ACRP 02-80
Quantifying Emissions Reductions at Airports from the Use of Alternative Jet Fuels

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Booz | Allen | Hamilton

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Contents

- Overview
- State of the Industry Report
- Emissions Quantification Methodology
- Other Research Products
- Conclusion & Next Steps
The Airport Cooperative Research Program (ACRP) is an industry driven, applied research program that develops near-term, practical solutions to problems faced by airport operators.

ACRP is managed by the Transportation Research Board (TRB) of the National Academies of Sciences, Engineering, and Medicine, authorized by Congress, and sponsored by the Federal Aviation Administration (FAA).

The research is conducted by contractors who are selected on the basis of competitive proposals.
The objective of this research is to develop a method to help airport industry practitioners estimate potential emissions impacts by the use of ASTM-certified alternative jet fuels.

Key Research Products

- **State of the Industry Report**: A stand-alone report that includes a literature review and gap analysis of existing knowledge of emissions from SAJF.
- **Emissions Reductions Methodology**: A process that quantifies the emissions impacts that will allow airports to capture the air quality benefits from the use of SAJF.
- **Alternative Jet Fuel Emission Reduction Fact Sheet**: Quick slick-sheet that showcases the benefits of using alternative jet fuels at airports.
- **Alternative Jet Fuel Assessment Tool**: An easy to use tool to help airports apply the emissions reductions methodology.
PHASE 1
Emissions Quantification Plan and Review
- Conduct Literature Review
- Develop Plan for Quantifying Emission Impacts
- Develop Plan for Independent Review

OBJECTIVES

PHASE 2
Emissions Quantification Methods Creation and Validation
- Create Emissions Quantification Methodologies
- Conduct Independent Review
- Identify Case Studies
- Develop Plan for Conducting Dispersion Analysis Case Studies
- Design Fact Sheet Template

OBJECTIVES

PHASE 3
Development of Tool and Final Deliverables
- Develop Alternative Jet Fuel Assessment Tool
- Conduct Case Studies
- Finalize Fact Sheet
- eLibrary Creation and Final Deliverables

OBJECTIVES
Purpose

• Captured the current status of knowledge regarding emissions from the use of sustainable alternative jet fuels (SAJF).

• Collected, reviewed, and compiled data from reports of SAJF emissions tests sponsored by DOD, NASA, FAA, OEMs, fuel producers, university labs, and technical government briefings/reports.

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<td>35,136</td>
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<td>9,369</td>
<td>Alternative jet fuel emissions + criteria pollutants</td>
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<tr>
<td>73</td>
<td>Alternative jet fuel emissions + criteria pollutants + emission measurements</td>
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### Fuel Production Pathway

<table>
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<tr>
<th>Annex #</th>
<th>Description</th>
<th>Emissions Tests Reported in Literature</th>
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<td>A1</td>
<td>Fischer-Tropsch Hydroprocessed Synthetic Paraffinic Kerosene (FT-SPK)</td>
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<tr>
<td>A2</td>
<td>Synthesized Paraffinic Kerosene from Hydroprocessed Esters and Fatty Acids (HEFA-SPK)</td>
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<td>A3</td>
<td>Synthesized Iso-Paraffins Produced from Hydroprocessed Fermented Sugars (HFS-SIP)</td>
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<td>A4</td>
<td>Synthesized Kerosene with Aromatics Derived by Alkylation of Light Aromatics from Non-Petroleum Sources (FT-SPK/A)</td>
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<td>A5</td>
<td>Alcohol-to-Jet Synthetic Paraffinic Kerosene (ATJ-SPK) limited initially to the use of ethanol and isobutanol, but eventually intended to allow the use of any C2-C5 alcohol</td>
<td>4</td>
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### Diagram

![Diagram showing the fuel production pathway](image-url)
Key Findings:
SAJF when blended with conventional jet fuel has:
• Significant reductions on SO$_x$ and PM emissions
• Modest reductions on CO and UHC emissions
• Minimal reductions or no effect on NO$_x$ emissions
The State of the Industry Report is published. It can be downloaded from this link:

Create a methodology for quantifying the emissions impacts levels that will allow airports to capture the air quality benefits from the use of SAJF

- Build on the data identified for the State of the Industry Report
- Suitable for different audiences
- Compatible with AEDT

Conduct Independent Review

- Review and validate the quantification methodology
- Create a diverse set of independent experts (US Government, Airports, Academia, SAJF Producers, Aircraft and Engine Manufacturers, Private Industry)
- Ensure methodology is suitable for different audiences
<table>
<thead>
<tr>
<th>Overview</th>
<th>Industry Report</th>
<th>Quant. Methodology</th>
<th>Other Products</th>
<th>Conclusion</th>
</tr>
</thead>
</table>

1. **Critical Metrics**

Identify critical metrics that define the positive or negative impact of burning SAJFs (e.g. engine type, operating condition, fuel composition, blend %, atmospheric condition)

2. **Pollutant Specific Impacts Spreadsheet**

Generate a pollutant specific spreadsheet based on the metrics identified and quantify the observed impacts, typically represented by percent changes in the emission indices.

3. **Pollutant Specific Impacts Data Assessment**

Assess the pollutant specific data to determine the extent to which a functional analysis per metric can be performed.

4. **Development of functional impact relationships**

Develop functional impact relationships for those species identified, i.e. having sufficient data to support the functional analysis.

5. **Functional Analysis**

Fit suitable functions to the measured data using different methodologies (e.g. general linear least squares)

6. **AEDT Compatible**

Report the pollutant, fuel, and engine specific impact relationships to use with the Aviation Environmental Design Tool (AEDT)
**FACT SHEET**

**Challenge**
Create material for non-experts on a complex topic.

**FOCUS**

- Present basic knowledge of the air quality issues related to SAJF.
- Identify potential benefits of using SAJF.
- Present the ACRP 02-80 results and products.

**Audience**
Airport employees who are not necessarily environmental or air quality specialists or scientists.
Content:

• Results of the emissions quantification methodology.
• Functionality for airports to evaluate the use of SAJF at their airport.

Status:

• A draft design has been built and discussed with Subject Matter Experts.
• The tool is currently being reviewed by the ACRP Panel.

• ACPR is currently reviewing the final deliverables

• Expected publication: May-June 2019
Thank You

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