Regional Approaches to Alternative Jet Fuel Development

Michael P Wolcott
ASCENT Director
Washington State University

James Hileman, FAA Program Manager
Nathan Brown, FAA Program Manager
Dan Williams, FAA Program Manager

ASCENT
AVIATION SUSTAINABILITY CENTER

Annual Budget ~$10 million

Funding 54 Research Projects

Producing 119 Publications, Reports, Presentations

Educating 112 Students

With 70 Industrial Partners

Annual Reports: https://ascent.aero/resources/

ASCENT OVERVIEW

ASCENT Team

Lead Universities:

Washington State University (WSU)*

Massachusetts Institute of Technology (MIT)

Core Universities:

Boston University (BU)

Georgia Institute of Technology

Missouri University of Science and Technology (MS&T)

Oregon State University (OSU)

Pennsylvania State University (PSU)*

Purdue University (PU)

Stanford University (SU)

University of Dayton (UD)

University of Hawaii (UH)

University of Illinois at Urbana-Champaign (UIUC)

University of North Carolina at Chapel Hill (UNC)

University of Pennsylvania (UPenn)

University of Tennessee (UT)*

University of Washington (UW)*

Denotes USDA NIFA AFRI-CAP Leads* and Participants

Advisory Committee - 58 organizations:

5 airports
4 airlines
7 NGO/advocacy
9 aviation manufacturers
11 feedstock/fuel manufacturers
22 R&D, service to aviation sector

International Partnerships

GARDN Green Aviation Research & Development Network

НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ MCMXXXIII

Itaka

UHASSELT KNOWLEDGE IN ACTION

UNIVERSITY OF TORONTO

RÉSEAU BIOFUELNET CANADA

ASCENT Focus Areas

Alternative Jet Fuels

3.1.1. Feedstock Development, Processing and Conversion

3.1.2. Regional Supply and Refining Infrastructure

3.1.3. Environmental Benefits Analysis

3.1.4. Aircraft Component Deterioration and Wear

3.1.5. Fuel Performance Testing

Environment

3.1.6. Aircraft Noise and Impacts

3.1.7. Aviation Emissions and Impacts

3.1.8. Aircraft Technology Assessment

3.1.9. Energy Efficient Gate-to-Gate Aircraft Operations

3.1.10. Aviation Modeling and Analysis

ASCENT Project

Research Topic Area	ASCENT Project Numbers
Analysis and Tools	10, 11, 12, 36, 37, 45, 46
Operations	15, 16, 23
Noise	3, 4, 5, 6, 7, 8, 17, 23, 35, 38, 40, 41, 42, 43
Emissions	Measurements: 2, 24, 33 Air Quality: 18, 19, 20, 39, 48 Climate: 13, 21, 22 CO2 Standard: 14, 32
Alternative Jet Fuels	AJF Analysis: 1, 13, 21, 24, 32 AJF Testing: 25, 26, 27, 28, 29, 30, 31, 32, 33, 34

Denotes overlap with AJF and Emissions

For project descriptions and other information see - http://ascent.aero

Federal Agencies and Coordination

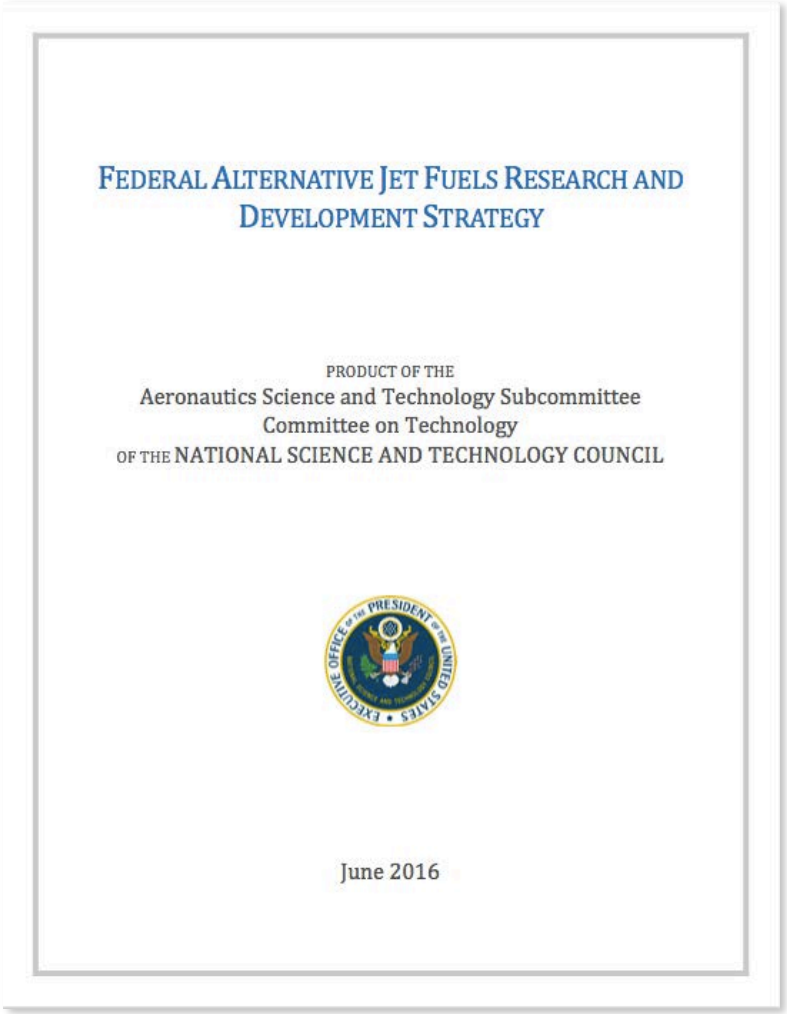
ASCENT Supply Chain Focus

USDA Regional CAP Projects

NARA Example

ALTERNATIVE JET FUEL OVERVIEW

Coordinated Federal Approach to AJF



FEDERAL ALTERNATIVE JET FUELS RESEARCH AND DEVELOPMENT STRATEGY

PRODUCT OF THE
Aeronautics Science and Technology Subcommittee
Committee on Technology
OF THE NATIONAL SCIENCE AND TECHNOLOGY COUNCIL

June 2016

- Enhance energy security;
- Expand domestic energy sources;
- Facilitate a diverse, secure, and reliable fuel supply;
- Contribute to price and supply stability;
- Reduce emissions that affect air quality and global climate;
- Generate economic and rural development; and
- Promote social welfare.

US Agency Specific Contributions






	Feedstock Development & Production	Feedstock Logistics	Fuel Conversion	Fuel Conversion Scale-Up	Fuel Testing & Evaluation	Integrated Challenges
DOC	X					X
DoD			X		X	
DOE	X	X	X			X
DOT					X	X
EPA						X
NASA					X	
NSF	X	X	X			
USDA	X	X	X			X

ASCENT Focus Areas

Alternative Jet Fuels

Feedstock Development, Processing and Conversion

Regional Supply and Refining Infrastructure

Environmental Benefits Analysis

Aircraft Component Deterioration and Wear

Fuel Performance Testing

ASCENT Project 001 Supply Chain Focus

Advanced Analytical Tools

- Feedstock Production (w/ DOE)
- Feedstock Logistics (w/ Volpe)
- Facility Siting Tools
- Harmonized Conversion Techno-Economic Analysis (TEA)
- Stochastic TEA
- Life Cycle Analysis (LCA) (w/ DOE)
- Systems Dynamic Models for Technology Adoption (w/ DOE)
- Environmental Services
- Supply Chain Risk Assessment

International Efforts

- ICAO CAEP Support
- CORSIA

Tactical Regional Deployment

- CAAFI 50-states Initiative
- USDA Regional Supply Chain Assistance

1. Inland Northwest Oilseed Project
2. Hawaii Tropical Feedstocks and Fuels
3. Southeastern US Fuels Development

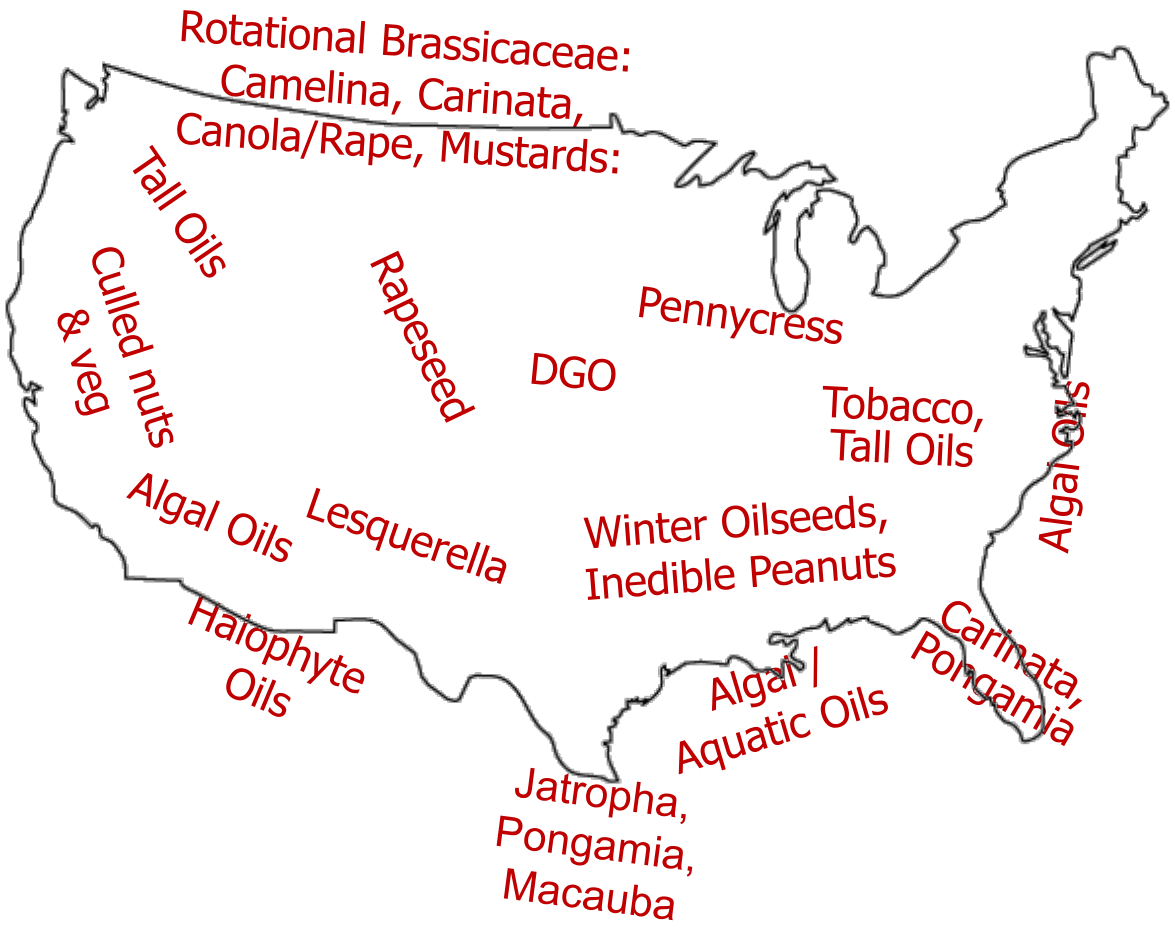
Approved Pathways

Approved	Gasification & FT (FT-SPK)	50 % max blend
	Hydroprocessing (HEFA-SPK)	50 % max blend
	Biochem sugars (HFS-SIP)	10 % max blend
	Aromatic tweak of FT (FT-SPK/A)	50 % max blend
	Conversion of alcohols (ATJ-SPK)	30 % max blend

Feedstocks	FT-SPK	Lignocellulosics, MSW
	HEFA-SPK	Fats, Oils, Grease
	HFS-SIP	Sugar, Starch, Cellulose
	FT-SPK/A	Lignocellulosics, MSW
	ATJ-SPK	Sugar, Starch, Cellulose

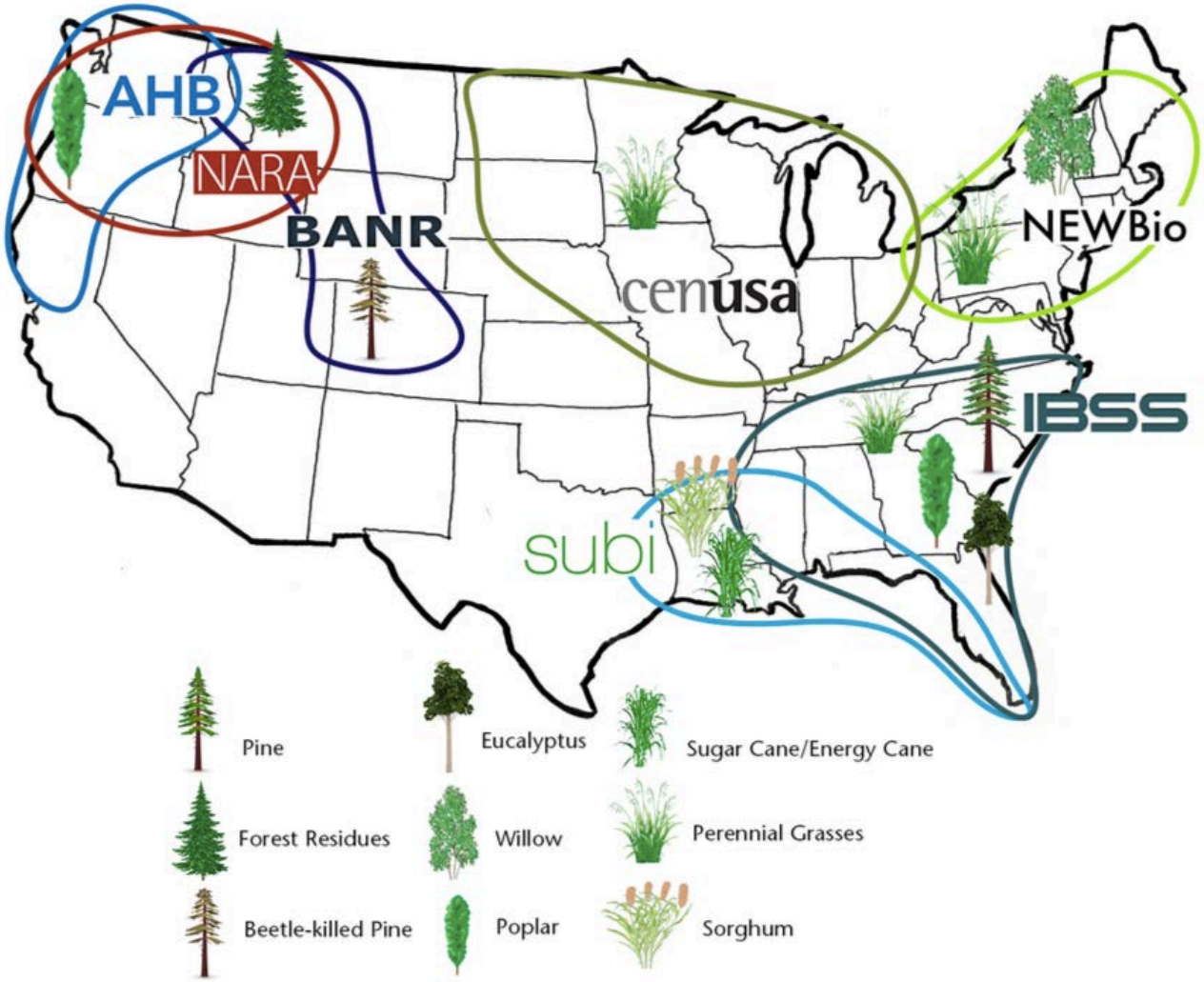
Modified from: S. Csonka (2017) The development and commercialization of Sustainable Alternative Jet Fuel (SAJF). ATIP Regional Forum. Richland, WA.

CAAFI Lipid Focus



Modified from: S. Csonka (2017) The development and commercialization of Sustainable Alternative Jet Fuel (SAJF). ATIP Regional Forum. Richland, WA.

USDA Feedstock Supply Chain Projects



Source:
William Goldner
National Program Lead
USDA NIFA

NARA Team

Alaska Airlines
ANDRITZ
Biomass ad Infinitum LLC
Catchlight Energy
CLH
Cosmo Specialty Fibers Inc.
Facing the Future
Forest Business Network LLC
Gevan Marrs LLC
Gevo, Inc.
ICM
Montana State University
National Center for Genome Research
National Renewable Energy Laboratory
Oregon State University
Penn State University
Salish Kootenai College
South Hampton Resources Inc.
Steadfast Management Inc.
Thomas Spink Inc.
University of Idaho
University of Minnesota
University of Montana
University of Utah
University of Washington
University of Wisconsin-Extension
USDA Forest Products Laboratory
USDA Forest Service
Washington State University
Western Washington University
Greenwood Resources
Weyerhaeuser

USDA

NARA
Northwest Advanced Renewables Alliance

NARA: Feedstock to Fuels

FRP

FOREST RESIDUES PREPARATION

Primary feedstock targets include forest residues from logging and thinning operations. We are also considering mill residues and discarded woody material from construction and demolition, in regions where these materials are under utilized.

T

TRANSPORTATION

Feedstocks are transported from the collection site to a conversion facility. Chipping can take place at the loading or in a preprocessing facility.

PT

PRE-TREATMENT

Wood chips are treated to make the sugar polymers (polysaccharides) accessible to degrading enzymes. These processes allow the lignin to be available for separation.

EH

ENZYMATIC HYDROLYSIS

Specific enzymes are added to hydrolyze (cleave) the polysaccharides and generate simple sugars (monosaccharides).

F

FERMENTATION

Specialized yeast convert the monosaccharides into isobutanol.

BCP

BIOJET & CO-PRODUCTS

Aviation fuels can be generated from the platform molecules derived from wood sugars. Lignin can be used to generate co-products such as epoxies, structural materials and bio-based plastics. As an alternative, lignin can be burned to produce renewable energy.

ONE BONE DRY **TON** WOODY BIOMASS + DIESEL + HEAT, WATER, & CHEMICALS = **~600** POUNDS LIGNIN AND **~59** GALLONS ISOBUTANOL OR **~45.6** GALLONS BIOJET

Completed Year 5 of 5

USDA

NARA

Northwest Advanced Renewables Alliance

Seattle to Washington DC – November 14, 2016

World First
Commercial Cellulosic Biofuels
Flight

QUESTIONS