ENABLEH2 Session EASN

Presentation 6:
Hydrogen – A Technically Feasible and Sustainable Fuel: "Technology Evaluation of LH_2-Fuelled Aircraft"

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Although the use of Liquid Hydrogen (LH_2) as a chemical fuel and as an energy carrier for propulsion/non-propulsive systems shall ensure CO_2-free emissions during aircraft operation, emphasis must be placed upon increasing the overall vehicular efficiency of any aircraft design concept. Such a focus will ensure a minimum amount of LH_2 will be needed in meeting the year entry-into-service 2050 operational requirements as defined in the European Commission Horizon 2020 ENABLEH2 Project. By virtue of aircraft sizing cascade effect, a minimum amount of LH_2 would then pave a way forward in maximising the extent of operating economics reduction and facilitate further improvements in both NO_x-emissions and aircraft external noise. In order to further amplify overall vehicular efficiency improvement, aircraft conceptual design ideas will also take stock of potential synergies afforded by hybrid/electric solutions; whether architectures are hybrid-electric or turbo-electric in nature.

The technology evaluation activity for ENABLEH2 involves a multi-faceted array of tasks. Ultimately, the goal is to undertake a critical appraisal exercise using the Techno-economic Environmental Risk Assessment (TERA) evaluation platform, which is considered to be suitable for multi-objective, multi-disciplinary assessments and trade-off studies. The TERA work will involve estimating life-cycle CO_2-emissions as well as predicting corresponding operating costs associated with use of LH_2 for commercial aviation. In order to establish some semblance of robustness of the final design candidates a number of different fuel prices and emissions taxation/fees scenarios will be examined as well.

The sequence of tasks that constitutes the ENABLEH2 Project technology evaluation activity is itemised as follows:

1. Suitable for Short-to-Medium Range (SMR) and Long-Range (LR) operations, down-selection of aircraft morphology, integrated systems including implementation of LH_2 fuel storage, fuel system heat management, and, Micro-mix combustion technologies developed by the ENABLEH2 Consortium all tempered by serious considerations given to safety;
2. Generation of "best-and-balanced" sized aircraft outcomes based upon the down-selected SMR and LR concepts defined in Item 1;
3. Declaration of reference aircraft based upon the premise they shall operate using JET-A1 / Drop-in Bio-fuel / LNG fuels only; and,
4. Undertake technology and scenario evaluation studies that will serve to compare and contrast the relative attributes of the sized SMR and LR aircraft concepts to each of the JET-A1 / Drop-in Bio-fuel / LNG fuelled references.

In view of the time planning adopted for ENABLEH2, Items 1 and 3 are scheduled to be completed by the time of the 9th EASN International Conference on Innovation in Aviation and Space. Accordingly, this presentation will initially review the variety of aircraft morphological and integrated systems candidates comprising the concept cloud for SMR and LR operations. Thereafter, engineering logic and rationale (based upon mostly qualitative arguments) will be offered in justifying the chosen design solutions. Information will also be offered about the attributes and characteristics of the final sized JET-A1 / Drop-in

Bio-fuel / LNG based reference aircraft. To round off, some discussion will take place regarding future work: sized outcomes for the down-selected SMR and LR aircraft concepts; and, the all-important benchmarking and assessment studies associated with each.