LCA OF SPACE GRADE METHANE LAUNCHERS PRODUCTION

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Abstract:
During the last decade numerous projects of new launchers of wide range of performance have been undertaken in the world. The tradeoffs that were performed indicated the advantages of alternative propulsion systems based on LOX/LCH4 with regards to the existing state of art of LOX/LH2 or LOX/kerosene launchers, such as simpler propulsion systems leading to production and exploitation cost reduction, better reliability and improved safety.

However that tradeoff concerns also the environmental issues: the propellant and whole launcher life cycle chain has now become as important as chemical composition for the selection of future launchers propulsion. Historically the fossil fuels were at the basis of the propellants production and all other aspects of launcher production and exploitation are associated to the energy mix used in addition to the raw materials and production processes. Last years indicated a wide field of opportunities linked to the development and exploitation of hydrogen for industrial applications. Therefore, the alternative H2 propellant production technologies 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. The similar study has been performed on biomethane production, due to low energy consumption thanks to natural organic decomposition. Other factors, such as reusability, mixture ratio and propellant loading varying between different launch systems concepts could play the role in the choice of the most optimal launch system.

The resulting trade-off of optimal launch system takes into account: the full life cycle of propellants together with its launcher, the performance impact, production and investment costs. It also includes strategies to optimize each production and exploitation step, to limit the propellant loss, process costs and emissions impacting environment as well as the elements of scaling up to an industrial launcher need equivalent to the heavy launchers on the market (“Ariane Next” industrialization needs). Compared solutions include the launcher using H2 produced from fossil resources, bio methane launcher, fossil methane and the “green H2” launcher.

The presented life cycle assessment (LCA) does not limit itself to the CO2 equivalent evaluation but discusses other factors, such as water consumption, non-renewable resources use and impact on biodiversity, which tend to be less discussed in the state of art, while they might have an important impact on the final choice of the preferred launch system concept.

In conclusion the LCA is very important for the launch system design choices. The richer is the analysis in terms of different factors the more sustainable and informed will be the chosen solution. In result the current reference for heavy launcher class “Ariane Next” is based on use of biomethane produced locally in French Guiana.

References:

[1] J. Vila, J. Hassin, Technology acceleration process for the THEMIS low cost and reusable prototype, 8TH European Conference for Aeronautics and Space Sciences (EUCASS), 2019

[2] M.Kurela, P.Noir, Methane production chain assessment for space launchers, 22e Congrès de Maîtrises des Risques et Sûreté de Fonctionnement λμ22, 2020