PhD Position in Impact of H_2 on the thermodynamic performances of Gas Turbines of different size

Context

The aim of the BE-HyFE – Belgian Hydrogen Fundamental Expertise project is to create a Belgian homebase for academic hydrogen expertise by establishing a core group of 16 broadly trained and highly networked early-stage researchers who can, together with their extended academic peer-network, support the Belgian industry in finding both technological and societal solutions to essential hydrogen challenges. They will achieve this by pursuing excellence in their fundamental research, obtaining specialized skills through extensive training, and exchanging knowledge between peers and within the academic-industrial network.

The project, funded by SPF Economie "Energy Transition Fund", is a collaboration between 12 Belgian universities and research centres.

Description of the PhD

Gas Turbines are obvious candidates for the restitution of the energy stored in hydrogen and hydrogen-based fuels. Besides the obvious impact on the combustion process, the use of these fuels has also an impact on the performance of the cycle, due to the changing properties, the changing pathways from storage to use in the gas turbine, and possibly due to cycle alterations, needed to increase fuel and operational flexibility.

The PhD student will assess the impact of the use of this green hydrogen and hydrogen-based fuels on small (micro gas turbines) and large-scale (Combined Cycle Gas Turbine) gas turbine cycle performance using advanced steady-state and transient cycle simulations. Within these simulations the candidate will focus on both the retrofit of existing units as well as the development of future units, possibly exploiting cycle innovations for improved fuel and operational flexibility. Moreover, the preparation of the fuel, from storage to combustion chamber, will receive particular attention. The main challenge lies in the correct simulation of the different cycles, using state-of-the-art models. Representative applications from different sizes will be studied, and conclusions will be drawn on the expected impact and output of the cycles, as well as on the most beneficial pathway for the usage of hydrogen and hydrogen-based fuels.

Description of Team

This offer will be for a joint PhD between Université de Mons (UMONS) and the Vrije Universiteit Brussel (VUB). The primary contract will be with UMONS, and the candidate will receive a PhD from both institutions.

The supervisor at UMONS is Prof. Ward De Paepe. The research interests of Prof. De Paepe are in the fields of advanced thermodynamic cycle development towards highly flexible and efficient, carbon-clear electricity, and possible heat when considering cogeneration, production in the future energy system.

The VUB supervisor is Prof. Julien Blondeau. He currently supervises research projects on renewable fuels (biomass, hydrogen, and e-fuels) and their conversion in various types of heat and power production units.

Starting date: October 2021 (tentative)
End date: September 2025
Location: UMONS and VUB (Belgium)
Salary: 2000€ (approximate net income)
Profile: Candidates should be proficient in English, motivated and aware of the (Belgian) energy context. Experience in programming (ideally Python), cycle performance analysis using commercial software (e.g., Aspen Plus or Thermoflow), or techno-economic analysis would improve the ranking.

Application: applications should contain a letter of motivation, a letter of recommendation, a short analysis of the project idea (max one page), and a short video (2 minutes max) explaining why we should hire the candidate. The application package should be sent to ward.depaepe@umons.ac.be and Julien.Blondeau@vub.be.