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Development and Evaluation of Alternative Aviation Fuels

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There continues to be significant interest in the development, certification, and use of alternative (non-petroleum) aviation fuels. The motivation for this is driven by many factors, including the growing demand and reduced supply of petroleum-derived fuels, cost volatility, and desire for a reliable domestic fuel supply. In addition, the production of alternative fuels from renewable/biological feedstocks can reduce the associated environmental footprint and impact during use. Extensive laboratory and full-scale testing during the past decade have resulted in the approval of synthetic paraffinic-type fuels for use in both commercial and military aircraft. These fuels have been successfully produced from fossil-based resources, plant oils and animal fats, and exhibit favorable operational characteristics, such as excellent high temperature stability and significantly reduced soot emissions. However, currently approved synthetic fuels cannot satisfy all operational needs, requiring blending with petroleum-derived fuels to insure Fit-For-Purpose requirements are satisfied. This constraint reduces beneficial operational aspects of the synthetic fuels and adds a logistical step to the process. As a result, there is continued interest in the identification of optimal feedstocks and processes for the development of Fully Synthetic Jet Fuels (FSJF), which can be used directly as drop-in replacements. An additional goal is that future synthetic fuels will have an environmental footprint which is equivalent to or lower than petroleum-derived fuels.

The successful development and fielding of alternative aviation fuels requires a multifaceted approach for identifying sustainable feedstocks and production processes, and evaluating the fuel suitability for use in legacy and future aircraft systems. Research and Development (R&D) performed by the Energy and Environmental Engineering Division of UDRI has been instrumental in the successful certification of current alternative aviation fuels, and on-going efforts will be critical for the approval of next-generation fuels. These efforts have ranged from performing initial analyses of novel fuel candidate physical and chemical properties, to aircraft-level evaluation of the combustion and emissions propensity of formulated synthetic fuels. An overview of UDRI expertise related to the development and use of current and future alternative aviation fuels will be provided, highlighting primary areas where our efforts have been pivotal in the development and approval processes.