Dipartimento di
Scienze Chimiche

Università degli
Studi di Padova

Dipartimento di
Fisica e Astronomia

CORSO DI LAUREA IN SCIENZA DEI MATERIALI

Tesi di laurea

L'ANIDRIDE CARBONICA: DA GAS SERRA A RISORSA

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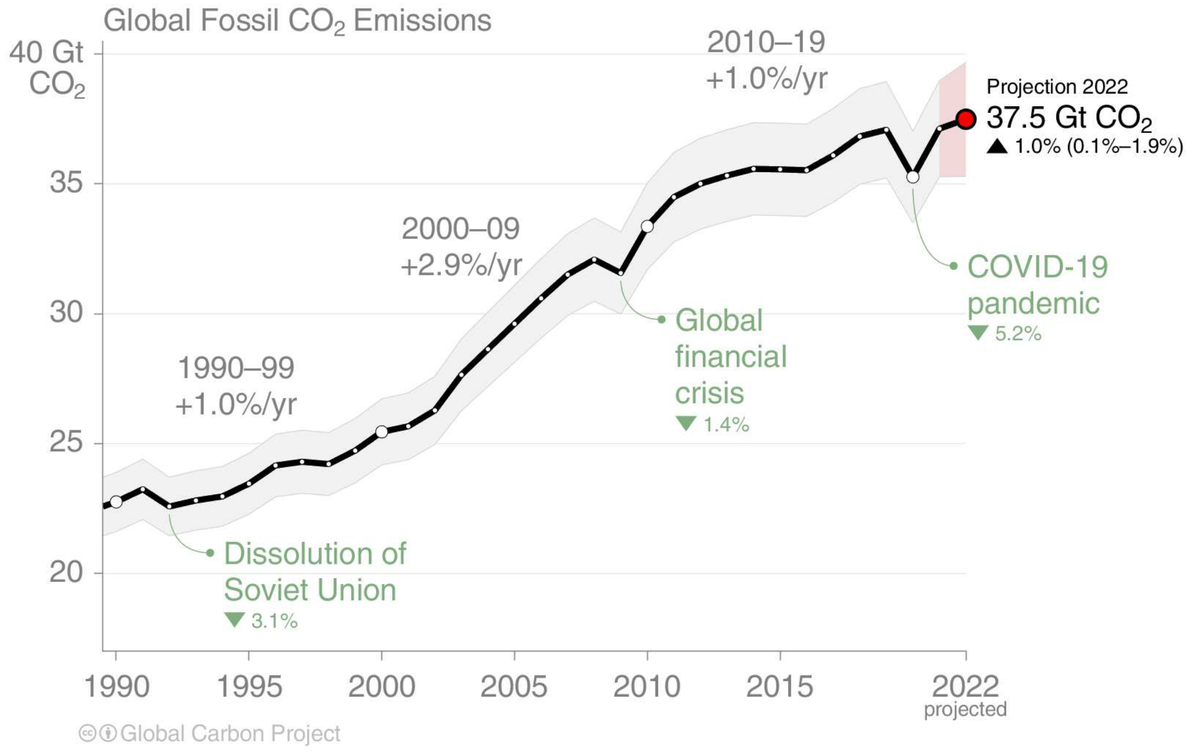
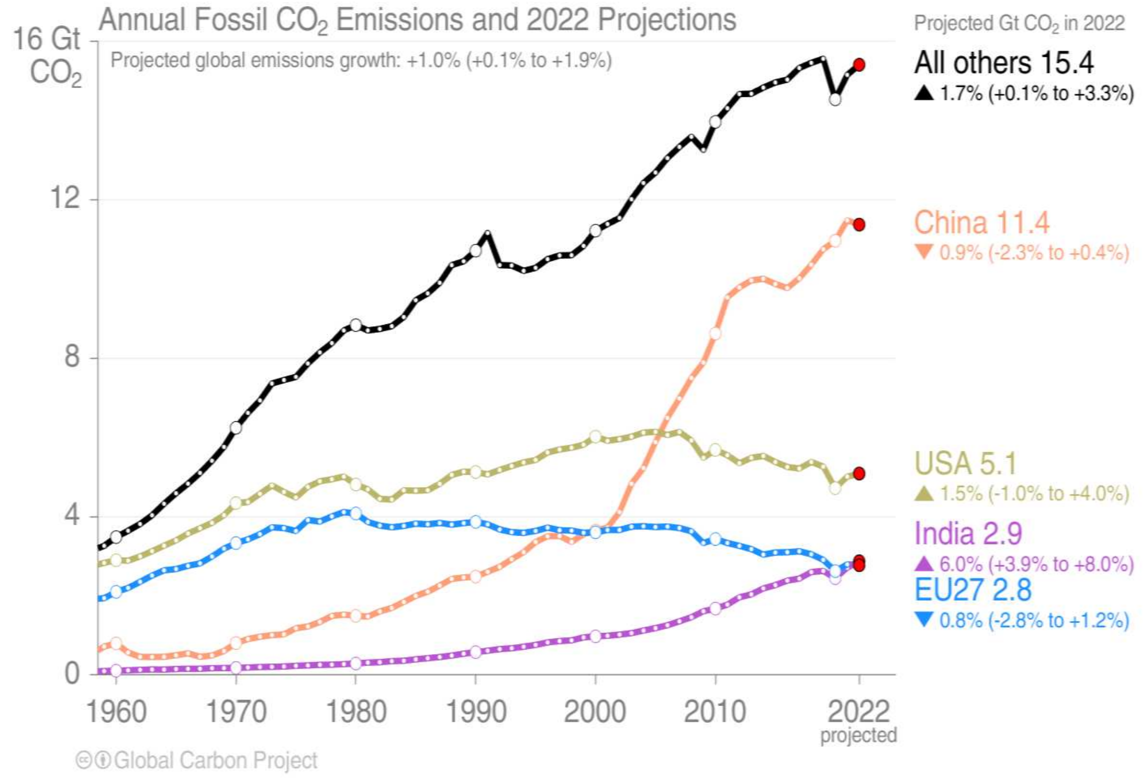
Anno accademico: 2022/2023

EMISSIONI GLOBALI DI CO_2

Emissioni globali di CO_2 fossile: 37.1 ± 2 GtCO2 in 2021, 63% in più del 1990.
Proiezioni per il 2022: 37.5 ± 2 GtCO2, 1.0% [0.1% to +1.9%] più alto del 2021.

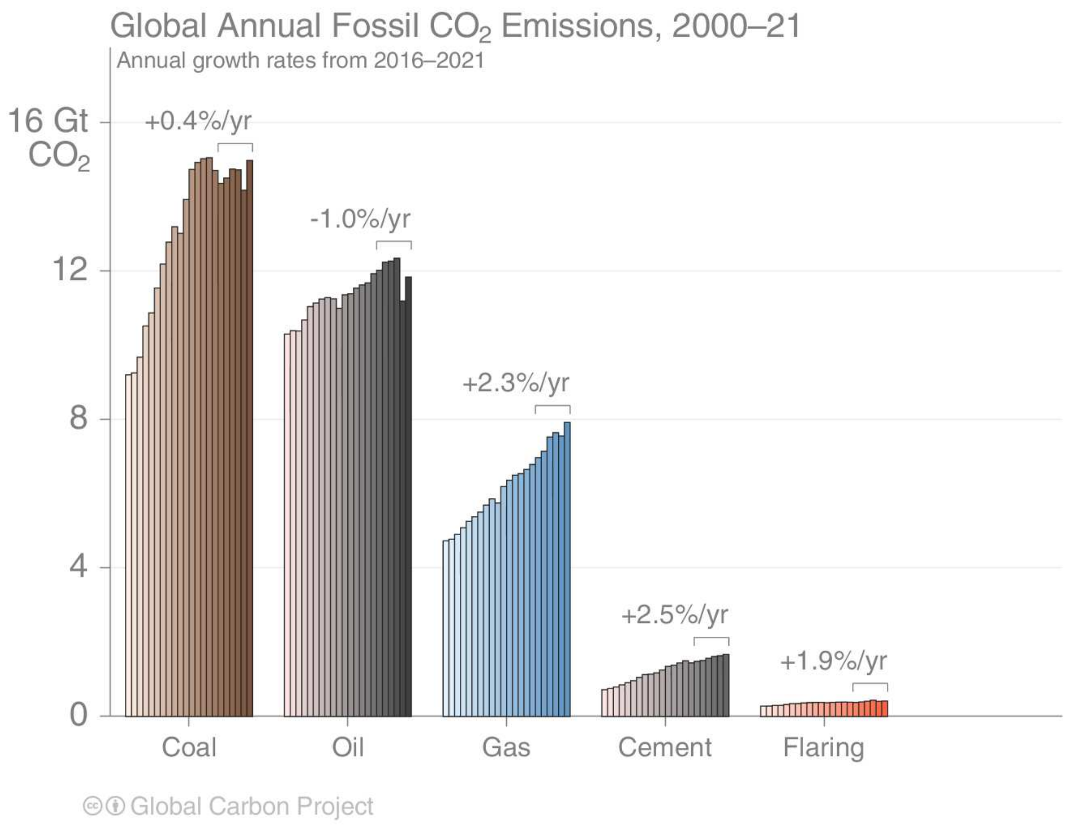




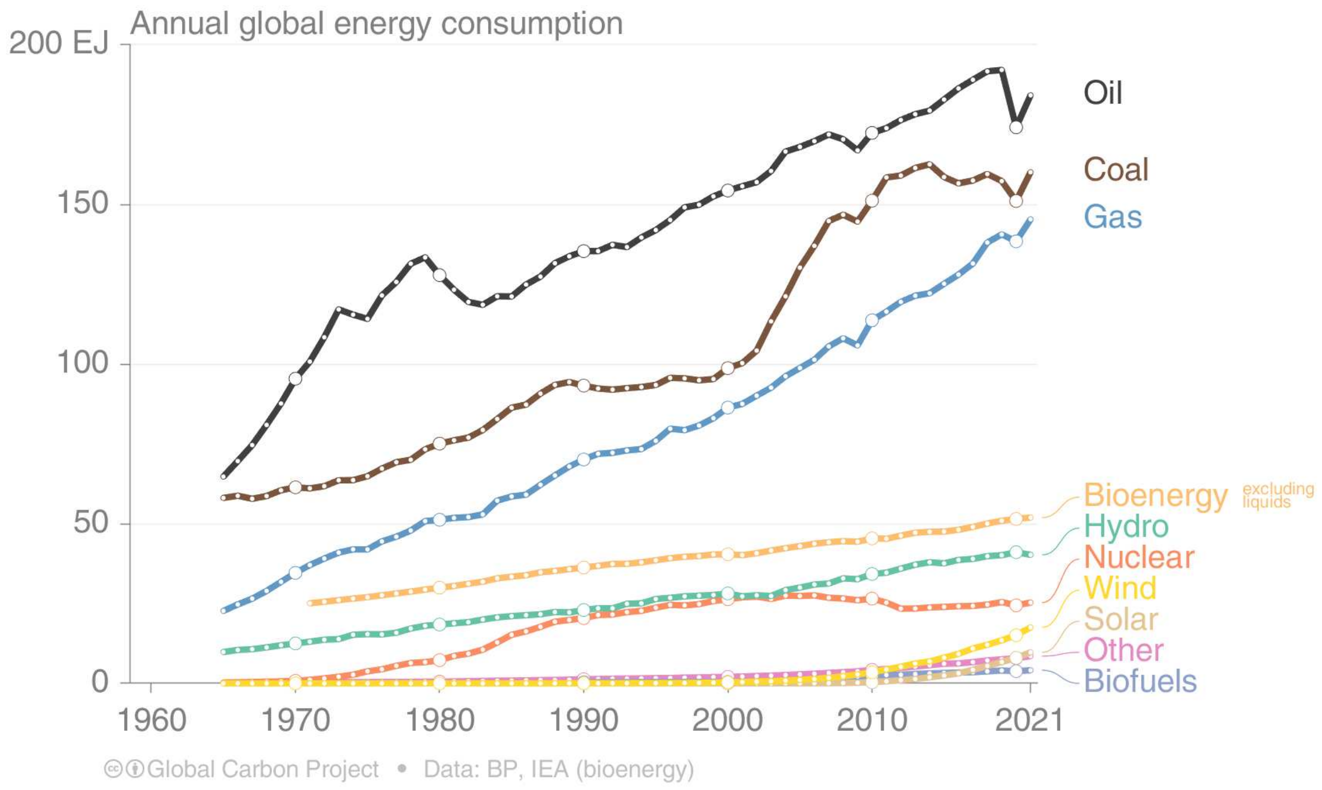
Source: Friedlingstein et al 2022; Global Carbon Project 2022

FONTI DI EMISSIONE DI CO_2

L'uso di carbone e petrolio è sceso complessivamente, tuttavia la crescita delle energia rinnovabili deve aumentare più velocemente per soddisfare il crescente fabbisogno e allo stesso tempo sostituire le fonti fossili.



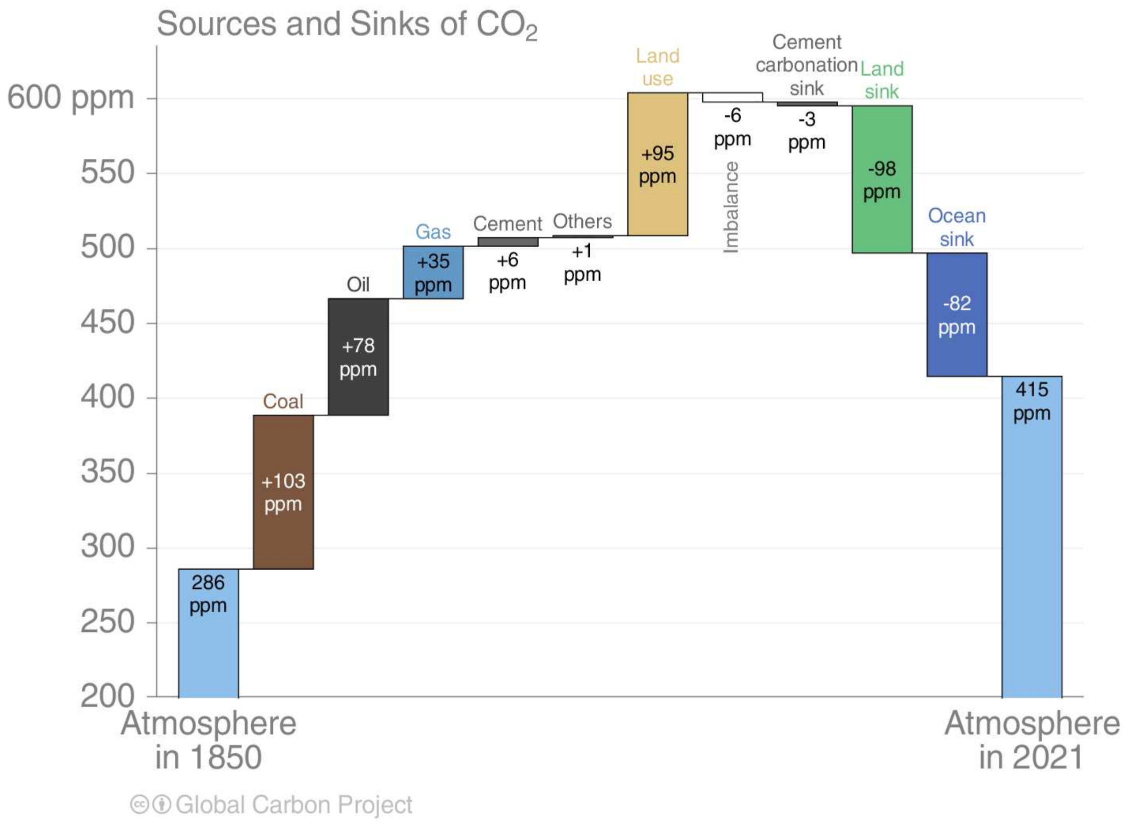
Source: CDIAC; Global Carbon Project 2022

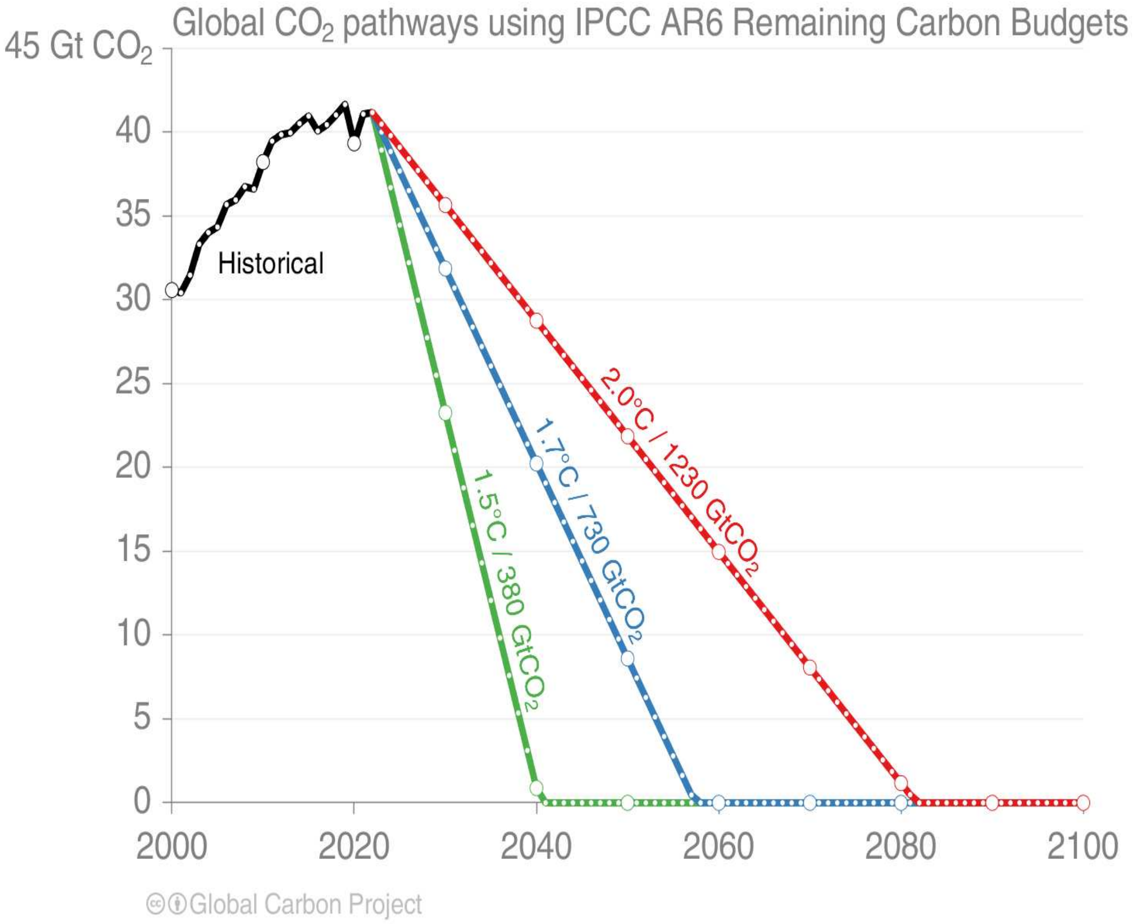


Source: BP 2022; Global Carbon Project 2022

GLOBAL CARBON BUDGET

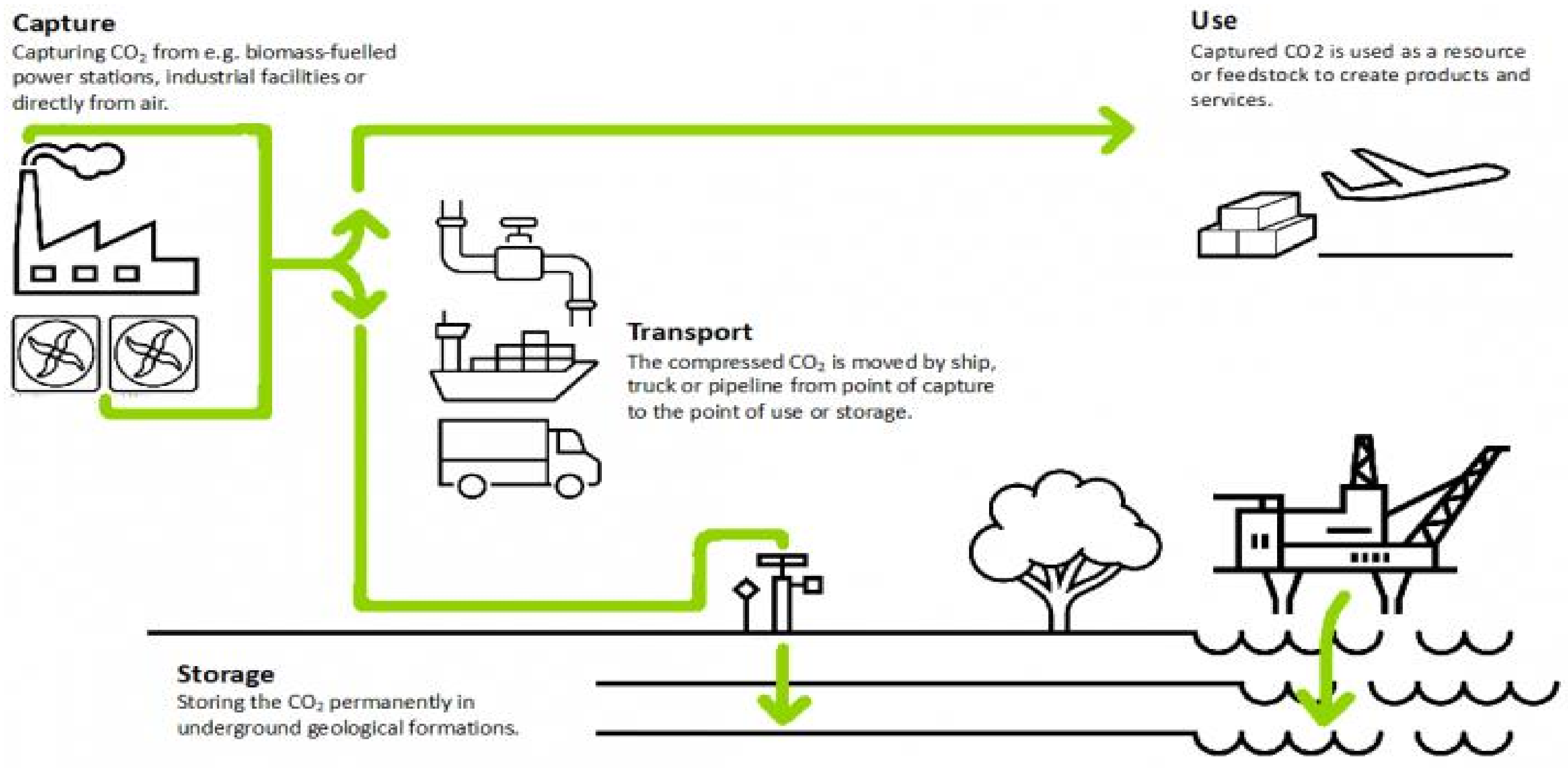
Il "carbon imbalance" rappresenta un divario nella attuale comprensione tra fonti e serbatoi di CO_2.





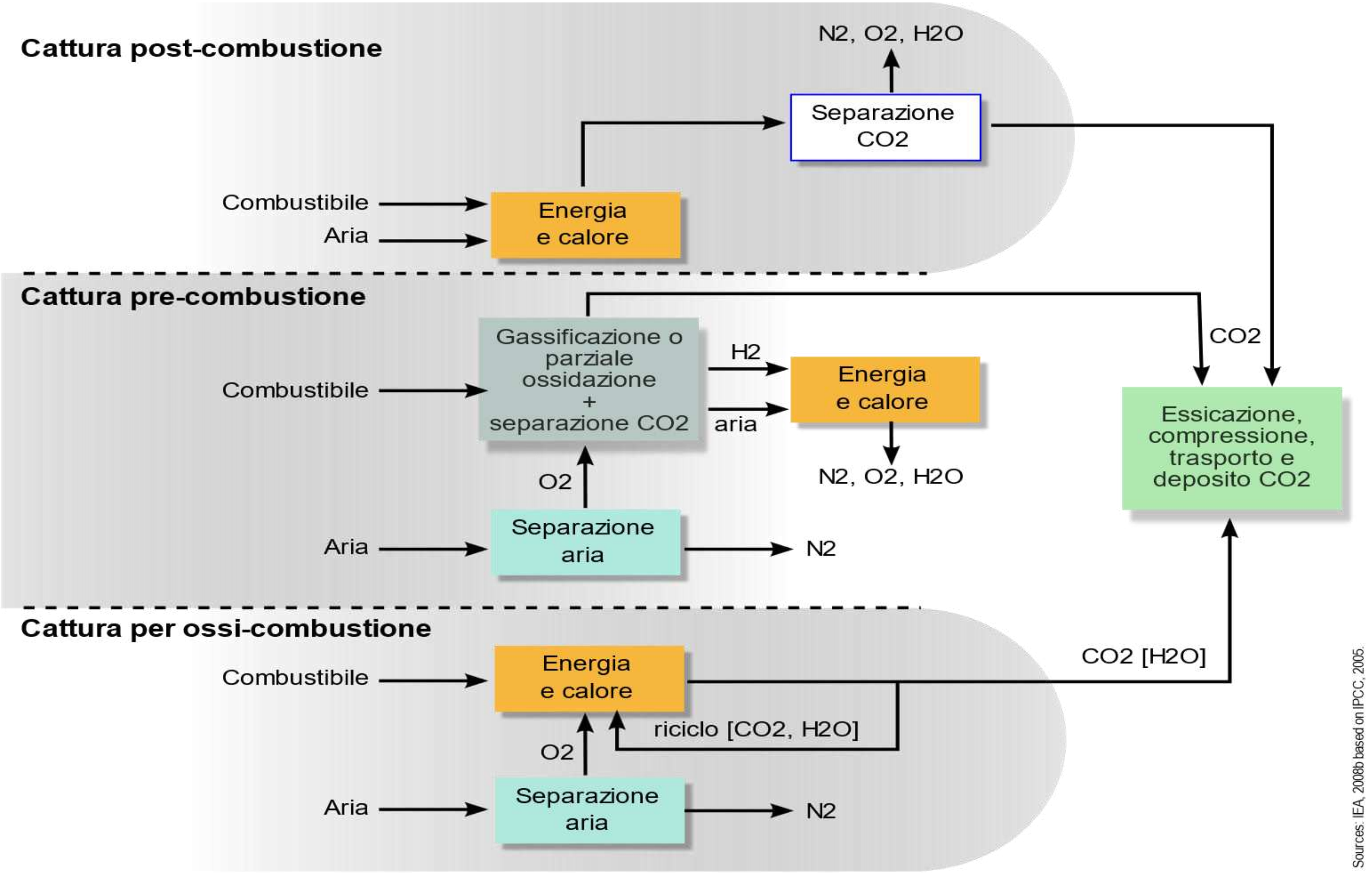
Source: Friedlingstein et al 2022; Global Carbon Project 2022

CARBON CAPTURE UTILISATION AND STORAGE

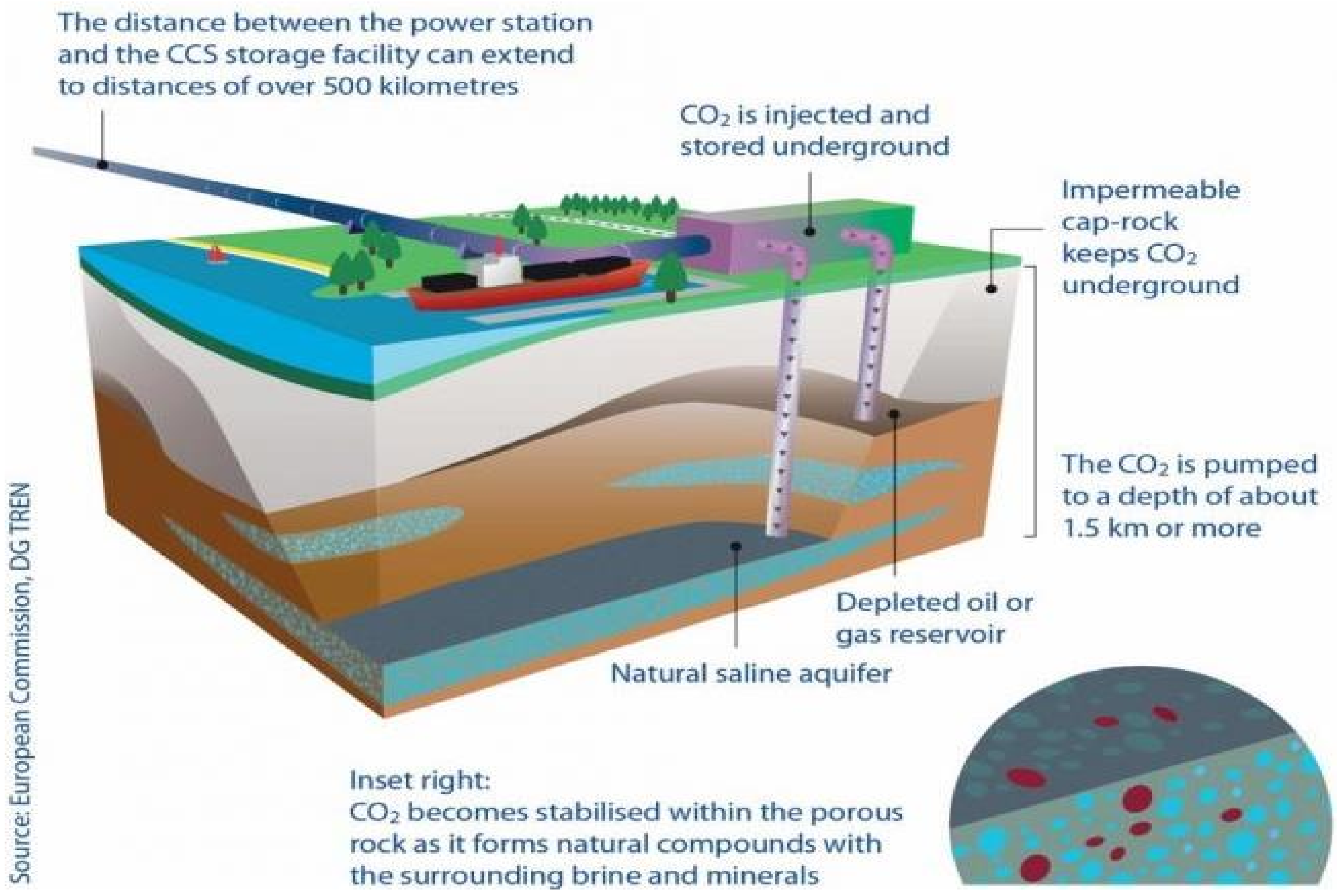


Sourche: https://climate.ec.europa.eu

DIFFERENTI TIPI DI CATTURA



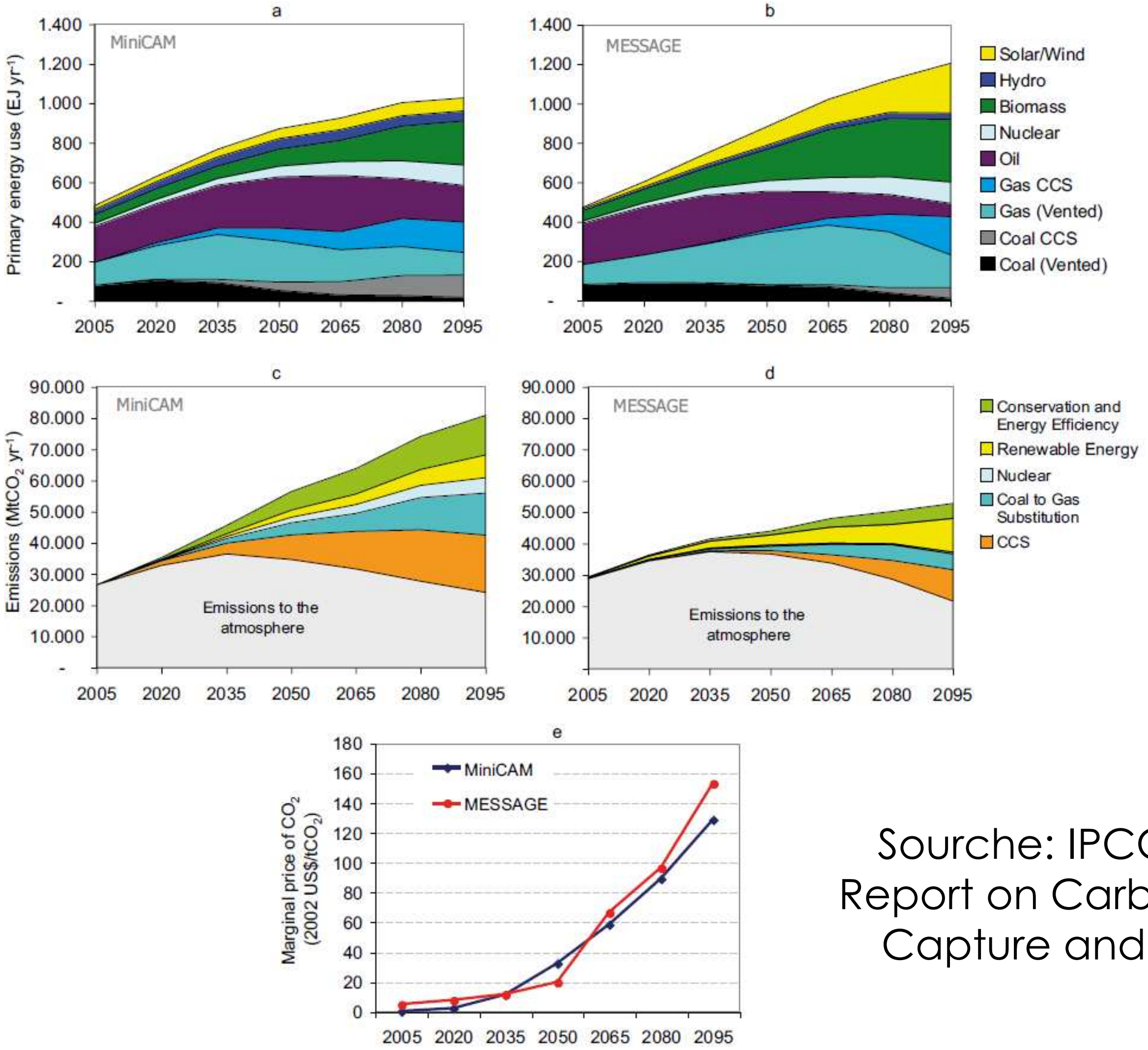
CARBON CAPTURE AND STORAGE (CCS)



Principali obiettivi:

- assicurarsi che la CO_2 catturata e stoccata rimanga isolata dall’atmosfera nel lungo periodo;
- assicurarsi che cattura, trasporto e stoccaggio non presentino rischi per la salute umana e degli ecosistemi.

CONTRIBUTO DEL CCS



Queste immagini sono un esempio illustrato del potenziale globale del CCS come parte di un più grande portfolio di misure di mitigazione.
Si basano su due modelli alternativi di valutazione integrate (MESSAGE e MiniCAM) che adottano le stesse assunzioni per i principali drivers di emissioni.

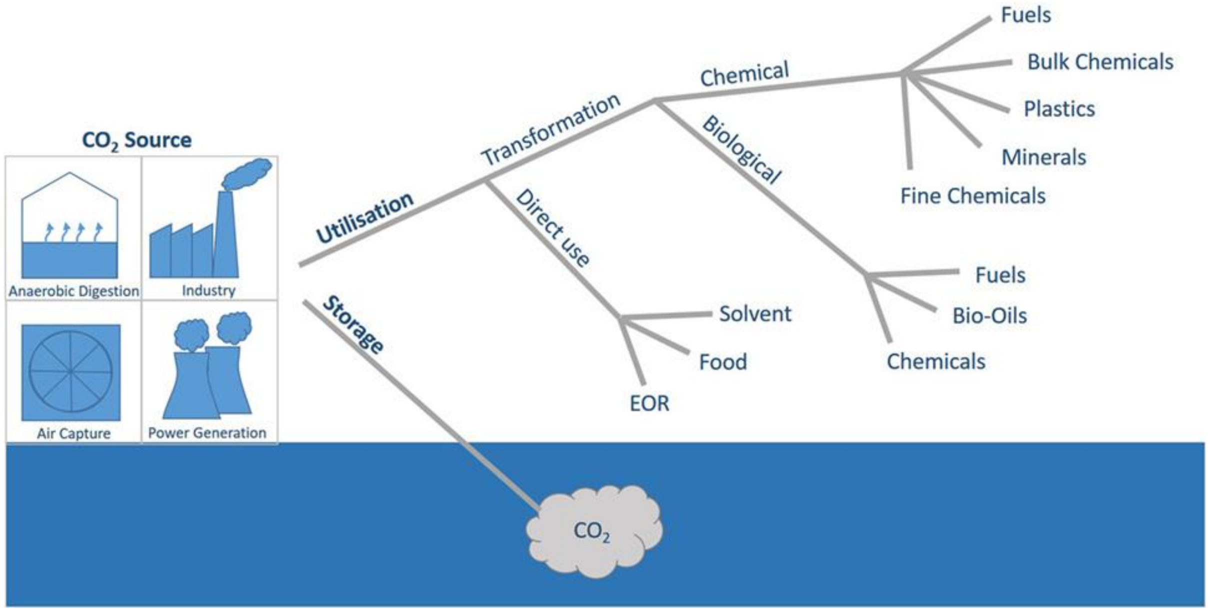
Sourche: IPCC Special Report on Carbon Dioxide Capture and Storage.

CARBON CAPTURE AND UTILISATION (CCU)

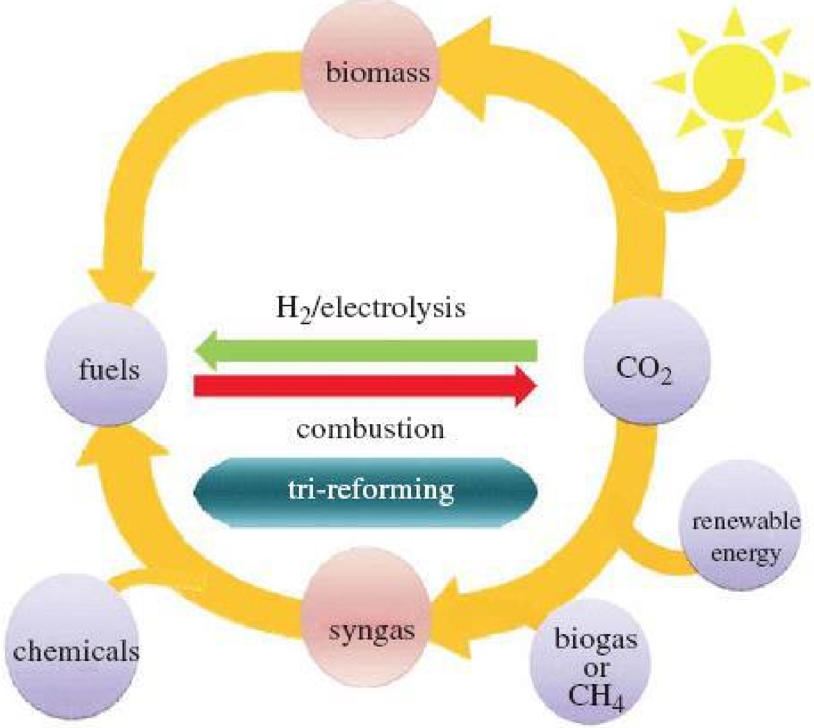
L'utilizzo della CO_2 nei processi di produzione dipende dalle tecnologie e procedure usate:

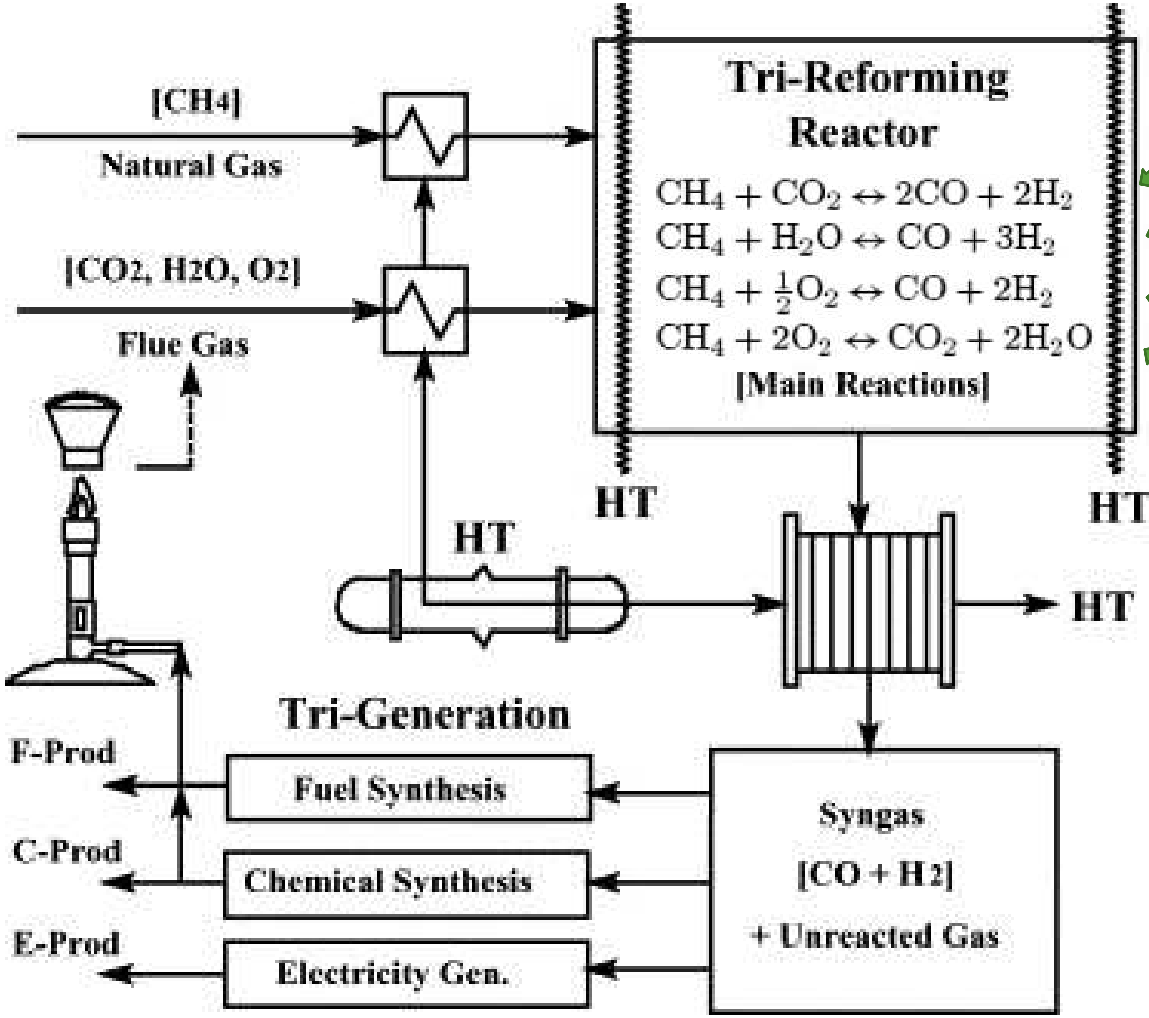
- uso diretto di CO_2 in bevande e serre;
- utilizzo come fluido di lavoro o solvente per Enhanced Oil Recovery (EOR);
- uso come materia prima e conversione in prodotti a valore aggiunto come polimeri, materiali da costruzione, prodotti chimici e combustibili sintetici.

Quest'ultima branca di nuove tecnologie che utilizzano la CO_2 come materia prima può contribuire all'economia circolare e agli obiettivi di mitigazione del clima.



TRI-REFORMING - OVERVIEW





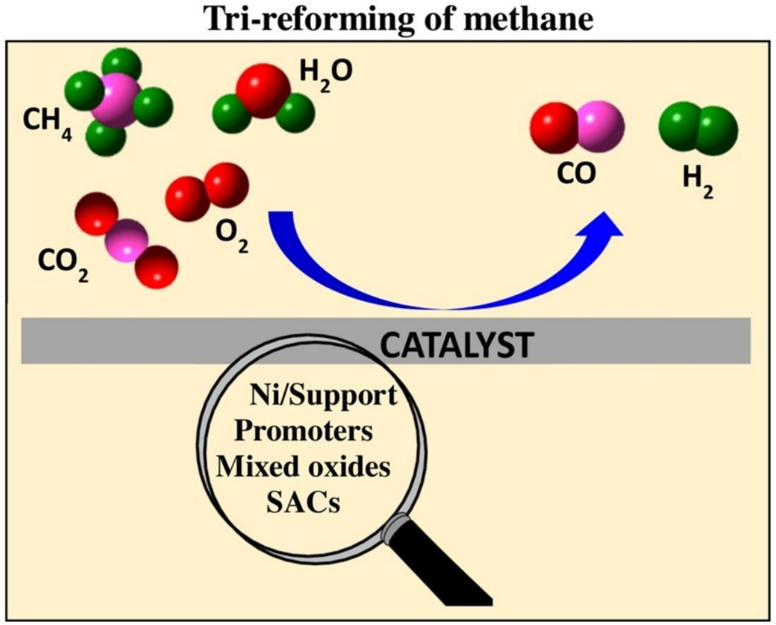
Dri-reforming

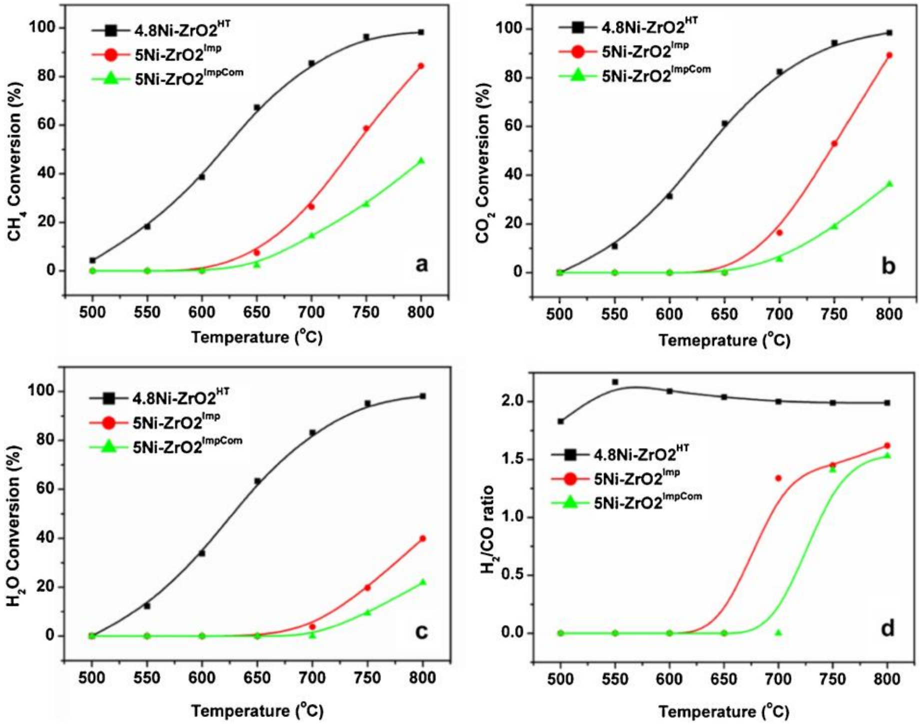
Steam reforming

Ossidazione parziale

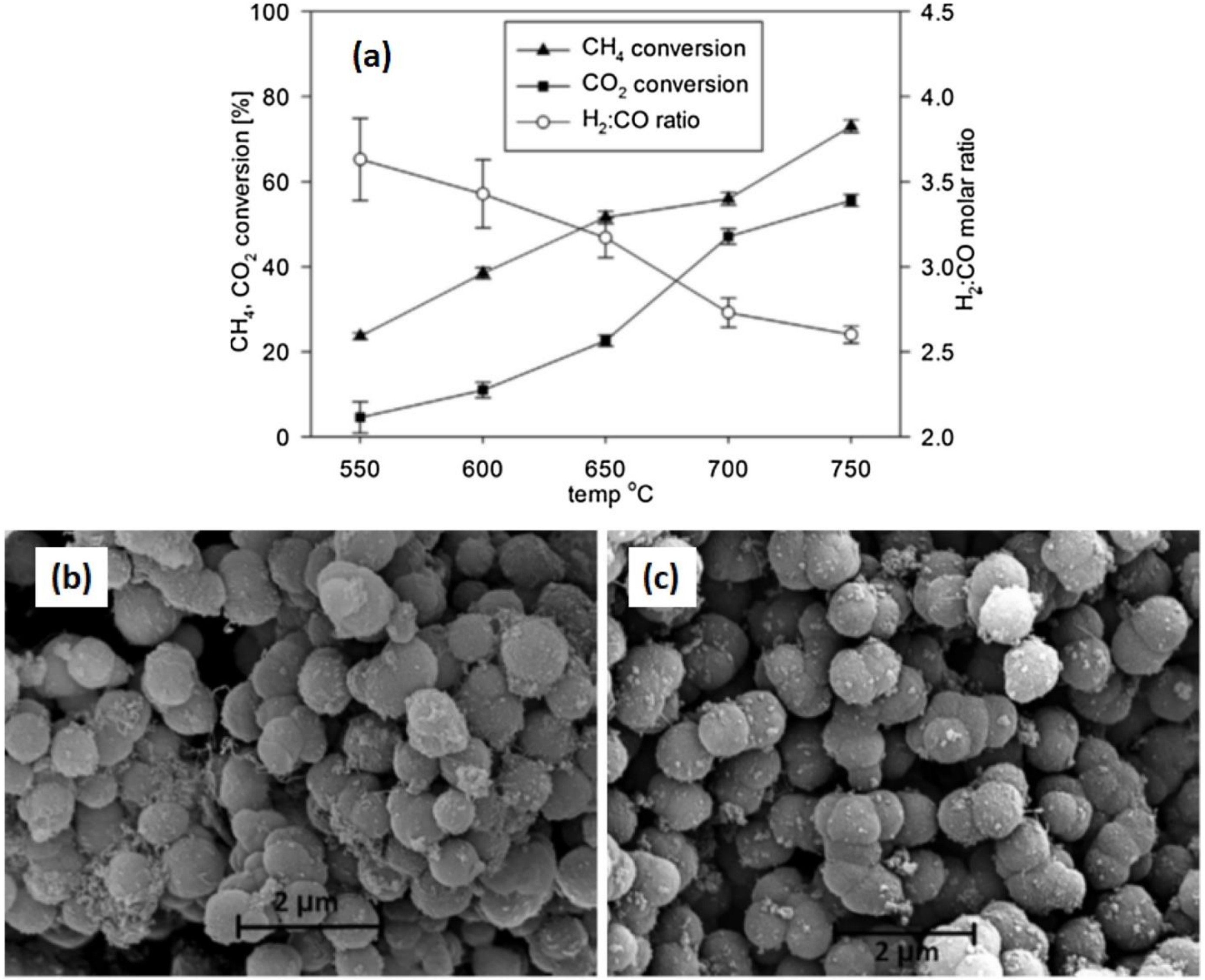
Combustione catalitica

TRI-REFORMING - CATALIZZATORI



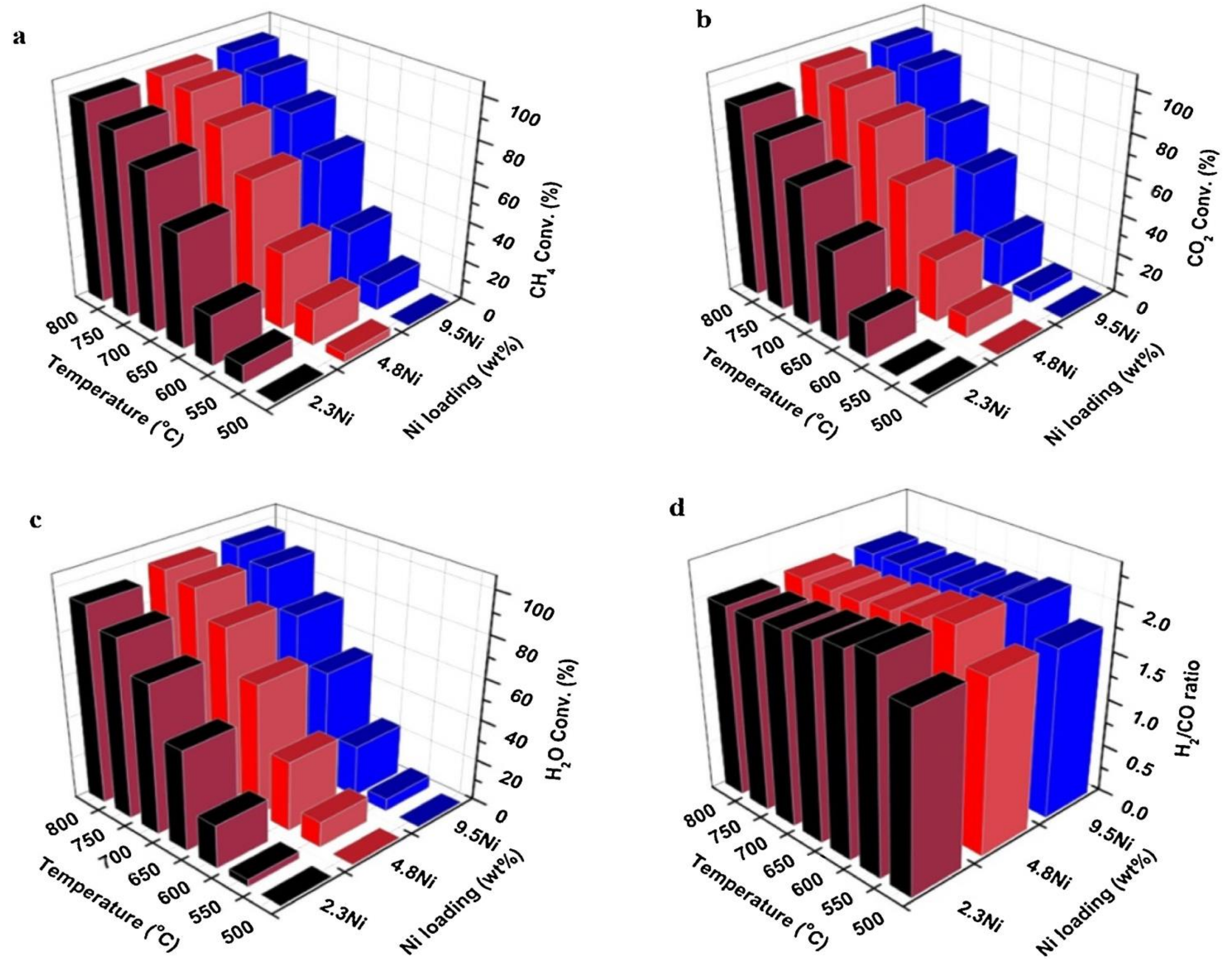


Effect of catalyst preparation method on (a) CH_4 conversion, (b) CO_2 conversion, (c) H_2O conversions and (d) H_2/CO ratios. Reaction conditions: reaction time = 6 h, temperature = 500–800 °C, GHSV = 80,000 mL g−1 h−1, molar ratio of $O_2:CO_2:H_2O:CH_4:He$ = 1:1:2.1:5:18.

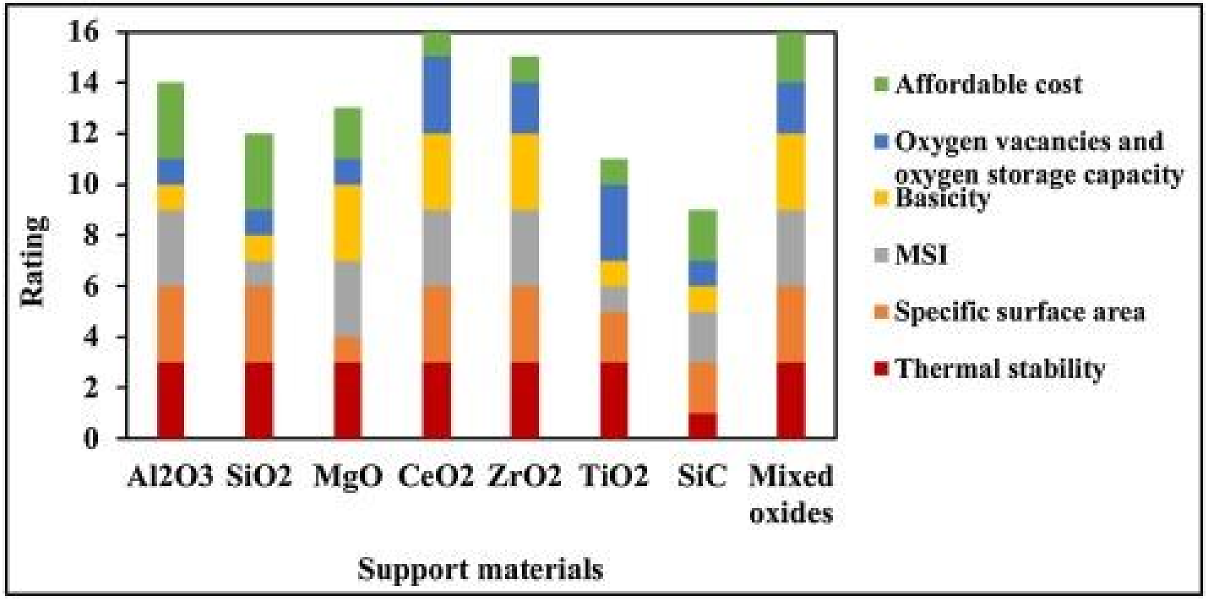


Conversion of CH_4 and CO_2 (average value from 4 h reaction) over Ni/SiO_2 catalyst at different temperatures. Reaction conditions: molar ratio of the feed CH_4:CO_2:H_2O:O_2:He = 1:0.5:0.5:0.1:0.4, CH_4 gas flow rate 25 mL min−1, 0.2 g of catalyst. b) and c) Scanning Electron Microscopy (SEM) micrographs of the Ni/SiO_2 core/shell catalyst after 4 h reaction at b) 550 °C, and c) 750 °C.

Effect of Ni loading during TRM over Ni–ZrO_2 on (a) CH_4 conversion, (b) CO_2 conversion, (c) H_2O conversion, and (d) H_2/CO ratio. Reaction conditions: reaction time = 6 h, temperature = 500–800 °C, GHSV = 80,000 mL g−1 h−1, molar ratio of O_2:CO_2:H_2O:CH_4:He = 1:1:2.1:5:18.



Relative comparison of TRM catalyst supports on the basis of the nominated criteria, taking into consideration the operation conditions of this process.



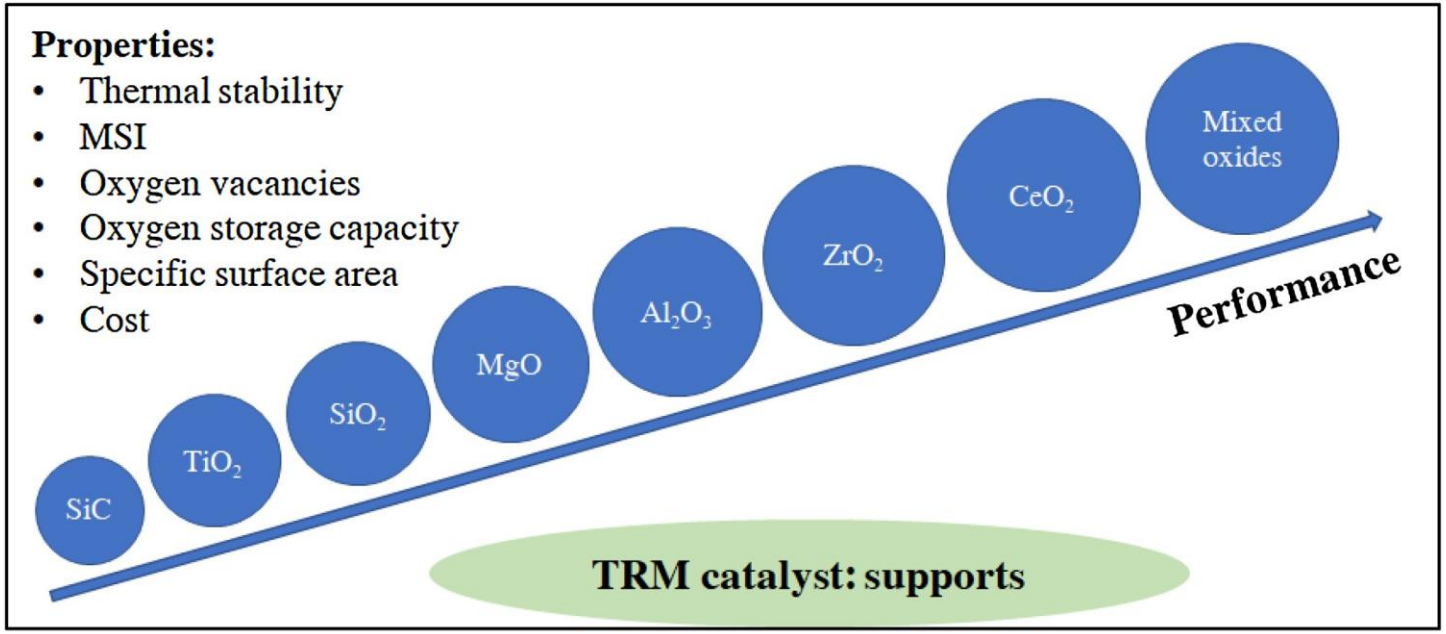
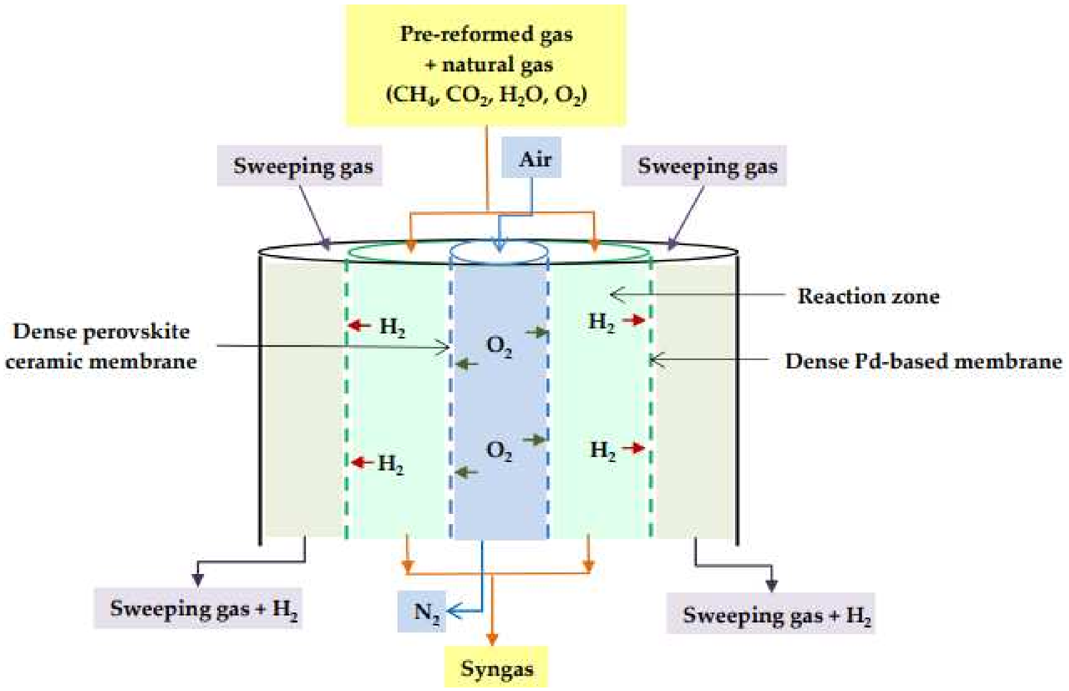
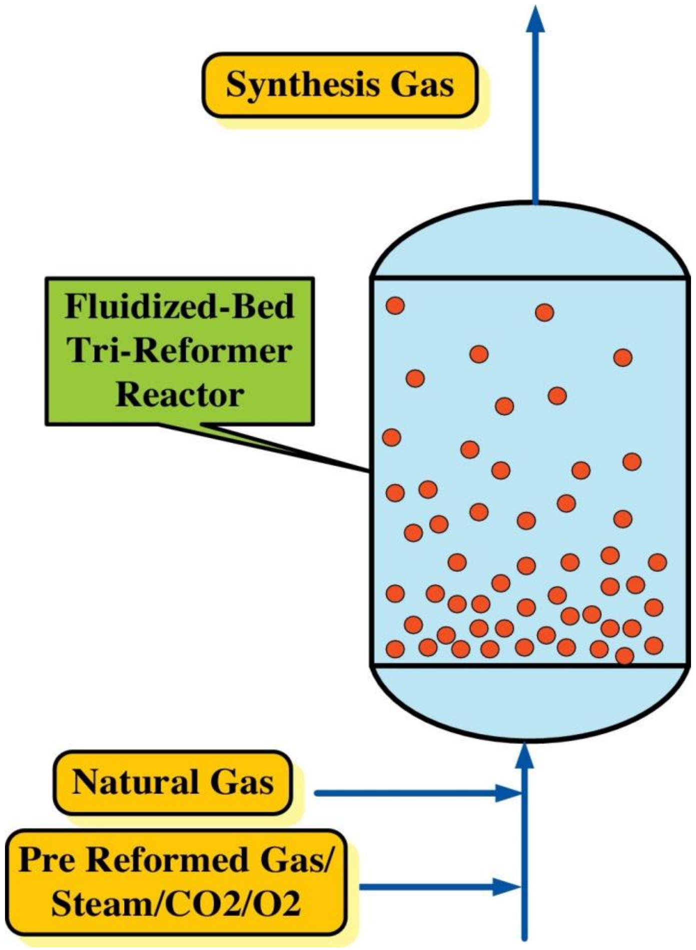


Illustration of the impact of supports in the design of TRM catalysts.

TRI-REFORMING - REATTORI



Permeable Membrane Reactor.



Schematic diagram of proposed novel fluidized-bed tri-reformer reactor.

OSTACOLI DA SUPERARE

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