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Learnings From the 2022 NREL Partner Forum: **Research Needs for Liquid Fuels**

During the 2022 Partner Forum[1] at the National Renewable Energy Laboratory (NREL), stakeholders and experts from across aviation came to the whiteboard to outline common goals, align interests, understand technologies, and discuss steps for safely and seamlessly decarbonizing aviation.

Experts identified challenges, strategies, and needed research on aviation fuels, infrastructure, and aircraft. Initial insights, strategies, and high-level suggestions from a focused sustainable aviation fuel (SAF) workshop are summarized below, including potential barriers and synergies for achieving bold decarbonization goals.

Feedstocks

Addressing feedstock availability, quality, and cost is a first step to growing the nascent SAF industry into a reliable national market.

Specific challenges to address:

- Develop strategies to stabilize the price and quality of raw materials, including finding an appropriate balance between biomass quality and cost.
- Strategically introduce feedstock variability to increase efficiency (such as adding intermediaries).
- Study how to lower the carbon intensity of sourcing, harvesting, and growing various feedstocks, including seed oils, lignocellulosic energy crops, and e-fuels made from atmospheric carbon dioxide.
- For e-fuels, ensure carbon dioxide and low-cost renewable electricity is readily available to conversion facilities.
- Understand the impact of SAF demand on fuel and feedstock selling prices, which may be on a rolling scale.
- Secure reliable and low-cost sources of green hydrogen for SAF production.

Feedstock Preprocessing

Feedstock preprocessing is the pivot for effectively valorizing national biomass supplies for large-scale conversion into liquid fuel.

Specific challenges to address:

- Address feedstock variability through preprocessing specific to given feedstocks, which come in a large variety.
- Consider the use of depots that sell homogeneous feedstocks, creating commodity markets for sugars, bio-oils, and other SAF intermediates.

[1] Discover other insights from the 2022 NREL Partner Forum: www.nrel.gov/docs/fy23osti/84111.pdf.

- Improve the reliability of supply chains by ensuring consistent supplies of high-quality materials.
- Use existing research capabilities to analyze the market competitiveness and carbon intensity of the entire slate of preprocessing technologies—providing unbiased assessments and comparisons.

Conversion

Fuel conversion presents important opportunities for improving SAF sustainability and economics, but more research is needed to effectively knit conversion facilities into a larger national SAF economy.

Specific challenges to address:

- Address variation in conversion costs, which vary depending on required capital costs and facility sizing (which is based on regional availability of feedstocks).
- Minimize process variability through rigorous stage gate scale-up, which can help ensure conversion steps are stable and predictable.
- Analyze broader SAF supply chains and perform life cycle assessments to understand carbon intensity impacts, such as considering the influence of farming practices and truck transport on fuel cost and carbon footprint.
- Study improvements in cost, quality control, and performance through the use of modular conversion systems built to scale with area feedstock supplies.

Finishing and Approvals

New SAF pathways must be developed and scaled with an awareness of ASTM International requirements and innovations in engine design.

Specific challenges to address:

- Understand the utility of incentives, carbon pricing, blending mandates, and fuel-based policies—including analyses on possible implications for long-term investments and business plans.
- Develop tools and processes to help expand SAF blending limits beyond 50%—paving the way for 100% drop-in SAF.
- Consider opportunities for SAF without aromatics, such as jet engines synergistically designed to operate on SAF with different chemical profiles than Jet A or drop-in SAF.

Infrastructure and Scale-Up

Beyond feedstock supply and conversion, a resilient national SAF supply chain may require infrastructure planning, policy innovation, and greater coordination among stakeholders.

Specific challenges to address:

- Consider infrastructure needs to supply SAF to airports—especially those that are not large hubs or located in areas where SAF supply chains are already established.
- Rigorously integrate technologies across the SAF value chain to ensure all components work synergistically—from feedstock production to conversion, delivery, and use.
- Increase coordination among research organizations to avoid duplication and more effectively address SAF fundamentals on price, sustainability, and carbon intensity.
- Identify and analyze factors that could affect SAF availability across the nation, such as:
  - Geographic limitations (i.e., location of airports in relation to SAF production).
  - Agricultural opportunities to lower fuel carbon intensity (including sustainable farming practices).
  - Fuel-based policies at both the federal and state levels.
  - Availability of high-quality data to inform policy and regulations.

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