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## **Transitioning to a Carbon-Neutral Future: A Review of Low/Zero Carbon Fuel Combustion Research at Southwest Research Institute**

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### **Abstract**

This work presents research activities related to combustion of ammonia, hydrogen, and sustainable aviation fuels at Southwest Research Institute (SwRI), emphasizing their importance in transitioning to a carbon-neutral future. Ammonia, a carbon-free fuel, has substantial potential to reduce greenhouse gas emissions. Its abundance and favorable storage capabilities, make it a promising candidate as a carbon-free fuel for power generation. Hydrogen offers an effective way of producing carbon-free energy. As hydrogen combustion only results in water, its utilization promises a complete removal of CO<sub>2</sub> emissions. This work explores how SwRI harnesses hydrogen's and ammonia's potential, outlining the operational activities, challenges, and implications for future energy strategies. Sustainable Aviation Fuels (SAFs) are a crucial component in the decarbonization of the aviation industry, a traditionally challenging sector to decarbonize. Derived from sustainable resources, SAFs have the capacity to drastically reduce the industry's carbon footprint. This work examines SwRI's role in investigating SAFs and the impact on aviation propulsion systems. This work will not only provide a detailed insight into SwRI's activities concerning these fuels but also critically assess their efficiency, reliability, and environmental advantages. The emphasis is on understanding the potential and challenges of these low/zero carbon fuels and their implementation. Conclusively, this work contributes to the broader discussion on sustainable energy solutions, underscoring the vital role of ammonia, hydrogen, and SAFs in achieving global carbon neutrality.