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TRADE-OFF STUDY BETWEEN BIOMETHANE AND GREEN HYDROGEN FOR FUTURE LAUNCHERS PROPULSION

Abstract

During the last decade numerous LOX/CH4 space engines projects have been undertaken in the world. The performed trade-offs checked the advantages of those propellants compared to existing state of art for LOX/LH2 or LOX/kerosene engines, such as simpler propulsion systems leading to production cost reduction, better reliability and safety. It also appeared that due to environmental issues, propellant production chain has now become as important as chemical composition for the selection of future launchers propulsion Taking into account these issues, CNES has defined a preliminary concept of biomethane production for future launchers. It is proposed to implement an installation able to provide propellants for a prospective, reusable Ariane Next launcher, passing through the step of Themis demonstrator reusable stage The retained concept for biogas production relies on methanization due to low energy consumption thanks to natural organic decomposition. Biogas is produced in an anaerobic generator, purified and finally liquefied to fulfill propellant requirements At the same time year 2020 has highlighted a wide field of opportunities linked to the development and exploitation of green hydrogen for industrial applications. Therefore, green H2 propellant for future propulsion has also been assessed by CNES. The studied configuration relies on electrolyze technology powered by green energy taking into account French Guiana resources including projection on their evolution for coming years. In this context strongly challenged by sustainable development criteria, CNES has performed a trade-off study between two main candidates for green space propulsion: biomethane end green hydrogen This trade-off takes into account: the full production life cycle of propellants, performance impact, production and investment costs. It also includes strategies to optimize each production step, to limit the propellant loss, process costs and emissions impacting environment as well as the elements of scaling up to Ariane Next industrialization needs. The article also compares the results with other sources and state of art for propellants production means including their logistic chains to evaluate the expected cost gains and environmental impacts, typically methanol reforming for hydrogen production and fossil methane production. The article finally highlights the social and economic interest of green propellant production by contributing to initiate a circular economy in French Guiana in line with European renewable rules. In conclusion, the results confirm the interest of producing green propellants in French Guiana due to cost savings and positive environmental impacts. Advantages and disadvantages of both biomethane and green H2 are also checked and provided