Cost-effective pathways for decarbonized production of hydrogen from natural gas and biogenic waste

Presented by Professor Abdelghafour Zaabout[[1]](#footnote-1)

Mohammed 6 Polytechnic University

Key contributors:

Schalk Cloete, Shahriar Amini, Chaitanya Dhoke, Solomon Wassie, Mogahid Osman, Ambrose Ugwu, Henri Cloete, Antonia Helf, Florian Pruvost, Mohamed Medhat, Massamba Sow

This talk will address decarbonization of fossil fuel to hydrogen. Two main sectors will be studied; natural gas and biogenic-based feedstocks. The key technical decarbonization pathways are: i) Chemical looping for heat and oxygen supply while capturing CO2, ii) hydrogen-selective membrane, iii) calcium looping; iv) pyrolysis; v) hydrothermal. The different pathways bring different extents of emission reduction, energy efficiency, and cost performance.

This talk will introduce the different methods and illustrate the different ways of their integration in decarbonization of natural gas and biomass to pure hydrogen, natural gas blended with hydrogen or upgraded biogas. Experimental demonstration studies and techno-economic assessments have been completed for the different concepts showing promising prospects if appropriate frameworks are established for promoting industrial decarbonization.

## References

Schalk Cloete, Florine Melone, Carlos Arnaiz del Pozo, Chaitanya Dhoke, Øistein Farmen, Abdelghafour Zaabout. Zero-cost partial decarbonization of natural gas via molten salt pyrolysis, International Journal of Hydrogen Energy, 2023, <https://doi.org/10.1016/j.ijhydene.2023.11.124>.

Florian Pruvost, Schalk Cloete, Carlos Arnaiz del Pozo, Abdelghafour Zaabout. Blue, green, and turquoise pathways for minimizing hydrogen production costs from steam methane reforming with CO2 capture, Energy Conversion and Management, Volume 274, 2022, <https://doi.org/10.1016/j.enconman.2022.116458>.

Antonia Helf, Schalk Cloete, Florian Keller, Jan Hendrik Cloete, Abdelghafour Zaabout. Carbon-negative hydrogen from biomass using gas switching integrated gasification: Techno-economic assessment. Energy Conversion and Management, Volume 270, 2022, <https://doi.org/10.1016/j.enconman.2022.116248>.

Ambrose Ugwu, Carlos Arnaiz del Pozo, Abdelghafour Zaabout, Shareq Mohd Nazir, Nimet Uzun Kalendar, Schalk Cloete, Szabolcs Szima, Szabolcs Fogarasi, Felix Donat, Geert van Diest, Jan Hendrik Cloete, Ángel Jiménez Álvaro, Knuth Albertsen, Ana-Maria Cormos, Calin-Cristian Cormos, Shahriar Amini. Gas switching technology: Economic attractiveness for chemical looping applications and scale up experience to 50 kWth, International Journal of Greenhouse Gas Control, Volume 114, 2022, <https://doi.org/10.1016/j.ijggc.2022.103593>.

Mogahid Osman, Abdelghafour Zaabout, Schalk Cloete, Shahriar Amini. Pressurized chemical looping methane reforming to syngas for efficient methanol production: Experimental and process simulation study, Advances in Applied Energy, Volume 4, 2021, <https://doi.org/10.1016/j.adapen.2021.100069>.

1. Several co-authors and collaborators have contributed to the studies to be presented in this talk [↑](#footnote-ref-1)