Electronic Supplementary Material (ESI) for Green Chemistry.

Supplementary information

Carbon-Negative Hydrogen: Aqueous Phase Reforming (APR) of Glycerol over NiPt Bimetallic Catalyst Coupled with CO_2 Sequestration

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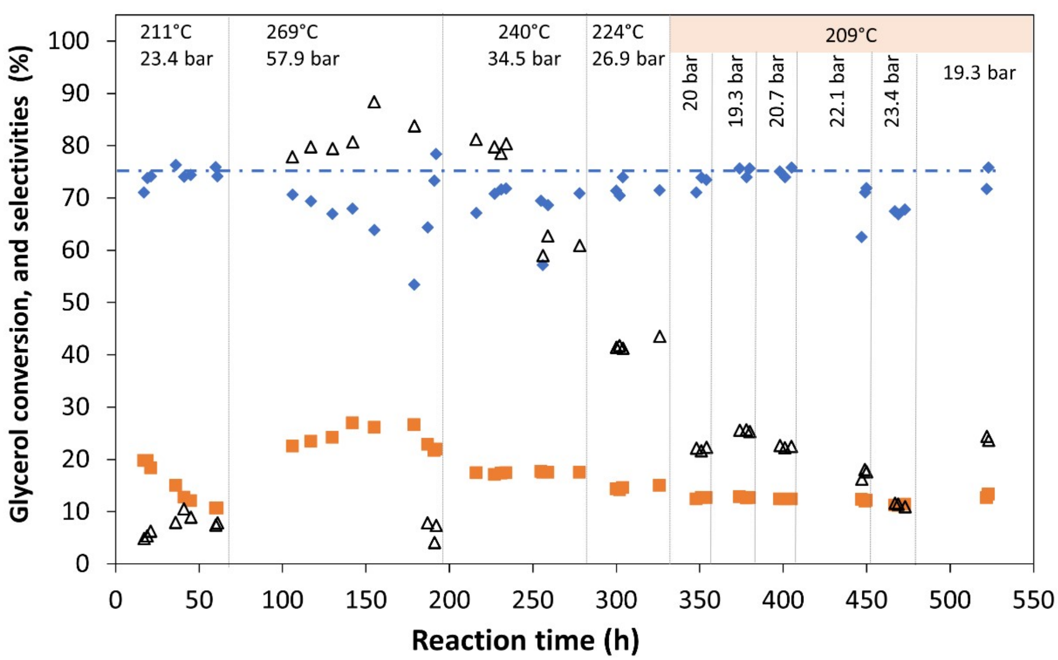


Figure S1. Glycerol conversion (Δ), hydrogen selectivity (◷), and alkanes selectivity (○) in the aqueous phase reforming of 10 wt% of glycerol. Catalyst: Pt – 260. WHSV of 0.367 h^{-1}. Total time on stream: 523 h.

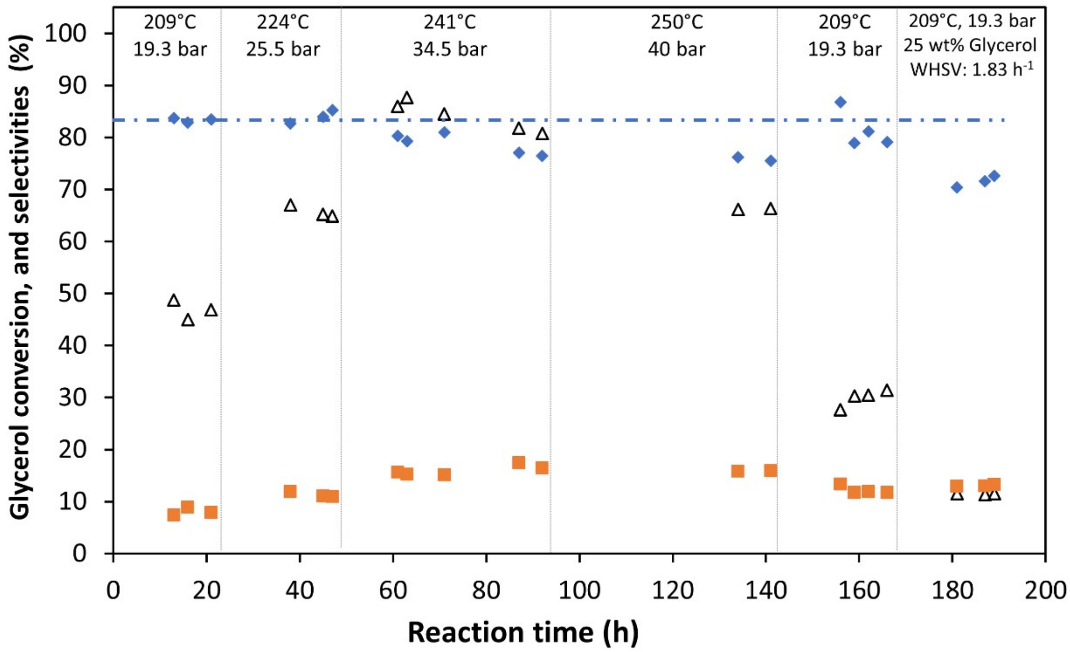


Figure S2. Glycerol conversion (Δ), hydrogen selectivity (◷), and alkanes selectivity (○) in the aqueous phase reforming of 10 wt% of glycerol. Catalyst: Ni_1Pt_1 – 260. WHSV of 0.37 h^{-1}. Total time on stream: 190 h.

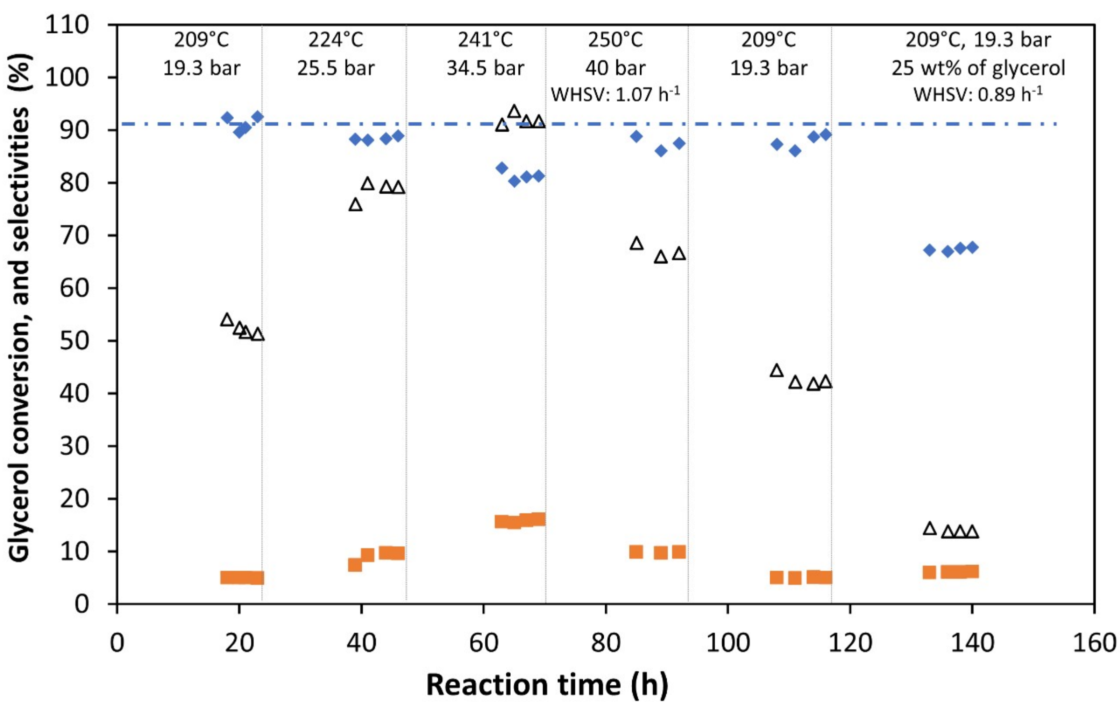


Figure S3. Glycerol conversion (Δ), hydrogen selectivity (◷), and alkanes selectivity (○) in the aqueous phase reforming of 10 wt% of glycerol. Catalyst: Ni_8Pt_1 – 260. WHSV of 0.36 h^{-1}. Total time on stream: 140 h.

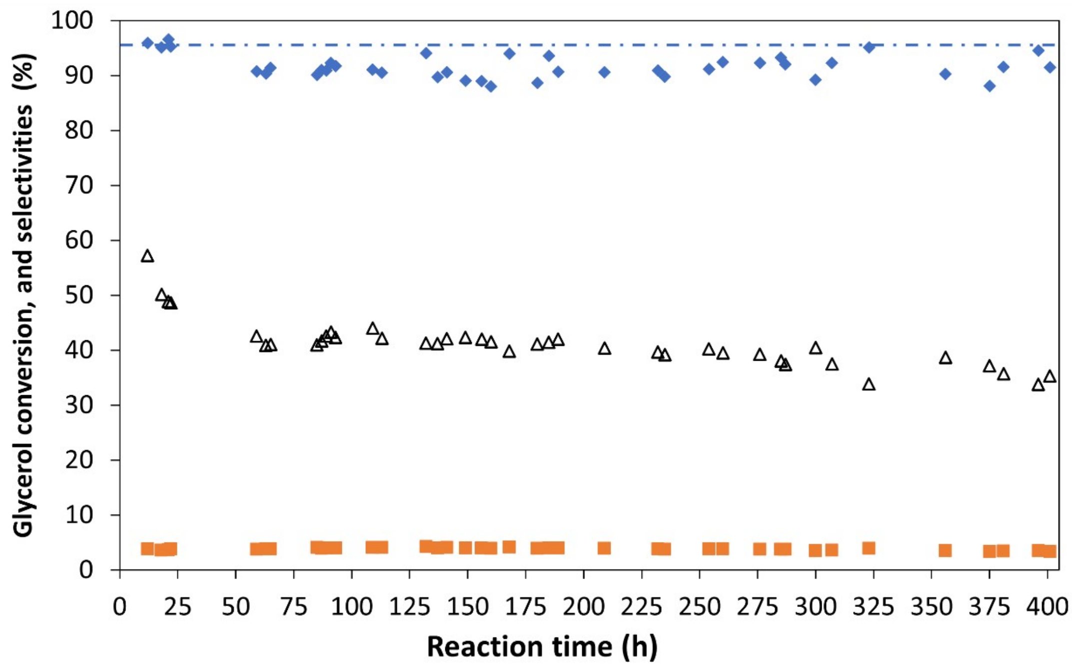
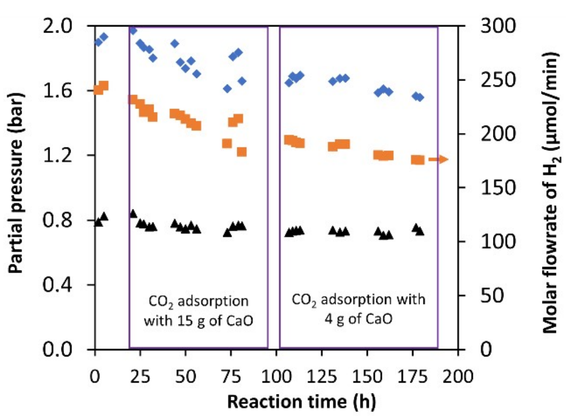
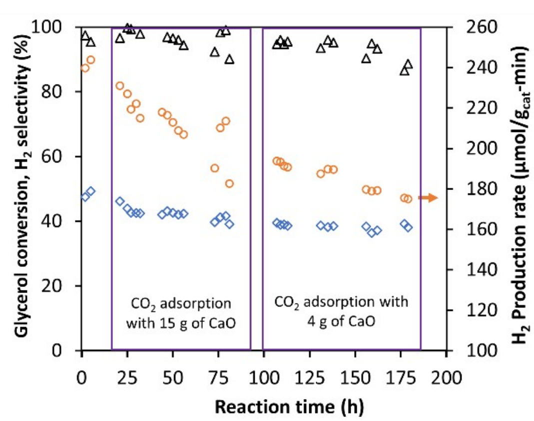


Figure S4. Glycerol conversion (Δ), hydrogen selectivity (◌), and alkanes selectivity (**O**) in the aqueous phase reforming of 10 wt% of glycerol. Catalyst: Ni_8Pt_1 – 450. WHSV of 0.36 h^{-1}. Total time on stream: 401 h. Reaction conditions: 209°C, and 19.3 bar.

APR Experiment for isothermal CO_2 adsorption at 600°C



(a)



(b)

Figure S5. (**a**) Hydrogen (◌), and CO_2 (▲) partial pressure of the inlet stream to the CO_2 bed at 600°C, from the APR of 10 wt% of glycerol (209°C and 19.3 bar), and hydrogen molar flowrate (**O**). (**b**) Glycerol conversion to the gas phase (◊), hydrogen selectivity (Δ), and hydrogen production rate (o) in the APR of 10 wt% of glycerol, used for the CO_2 adsorption at 600 °C. Catalyst: Ni_8Pt_1-450.

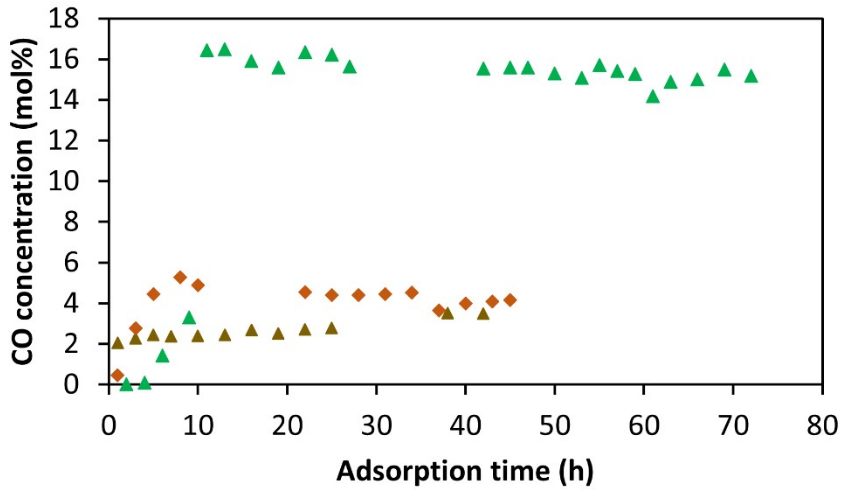


Figure S6. CO concentration in the outlet stream of the CO_2 adsorber at 600°C. CaO-packed bed with 4 g (▲) and 15 g (◆) at 0.75 bar of CO_2 partial pressure; inlet gas composition (mol%): 86.8% N_2, 9.1% H_2, 4% CO_2, 0.12% CH_4; and total molar gas inlet flow = 0.00223 mol/min. ▲ CaO-packed bed with 25 g at 5.3 bar of CO_2 partial pressure; inlet gas composition(mol%): 4.7% N_2, 63.4% H_2, 27.7% CO_2, 1.3% CH_4; and total gas molar inlet flow = 0.00081 mol/min.

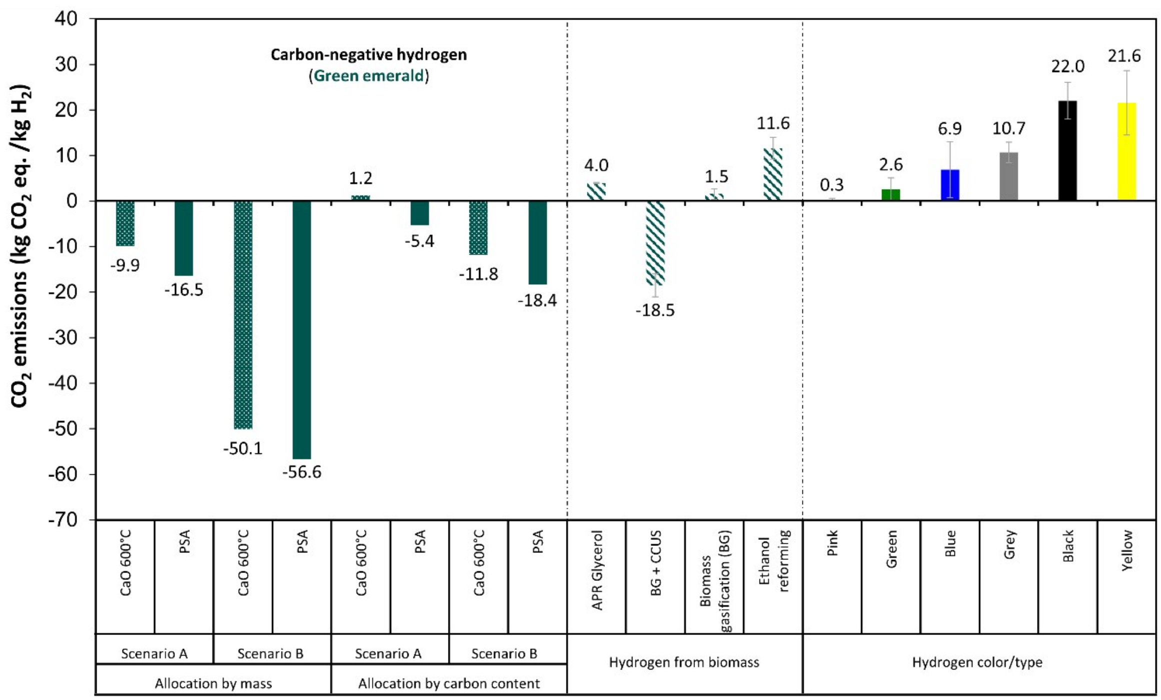


Figure S7. GHG emissions of all scenarios and the contributions of each production stage to the total GHG emissions considering PSA.

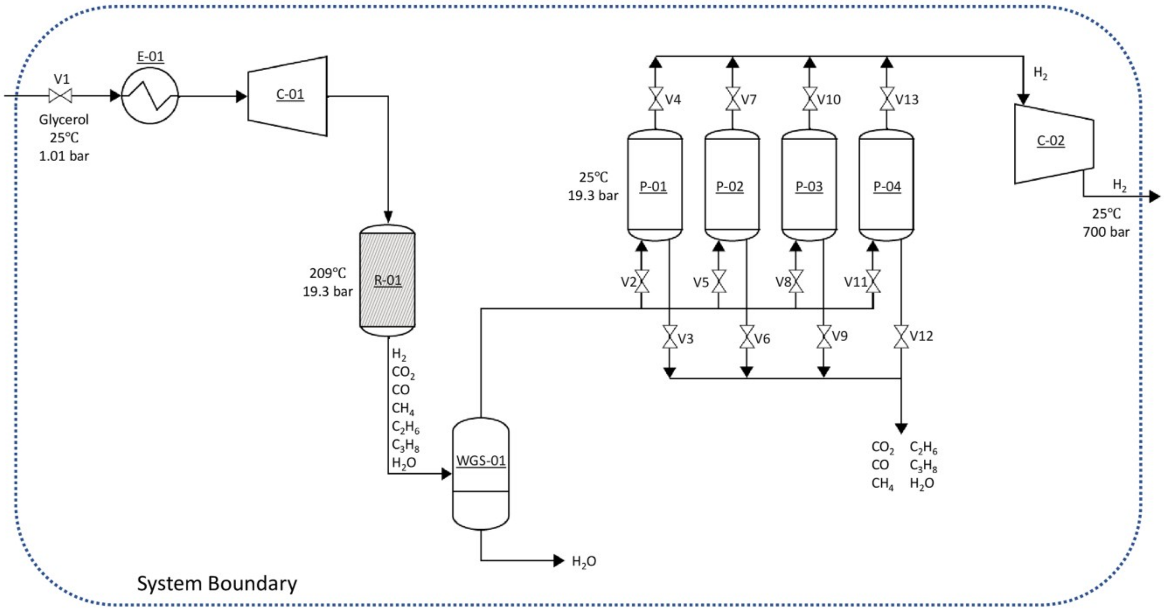


Figure S8. Process scheme of APR of glycerol to produce H_2 analyzed considering PSA.