ACRP AIRPORT COOPERATIVE RESEARCH PROGRAM

# ACRP 02-80

## Quantifying Emissions Reductions at Airports from the Use of Alternative Jet Fuels

### UC Davis Aviation Noise & Emissions Symposium 2019

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Date: March 5, 2019

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- *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
Complete
OBJECTIVES
• Conduct Literature Review
• Develop Plan for Quantifying Emission Impacts
• Develop Plan for Independent Review
ACRP


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


PHASE 3
Development of Tool and Final Deliverables
Current Step
OBJECTIVES
• Develop Alternative Jet Fuel Assessment Tool
• Conduct Case Studies
• Finalize Fact Sheet
• eLibrary Creation and Final Deliverables
ACRP

## 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.

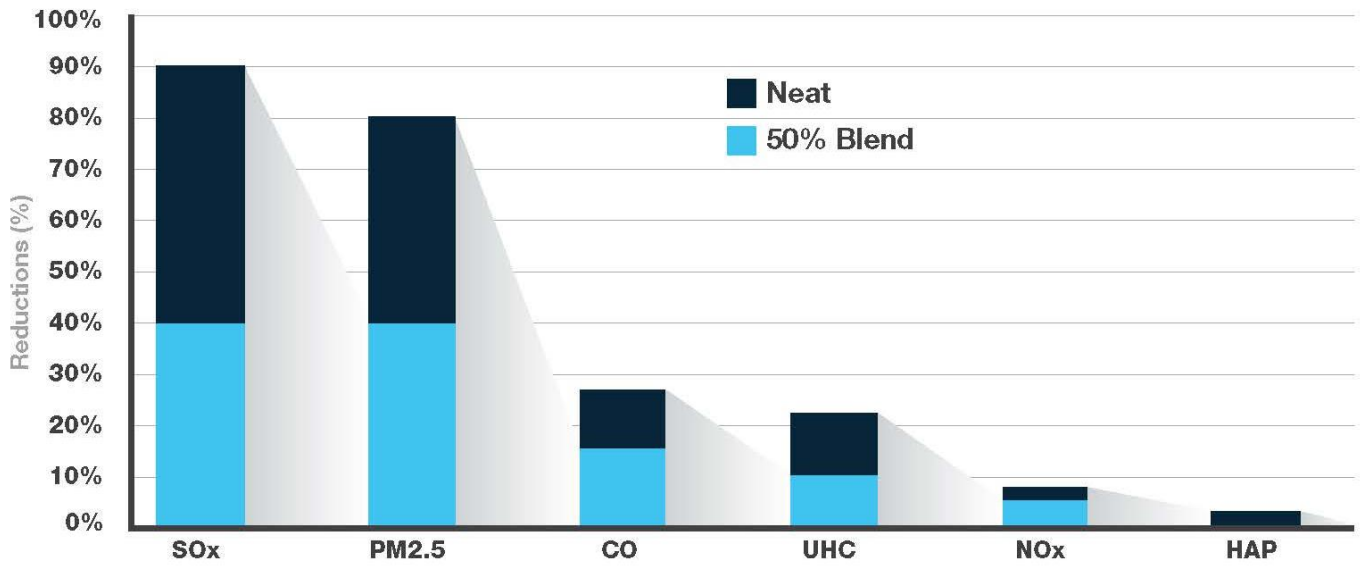
| Document Hits | Search Criteria |
|---|---|
| 35,136 | Alternative jet fuel emissions |
| 9,369 | Alternative jet fuel emissions + criteria pollutants |
| 73 | Alternative jet fuel emissions + criteria pollutants + emission measurements |
| 51 | Reports with quantitative emissions analysis (used in this literature review) |

| Annex # | Fuel Production Pathway | Emissions Tests Reported in Literature |
|---|---|---|
| A1 | Fischer-Tropsch Hydroprocessed Synthetic Paraffinic Kerosene (FT-SPK) | 15 |
| A2 | Synthesized Paraffinic Kerosene from Hydroprocessed Esters and Fatty Acids (HEFA-SPK) | 13 |
| A3 | Synthesized Iso-Paraffins Produced from Hydroprocessed Fermented Sugars (HFS-SIP) | 3 |
| A4 | Synthesized Kerosene with Aromatics Derived by Alkylation of Light Aromatics from Non-Petroleum Sources (FT-SPK/A) | 0 |
| A5 | 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 | 4 |

## 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:

http://www.trb.org/ACRP/Blurbs/177509.aspx

# Emissions Impacts Quantification Overview



*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*

# Emissions Impacts Quantification: Independent Reviewers



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)

## Challenge

Create material for non-experts on a complex topic.

## Audience

Airport employees who are not necessarily environmental or air quality specialists or scientists.

## 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.

## 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.

# Conclusion




- **State of Industry Report is currently available: http://www.trb.org/ACRP/Blurbs/177509.aspx**
- **ACPR is currently reviewing the final deliverables**
- **Expected publication: May-June 2019**

# Thank You

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