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M2Or4A-03: [Invited] The “IZEA-light” zero-emission aviation conceptual design

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The Integrated Zero Emission Aviation (IZEA) consortium is a NASA-funded University Leadership Initiative that explores the conceptual design of regional passenger aircraft with reduced greenhouse gas emissions. The project concept explores liquid hydrogen as both a fuel and as a cryogenic coolant to facilitate high power-density components such as superconducting generators, superconducting power transmission, and cryogenic motors. Power generation by fuel cells increases the opportunities for emission reduction but come with a tradeoff for increased weight due to their low power density. This presentation will overview IZEA’s present focus on a “light” configuration where about 20% of the 7 MW needed during the cruise mission segment is generated by fuel cells. The vehicle is a blended wing-body airframe with a mission range of 2,200 nautical miles carrying 112 passengers and their cargo. Input to multidisciplinary design and optimization frameworks have resulted in specifics for engines, efficiency, take-off weight, airfoil design, contrail production, and other factors important for considerations of fleet evolution. Thermal balancing of the integrated sub-systems across the broad temperature range from 20 to 350 K presents opportunities for efficiency optimization. The present thermal model has produced detailed information regarding liquid hydrogen tank size, rate of coolant flow and energy consumption, motor configurations with integral cooling, and heat exchange requirements for power electronics and fuel cells. Novel concepts such as skin cooling and co-flow jets are proposed where technological solutions do not presently exist to manage challenges such as removing waste heat from fuel cells.

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