Finanziato dall'Unione europea NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA
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NI-BASED CATALYSTS FOR BIOGAS UPGRADING

Tommasi M, Gramegna A, Falletta E, Prati L, Rossetti I

Department of Chemistry, Università degli Studi di Milano, via Golgi 19, 20133, Milano, Italy

UNIVERSITÀ DEGLI STUDI DI MILANO
CHEPIC LAB
DIPCHI DIPARTIMENTO DI CHIMICA

E-mail:
ilenia.rossetti@unimi.it matteo.tommasi@unimi.it

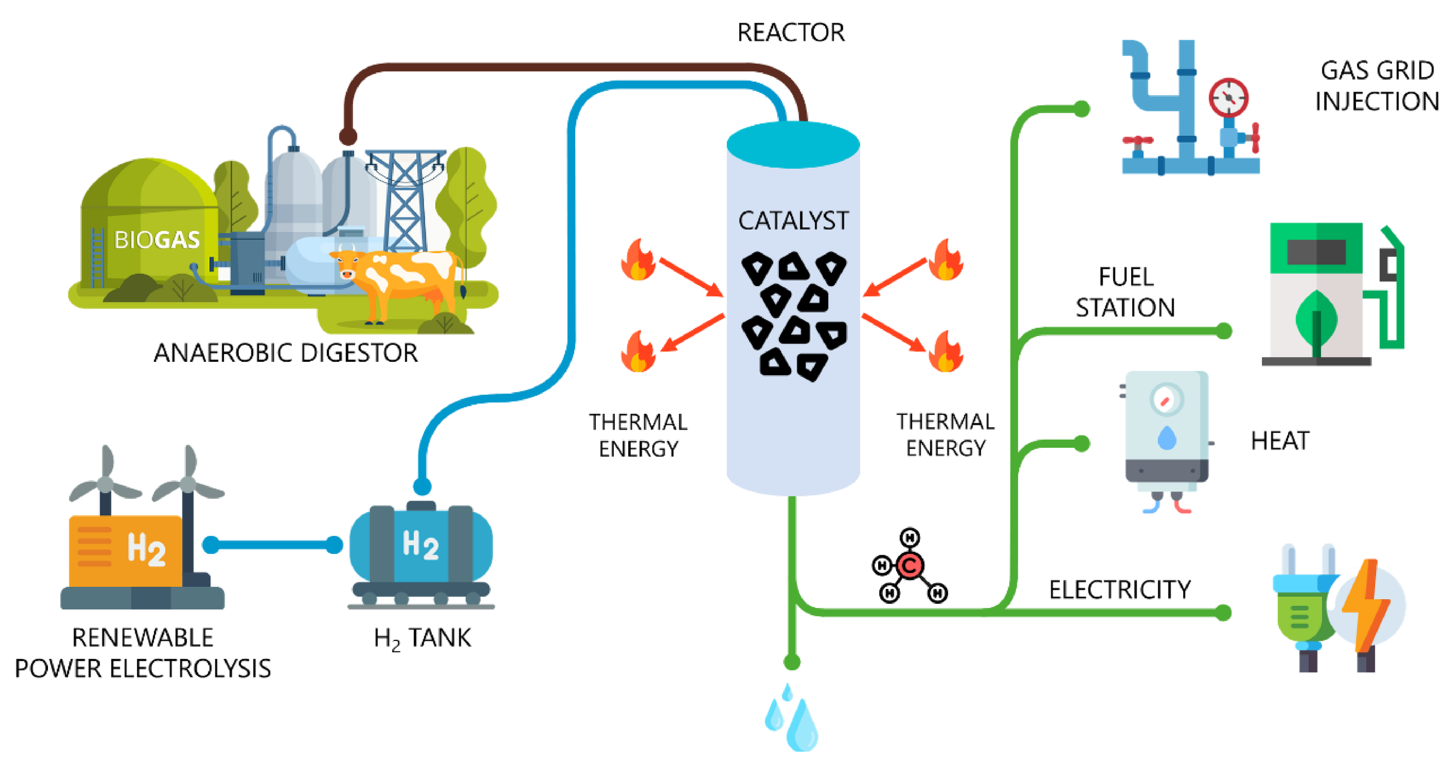
SPOKE 8, WP 2, TASK 8.2.3 & TASK 8.4.1

Green H_2 storage → Low volumetric energy density ➔ Different storage solution → **Requirements** →

- Massive use
- Existing infrastructure
- Existing regulations
- «Reasonable» cost

→ **CH_4** ← **Direct Biogas upgrading**

ABSTRACT AND BACKGROUND

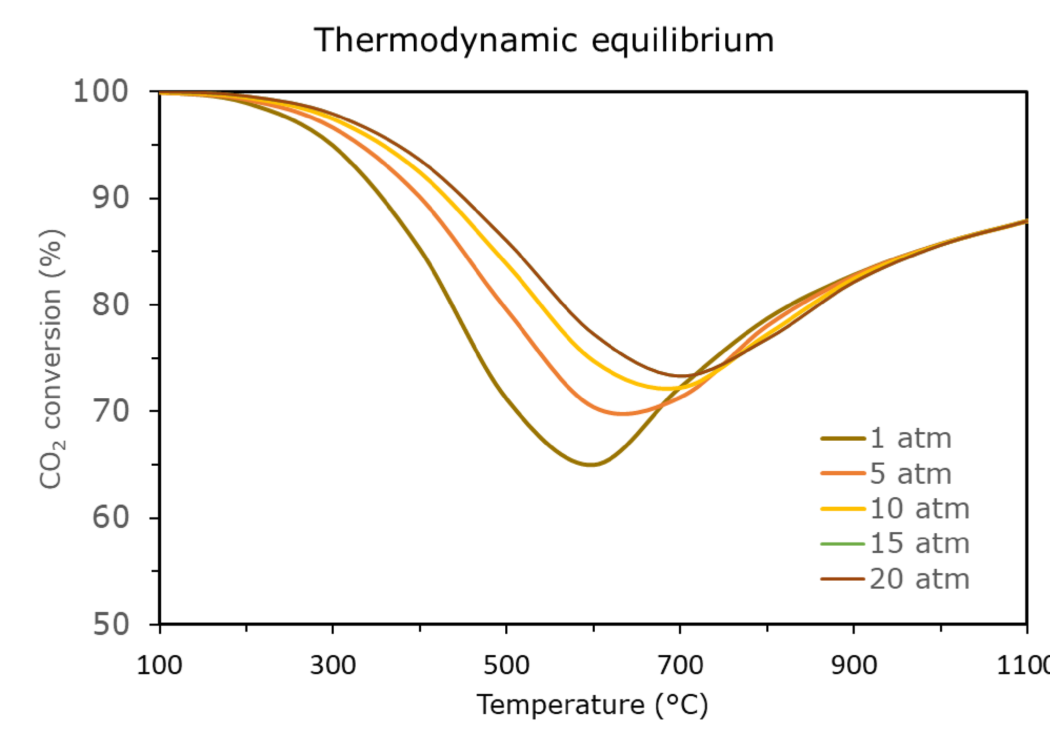


PROS

- Double environmental impact (Green H_2 and CCU)
- Infrastructure already present
- Injectable in natural gas grid (tolerance to H_2 content)
- CH_4 is already well regulated

KEY ISSUES

- Virtually no zero emission
- Economic sustainability



MATERIALS, METHODS AND EXPERIMENTAL SETUP

Use of Ni as active phase

Initial screening of the supports
➔ 36% wt. Ni loading

- *Wet-impregnation (WI) technique, using $Ni(NO_3)_2 \cdot 6H_2O$ (Merck) + Support*
- *Sol-gel and co-precipitation technique for CeO_2 supported catalyst*

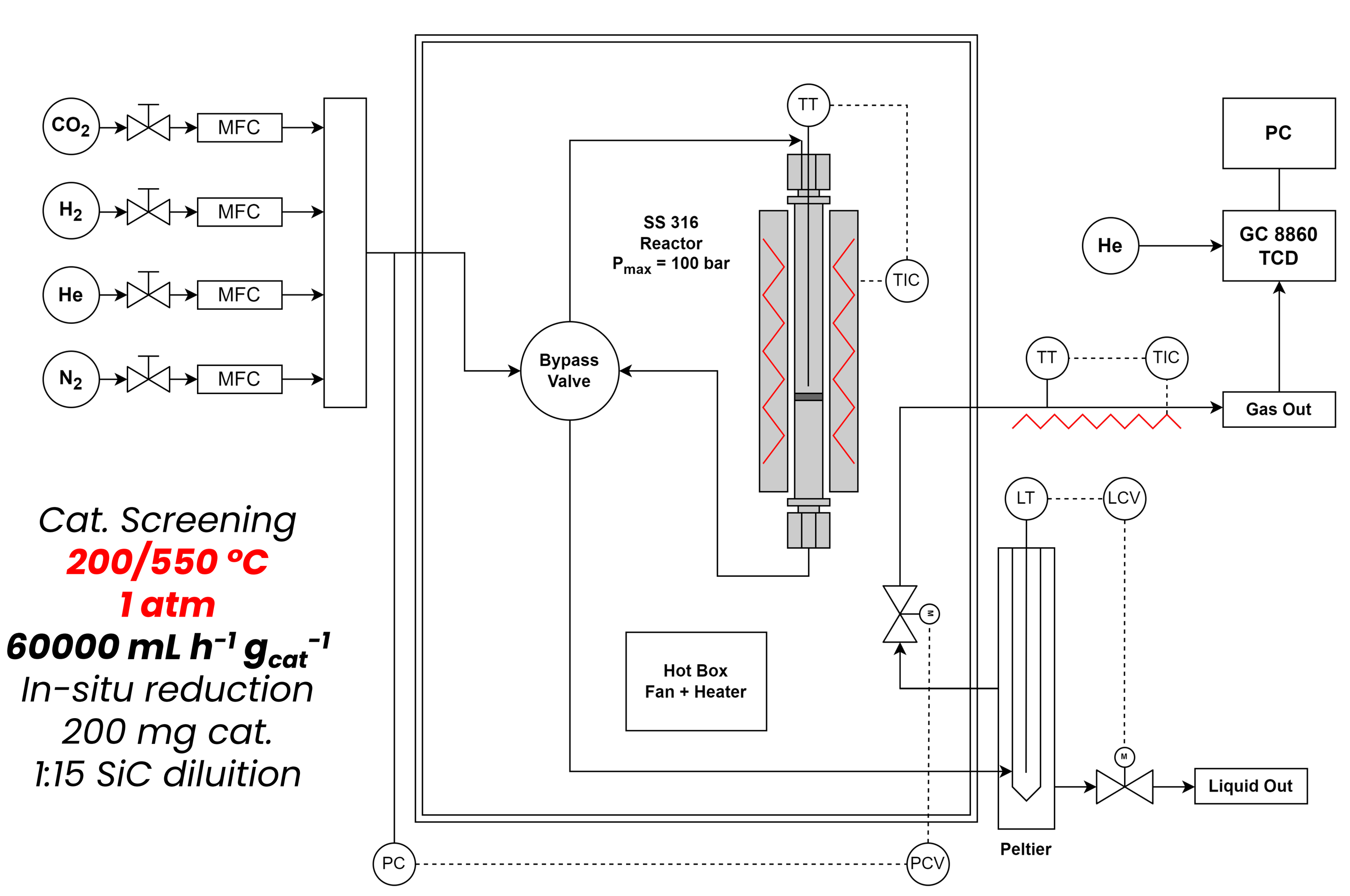
In house synthesized through nitrate precursor calcination

36% Ni/CeO_2 (CN),
36% Ni/ZrO_2 (CN),
36% Ni/Al_2O_3 (CN)
36% Ni/MgO (CN)

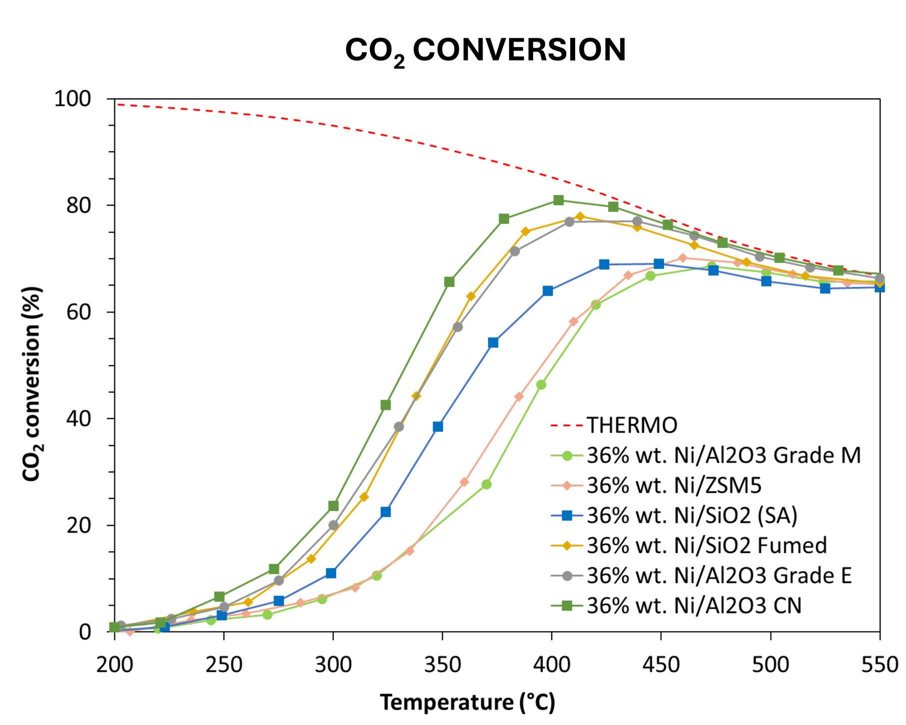
Commercial

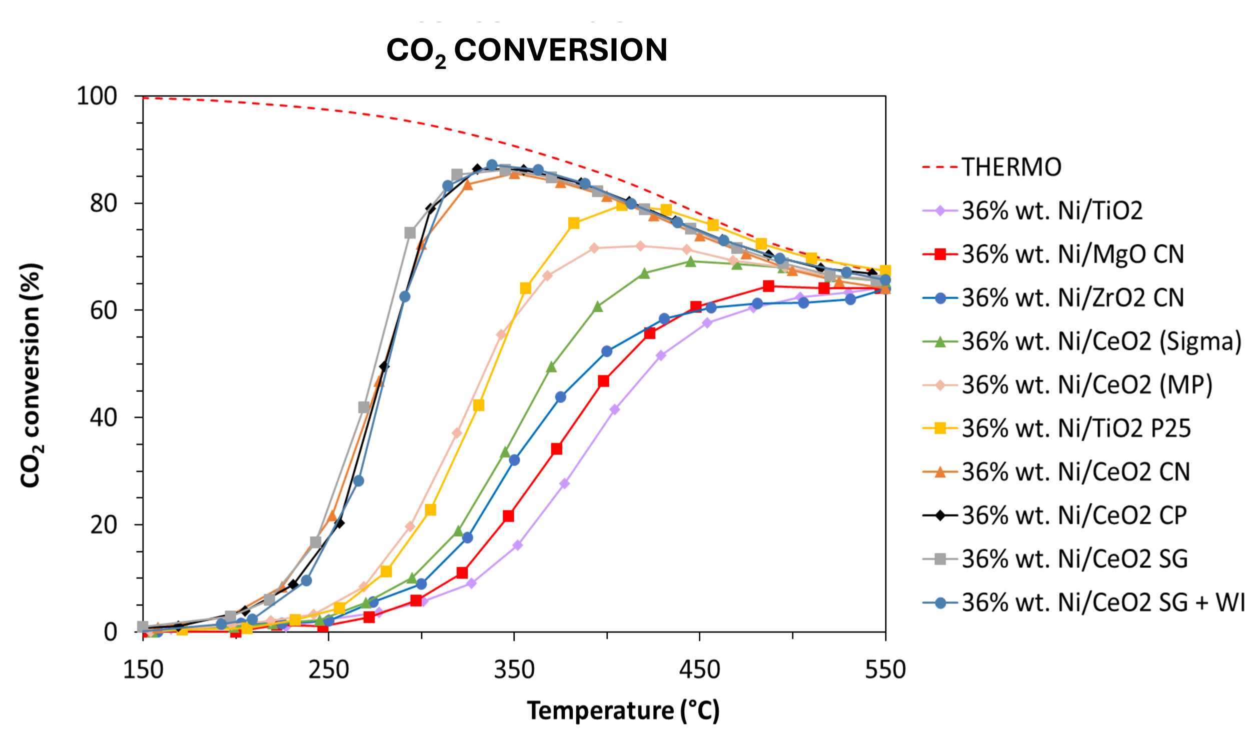
36% Ni/Al_2O_3 (Grade E),
36% Ni/Al_2O_3 (Grade M),
36% Ni/ZSM-5 (Zeolyst CBV),
36% Ni/SiO_2 Fumed,
36% Ni/TiO_2 P25 (Evonik),
36% Ni/CeO_2 (Sigma Aldrich),
36% Ni/TiO_2 (Merck)
36% Ni/SiO_2 (Sigma Aldrich).

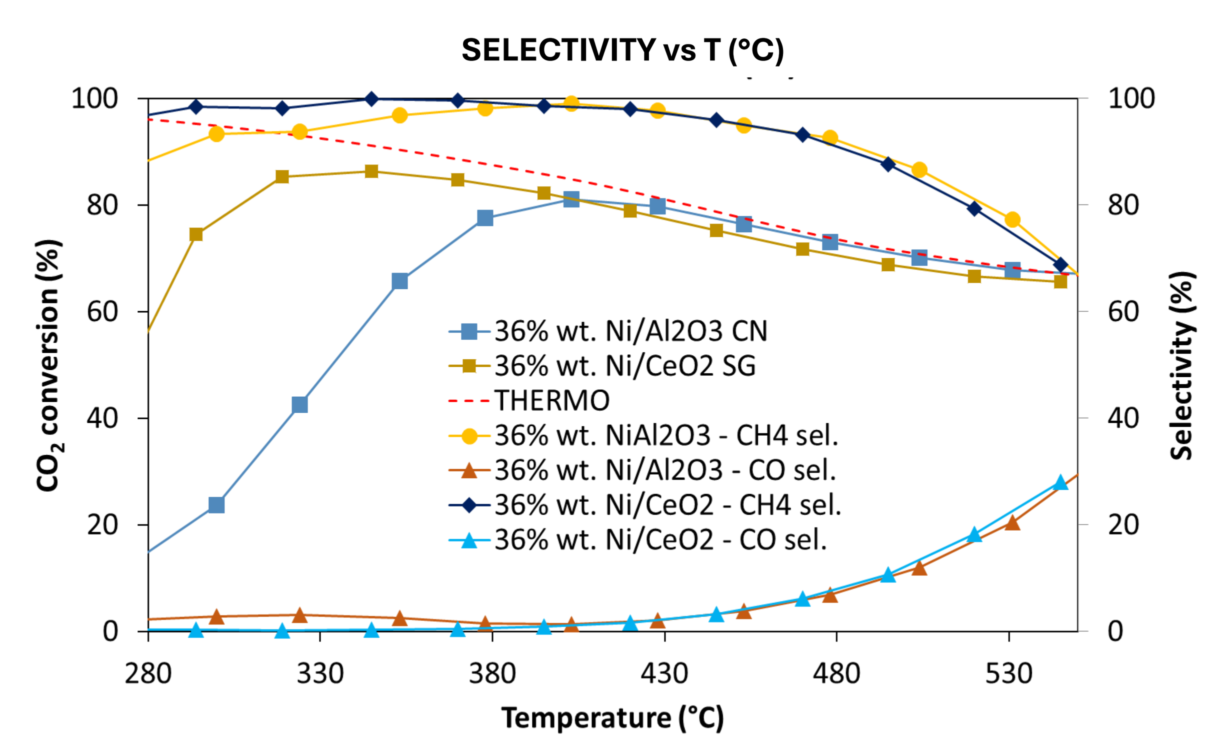
Cat. Screening
200/550 °C
1 atm
60000 mL h^{-1} g_{cat}^{-1}
In-situ reduction
200 mg cat.
1:15 SiC diluition



CATALYSTS PERFORMANCES – CO_2 CONVERSION AND SELECTIVITIES







CeO_2 supported catalyst approached the thermodynamic CO_2 conversion (86%) with complete selectivity towards CH_4 at 345°C

REFERENZE

[1] Tommasi, M.; Naz, S.; Ramis, G.; Rossetti, I. *Advancements in CO_2 Methanation: A Comprehensive Review of Catalysis , Reactor Design and Process Optimization*. **Chem Eng Res Des 2023**, *201*, 457–482, doi:10.1016/j.cherd.2023.11.060
[2] Gao, J.; Wang, Y.; Ping, Y.; Hu, D.; Xu, G.; Gu, F.; Su, F. A *Thermodynamic Analysis of Methanation Reactions of Carbon Oxides for the Production of Synthetic Natural Gas*. **RSC Adv. 2012**, *2*, 2358, doi:10.1039/c2ra00632d

This study was carried out within the Agritech National Research Center and received funding from the European Union Next-GenerationEU (PIANO NAZIONALE DI RIPRESA E RESILIENZA (PNRR) – MISSIONE 4 COMPONENTE 2, INVESTIMENTO 1.4 – D.D. 1032 17/06/2022, CN00000022). This manuscript reflects only the authors' views and opinions, neither the European Union nor the European Commission can be considered responsible for them.