

PHD RESEARCH PROPOSAL

Doutoramento em Engenharia da Refinação, Petroquímica e Química (EngIQ)

BIOGAS VALORISATION THROUGH REFORMING REACTIONS IN A MULTIFUNCTIONAL REACTOR

Summary / Framework

The energy sector is one of the pillars of growth and development of modern economies. However, energy production and consumption increase CO₂ concentrations in the atmosphere, causing severe economic and ecological damage. Hence, the decarbonization of the economy is an urgent matter for humanity. With the European Green Deal, the Commission committed to making the EU climate neutral by 2050. Hydrogen obtained from renewable sources has a central role in helping the world to reach net-zero emissions. This work proposes an innovative and integrated solution aiming to produce clean energy (in the form of biohydrogen) from renewable biogas (methane and carbon dioxide mixture) through reforming processes ($\text{CH}_4 + \text{CO}_2 \rightleftharpoons 2\text{H}_2 + 2\text{CO}$ and $\text{CH}_4 + \text{H}_2\text{O} \rightleftharpoons 3\text{H}_2 + \text{CO}$), using CO₂ as a reactant, therefore being captured and used. Accordingly, this work focuses on developing and optimising a hydrogen membrane reactor, shifting the reactions in the forward direction and inherently overcoming equilibrium limitations. In this reactor, the permeate and the retentate streams are generated; the first is constituted by high-purity hydrogen, and the latter is formed by unconverted methane and CO₂, CO, H₂O, and hydrogen. The retentate stream of this reactor could be fed to existing reforming facilities to produce more hydrogen (with the potential of increasing the performance of subsequent stages), or also for the synthesis of e-fuels such as renewable methanol.