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NextFuel

THE NEXT SHIPPING FUEL: ELECTRIFYING STEAM METHANE REFORMING FOR BIOMETHANOL PRODUCTION

Athanasia Maria Moustaka, Attila Akac, Afroditi Anagnostopoulou, Vassilios Kappatos

Hellenic Institute of Transport (HIT), Centre for Research & Technology Hellas (CERTH)

Thermi, Thessaloniki, Greece

INTRODUCTION

As the maritime sector aims to reduce emissions, biomethanol emerges as a promising green fuel. It has the potential to substantially cut emissions compared to traditional marine fuels while remaining economically viable. *NextFuel* project focuses on electrifying the Steam Methane Reforming (SMR) process to produce biomethanol more sustainably, significantly reducing its the carbon footprint. By starting methanol synthesis with biogas (or biomass) instead of natural gas, the sustainability of the process is further enhanced.

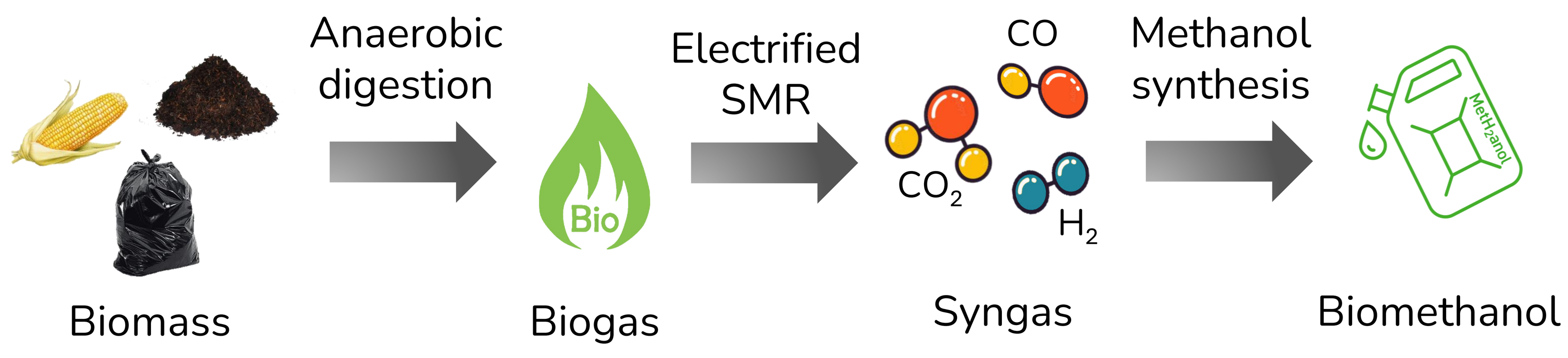

Figure 1. Biomethanol production pathway from biomass feedstocks

The electrification of the SMR process represents a major advancement in sustainable fuel production. By utilizing renewable electricity and innovative reactor designs, it can greatly reduce fossil fuel dependency and CO_2 emissions. Furthermore, integrating onboard carbon capture technology ensures the maritime industry can move towards a zero-emission future. The adoption of electrified SMR technology is projected to significantly lower greenhouse gas emissions, contributing to a reduction of nearly 1% in global CO_2 emissions.[1]

METHODOLOGY

Traditional SMR reactors are energy-intensive, heavily relying on fossil fuels to drive the strongly endothermic reactions within the reactor, resulting in substantial CO_2 emissions. *NextFuel* introduces an electrified SMR process to revolutionize biomethanol production. By replacing the large furnace of conventional SMR reactors with electric resistance heated reactor walls, this method uses renewable electricity to convert biogas into syngas. This approach bypasses the thermal limitations of traditional SMR reactors, enhancing catalyst utilization, reducing reactor volume up to 100 times, and eliminating direct CO_2 emissions.[2]

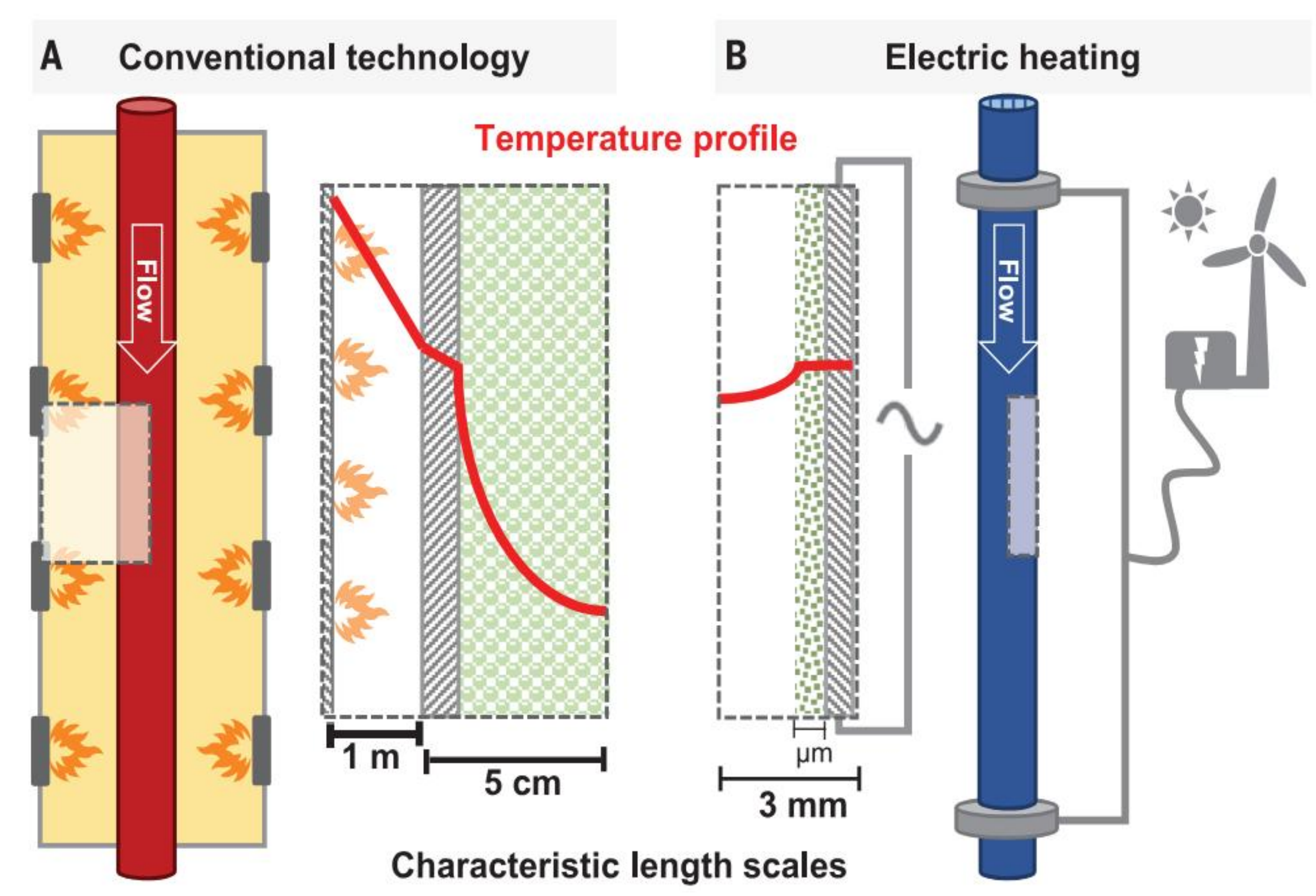

Figure 2. Heating principles of (A) Conventional SMR and (B) Electrified SMR.[2]

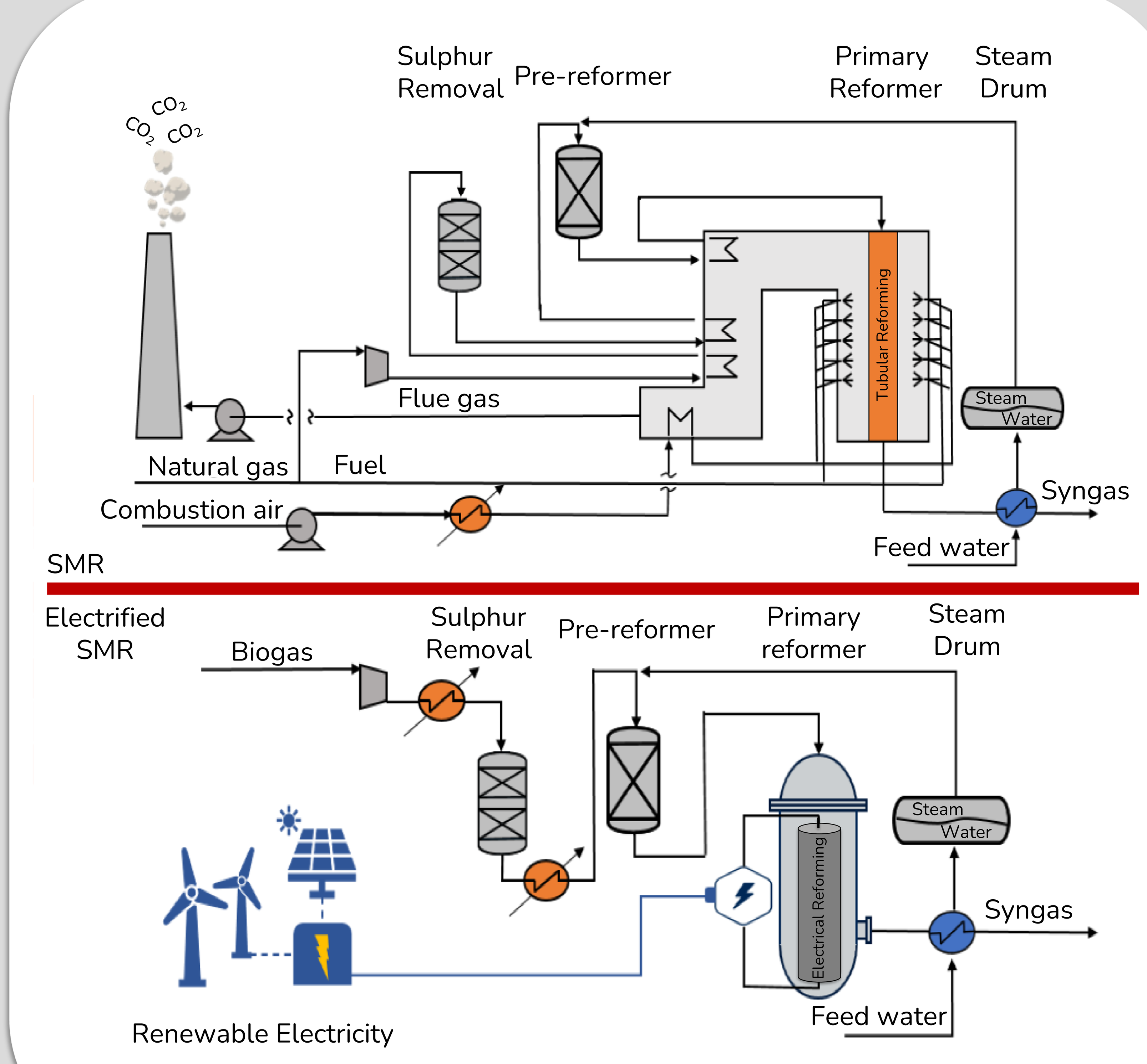

Figure 3. Conventional SMR (top) and electrified SMR (bottom) process flowsheet.[1]

NEXTFUEL: FROM LAB TO INDUSTRIAL SCALE

This novel approach has already been successfully demonstrated at lab scale by one of our project partners. With promising results, *NextFuel* aims to upscale it for commercial viability. Biomethanol production can be further expanded by using green hydrogen and CO_2 captured onboard ships as feedstock. This integration not only enhances fuel production but also contributes to significant CO_2 reduction, transforming emissions into valuable resources.

CONCLUSION

The electrification of the SMR process offers a transformative approach to sustainable biomethanol production. By leveraging renewable electricity, biogas, green hydrogen, and CO_2 capture, this technology can significantly reduce the maritime sector's carbon footprint. The scalability and flexibility of this method provide a viable pathway for widespread adoption, promising substantial environmental benefits.

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REFERENCES

[1] From TN, Partoon B, Rautenbach M, Østberg M, Bentien A, Aasberg-Petersen K, & Mortensen PM. (2024). Electrified steam methane reforming of biogas for sustainable syngas manufacturing and next generation of Plant Design: A pilot plant study. *Chemical Engineering Journal*, 479, 147205.

[2] Wismann ST, Engbæk JS, Vendelbo SB, Bendixen FB, Eriksen WL, Aasberg-Petersen K, … Mortensen PM. (2019). Electrified methane reforming: A compact approach to greener industrial hydrogen production. *Science*, 364(6442), 756–759.