the steel industry [3].
- Reduce CO_2 emissions by using renewable electricity (indirect industry electrification).

METHODOLOGY

- A standard steel industry of 2.8 million tons per year of steel production is assumed.
- The CO_2 is captured in an ammine scrubbing cycle (MDEA, 2.8-3.7 MJ/kgCO2). The thermal demand is supplied by the methanation.
- H_2 is produced with renewable electricity ($\mu_{electrolyser}$ = 3.8 kWh/Nm3)
- Isothermal methanation (350-300 °C; 2 reactors; ≈ 95% CH_4)
- The Blast Furnace (BF) is the main CO_2 emitor and the main energy consumer. PtG is applied in this process.
- The simulations have been carried out in Aspen Plus, in steady state.

PROCESS FLOW DIAGRAM

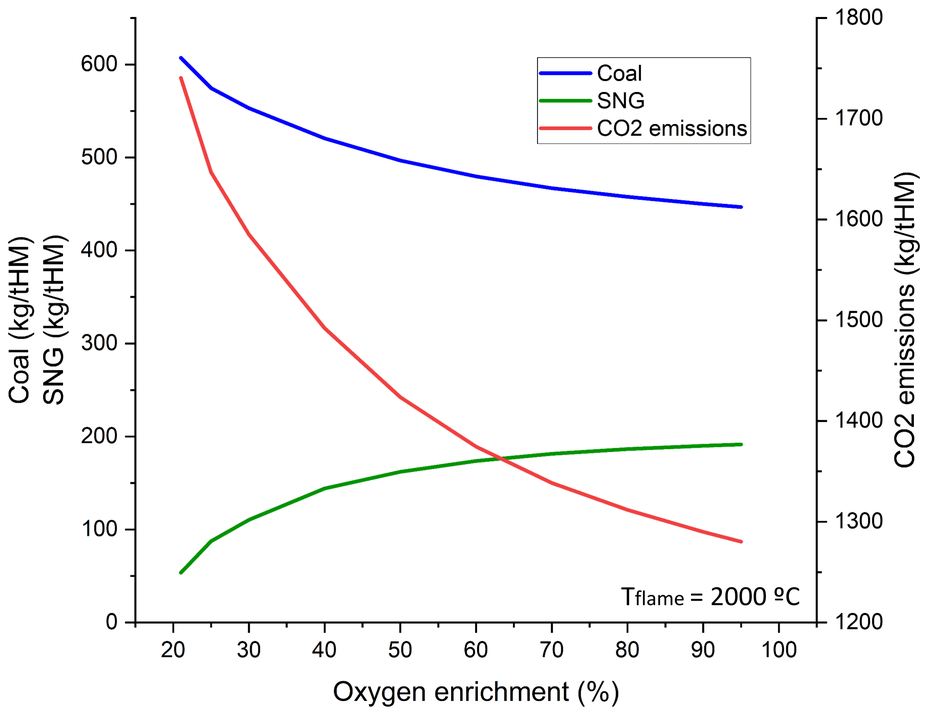


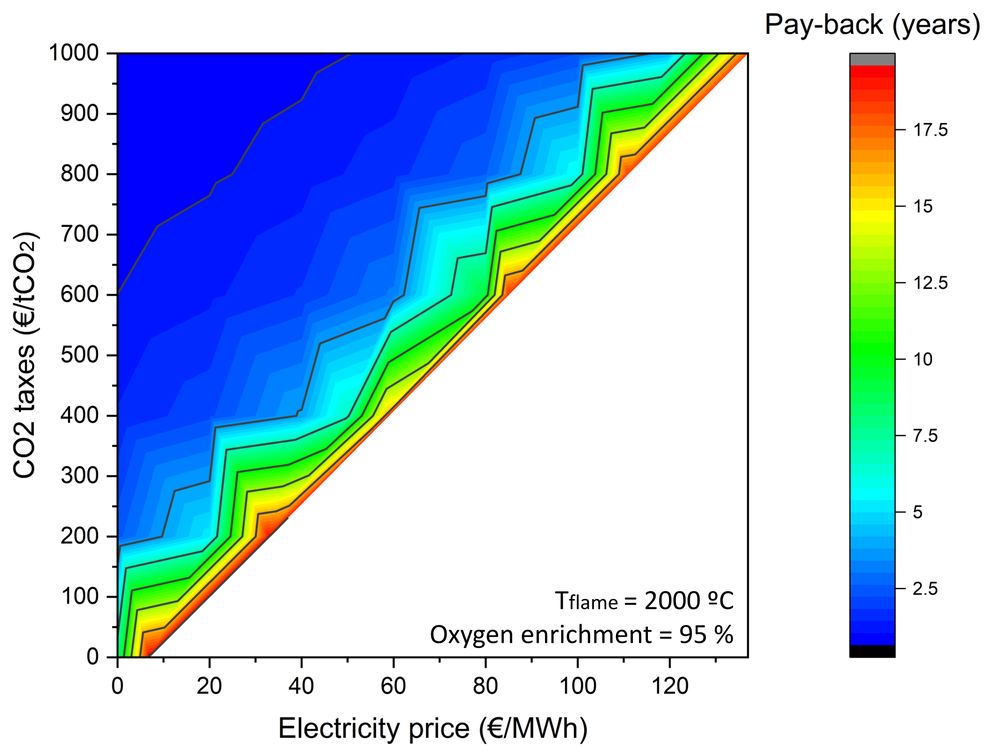
Proposed concepts to integrate the PtG in the steel industry

MAIN RESULTS

	21 % oxygen	95 % oxygen
SNG:	54 kg/tHM	192 kg/tHM
Emission savings:	9.4 %	34.2 %
Coal savings:	9.1 %	33.1 %
Electrolyser:	355 MW	1268 MW
Energy penalty:	16.2 MJe/kgCO2	17.4 MJe/kgCO2
Economically profitable:	22 €/MWh or 485 €/tCO2	16 €/MWh or 563 €/tCO2

MAIN RESULTS





CONCLUSIONS

- The **steel industry** is one of the most energy intensive (30% of direct industrial CO2 emissions).
- The analysed PtG technology uses **CO2** from the industry itself, together with **renewable H2**, to form **synthetic natural gas** (SNG), a fuel that is already used in the industry.
- The integration of the PtG allows **reductions in CO2 emissions**, keeping it captive in a closed loop (worldwide it would mean ≈ $9 \cdot 10^5$ t CO2/year and ≈ $3 \cdot 10^5$ t carbon/year)
- This PtG configuration makes it possible to **indirectly electrify the industry**, since fossil fuels are replaced by synthetic natural gas, which comes from hydrogen produced by **renewable sources**.

I'M A FINALIST OF THE GERG YOUNG RESEARCHERS' AWARDS

Acknowledgements: The work described in this paper has been supported by both the University of Zaragoza under the project UZ2020-TEC-06 and Khalifa University project CIRA-2020-080. This work has also received funding from the European Union's Horizon 2020 research and innovation program under the Marie Sklodowska-Curie grant agreement no. 887077.

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