ASCENT - FAA Center of Excellence for Alternative Jet Fuels and Environment

Michael P Wolcott
Director
Washington State University

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Co-Director
Massachusetts Institute of Technology

James Hileman, FAA Program Manager

ASCENT
AVIATION SUSTAINABILITY CENTER

Overview of ASCENT and our Partnerships

Discuss our Projects and Focus on AJF

How we fit within the Larger Federal Landscape

Two Project Areas

1. AJF Supply Chain Analysis and Regional Projects
2. National Jet Fuel Combustion Program (NJFCP)
   - Joshua Heyne from Univ of Dayton

TODAY'S PRESENTATION

Annual Budget ~$10 million

Funding 54 Research Projects

Producing 119 Publications, Reports, Presentations

Educating 112 Students

With 70 Industrial Partners

ASCENT OVERVIEW

ASCENT Team

Lead Universities:

Washington State University (WSU)*

Massachusetts Institute of Technology (MIT)

Core Universities:

Boston University (BU)

Georgia Institute of Technology (Ga Tech)

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)*

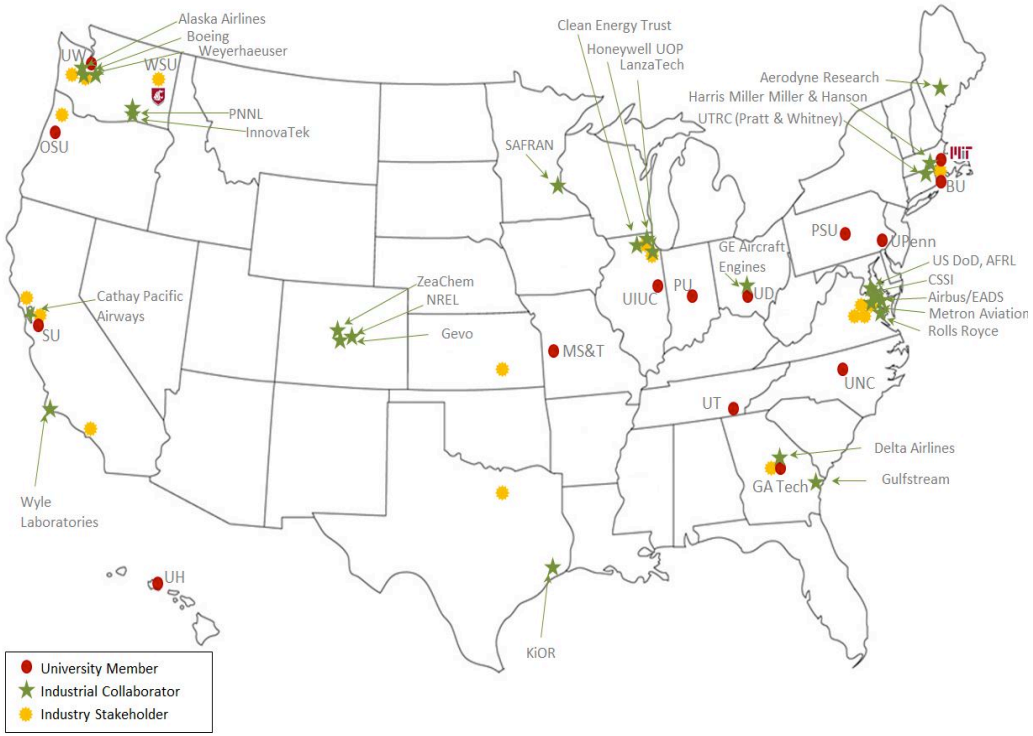
University of Illinois at Urbana-Champaign (UIUC)*

University of North Carolina at Chapel Hill (UNC)

University of Pennsylvania (UPenn)

University of Tennessee (UT)*

University of Washington (UW)*



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

*** Denotes USDA NIFA AFRI-CAP Leads and Participants & Sun Grant Schools**

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

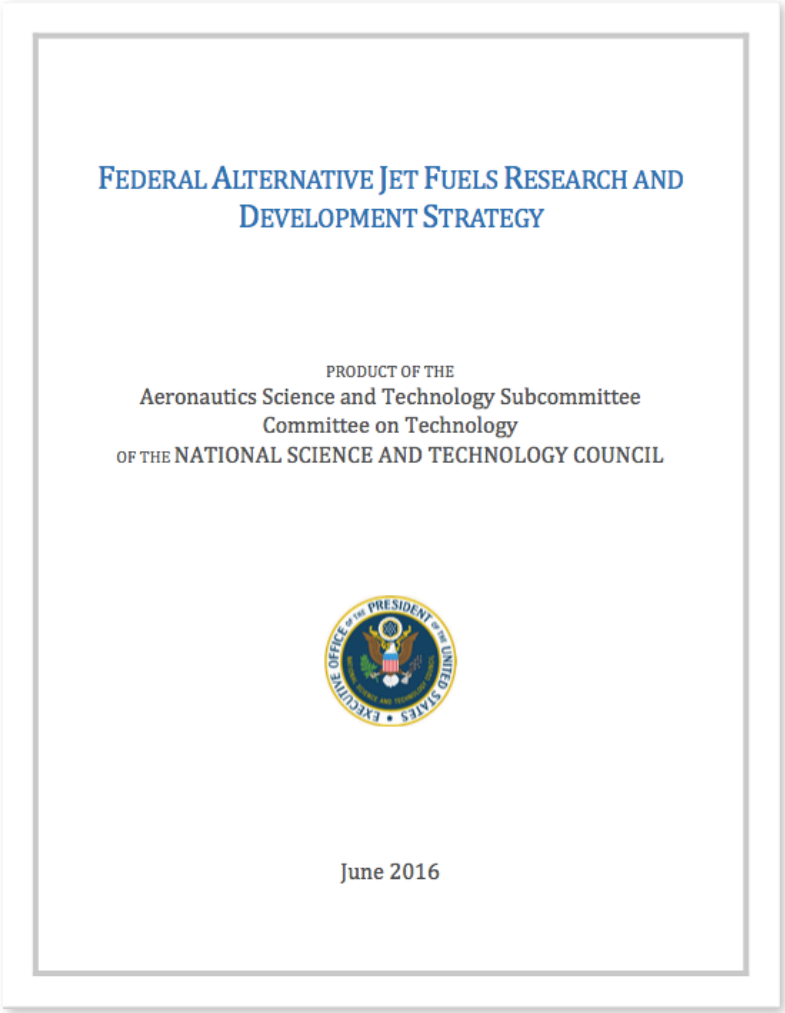
3.1.10. Aviation Modeling and Analysis

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

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

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

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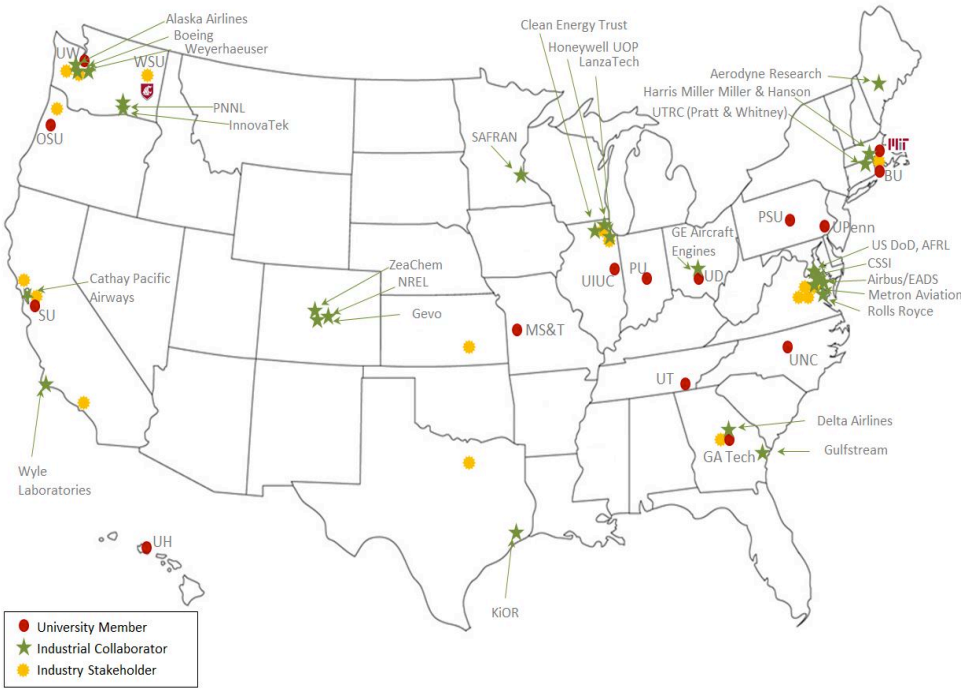
Denotes USDA NIFA AFRI-CAP Leads* and Participants



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PROJECTS

alternative jet fuels

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

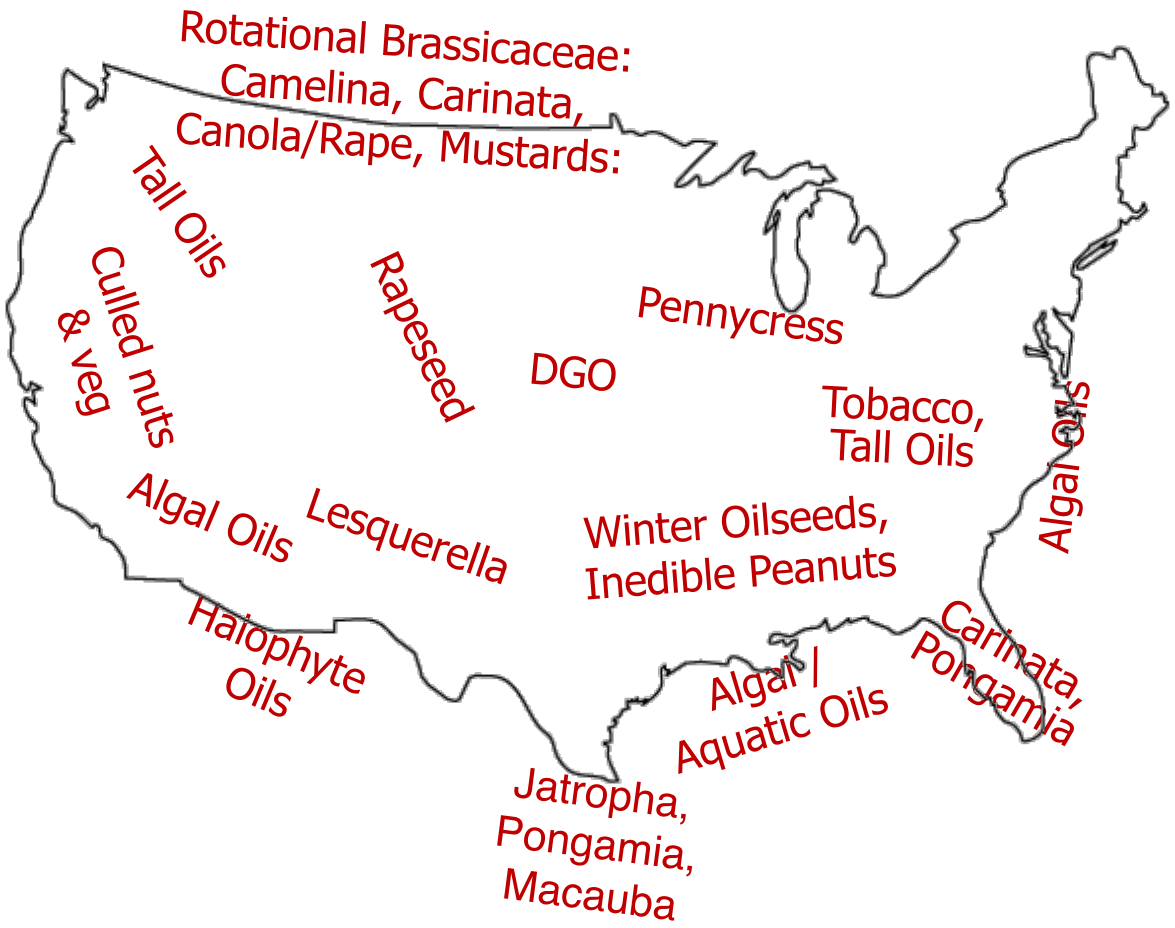
Design Cases and Economics of Approved Pathways

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

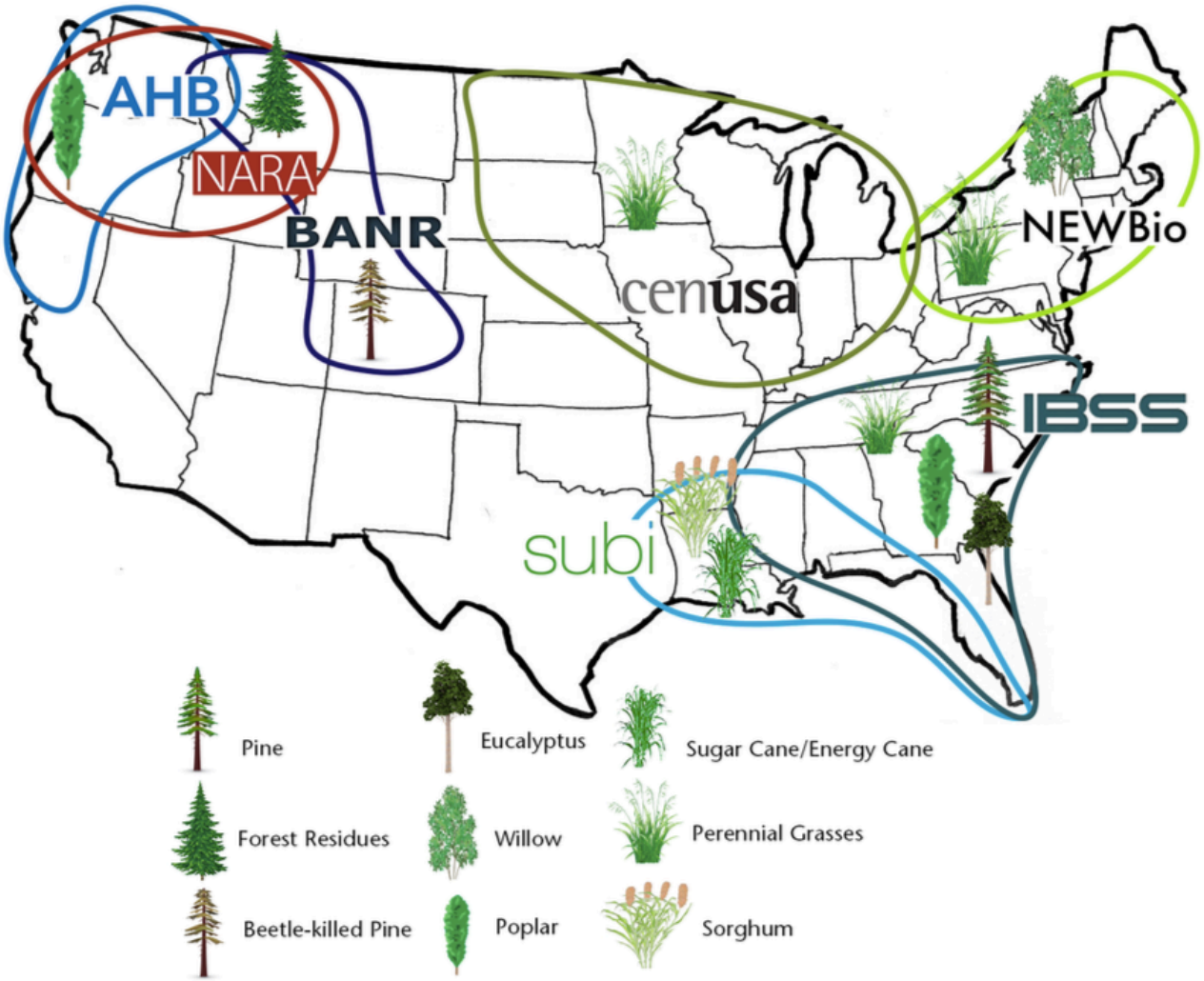
Modified from: S. Csonka (2017) The development and commercialization of Sustainable Alternative Jet Fuel (SAJF). ATIP Regional Forum. Richland, WA.

CAAFI Lipid Focus



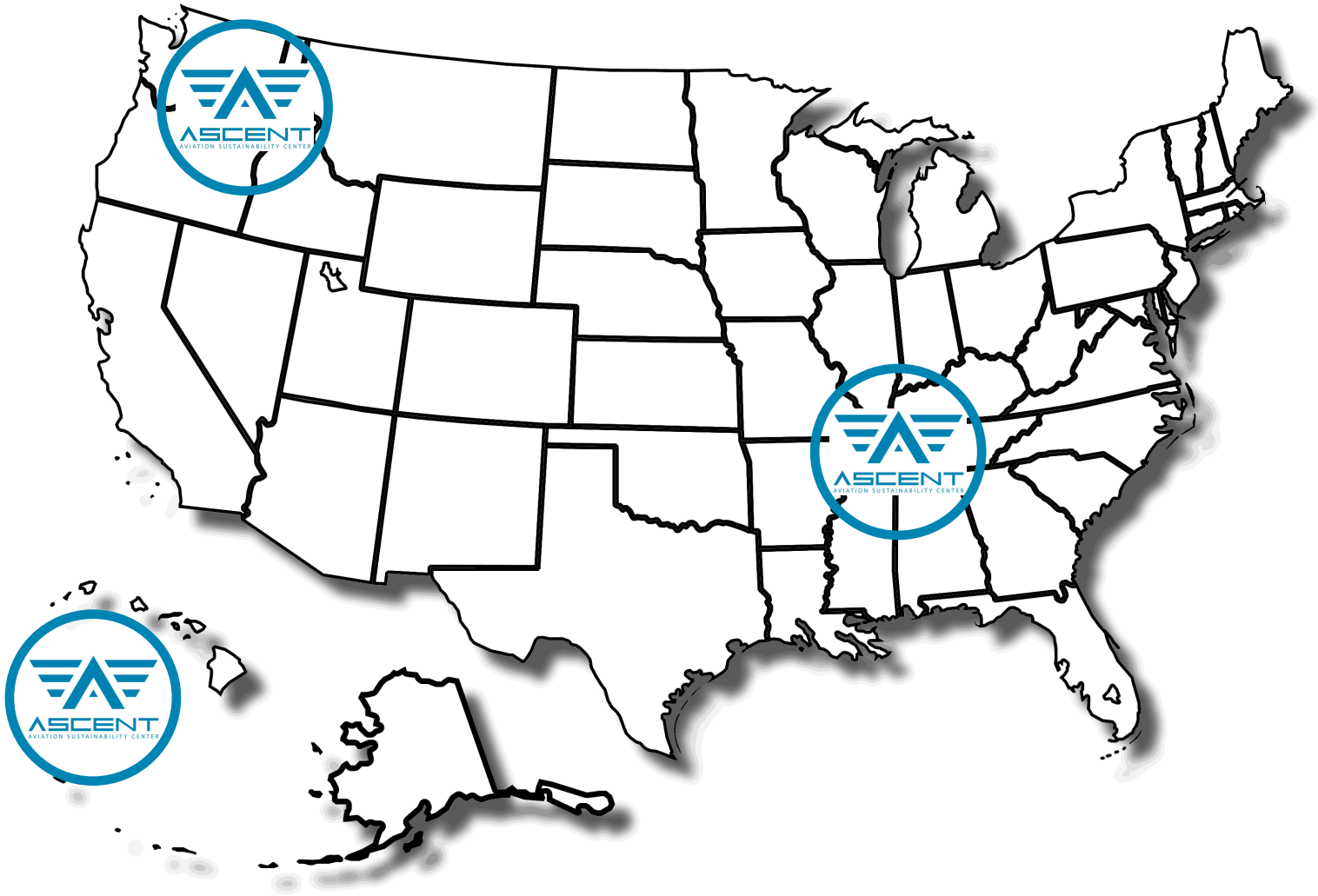
Modified from: S. Csonka (2017) The development and commercialization of Sustainable Alternative Jet Fuel (SAJF). ATIP Regional Forum. Richland, WA.

USDA Feedstock Supply Chain Projects



Source:
William Goldner
National Program Lead
USDA NIFA

ASCENT Regional Projects (tactical)



ASCENT Focus Areas

Alternative Jet Fuels

Feedstock Development, Processing and Conversion

Regional Supply and Refining Infrastructure

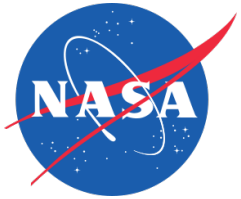
Environmental Benefits Analysis

Aircraft Component Deterioration and Wear

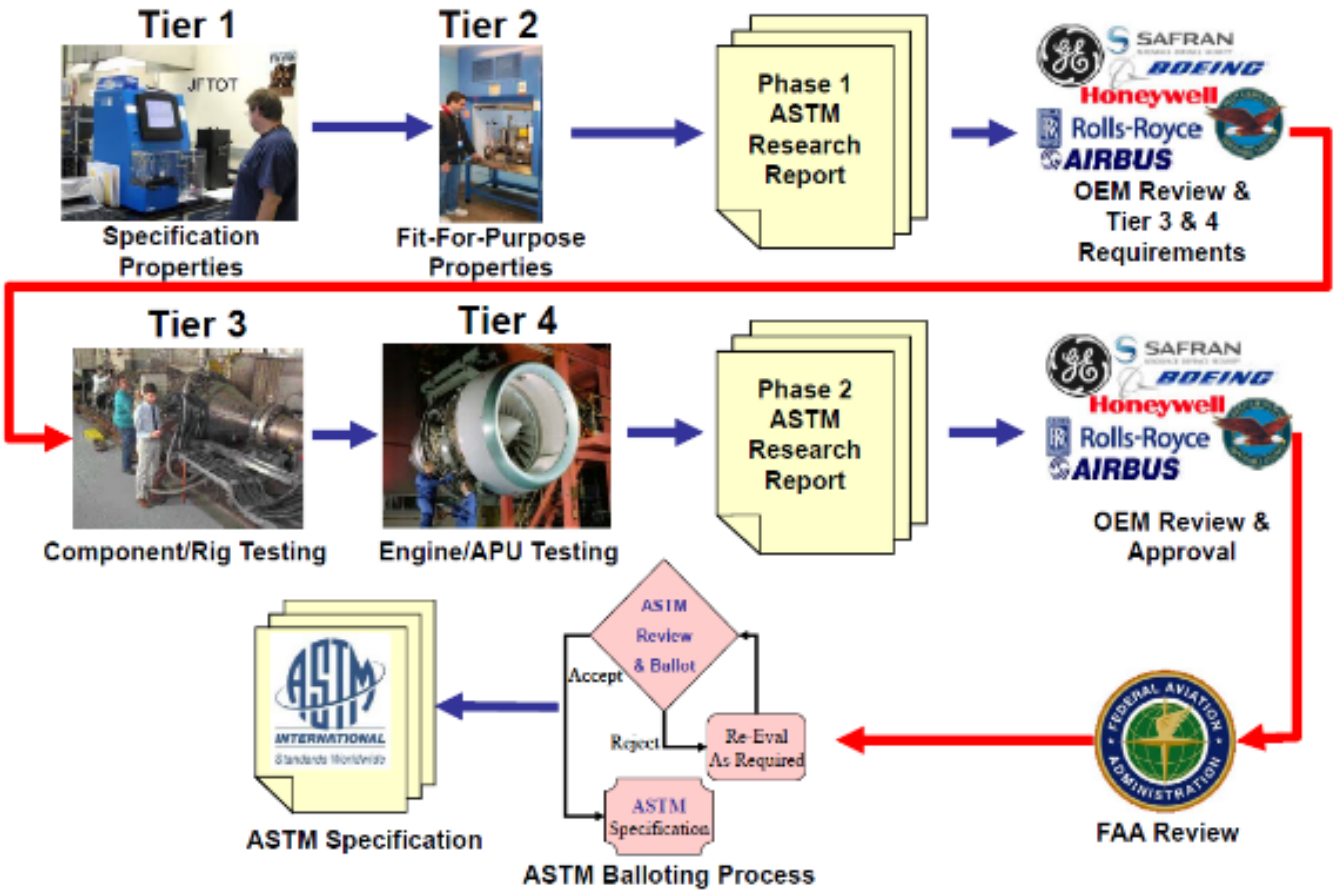
Fuel Performance Testing

NATIONAL JET FUEL COMBUSTION PROGRAM
NJFCP

Joshua Heyne (Dayton), Meredith Colket (UTRC Retired), Jeff Moder (NASA), Cecilia Shaw (FAA), Mohan Gupta (DOE), Tim Edwards (AFRL), Mel Roquemore (AFRL), Chiping Li (AFRL), Mark Rumizen (FAA)



Current Two-Phase ASTM Approval Process



Overview and Potential Impact of NJFCP

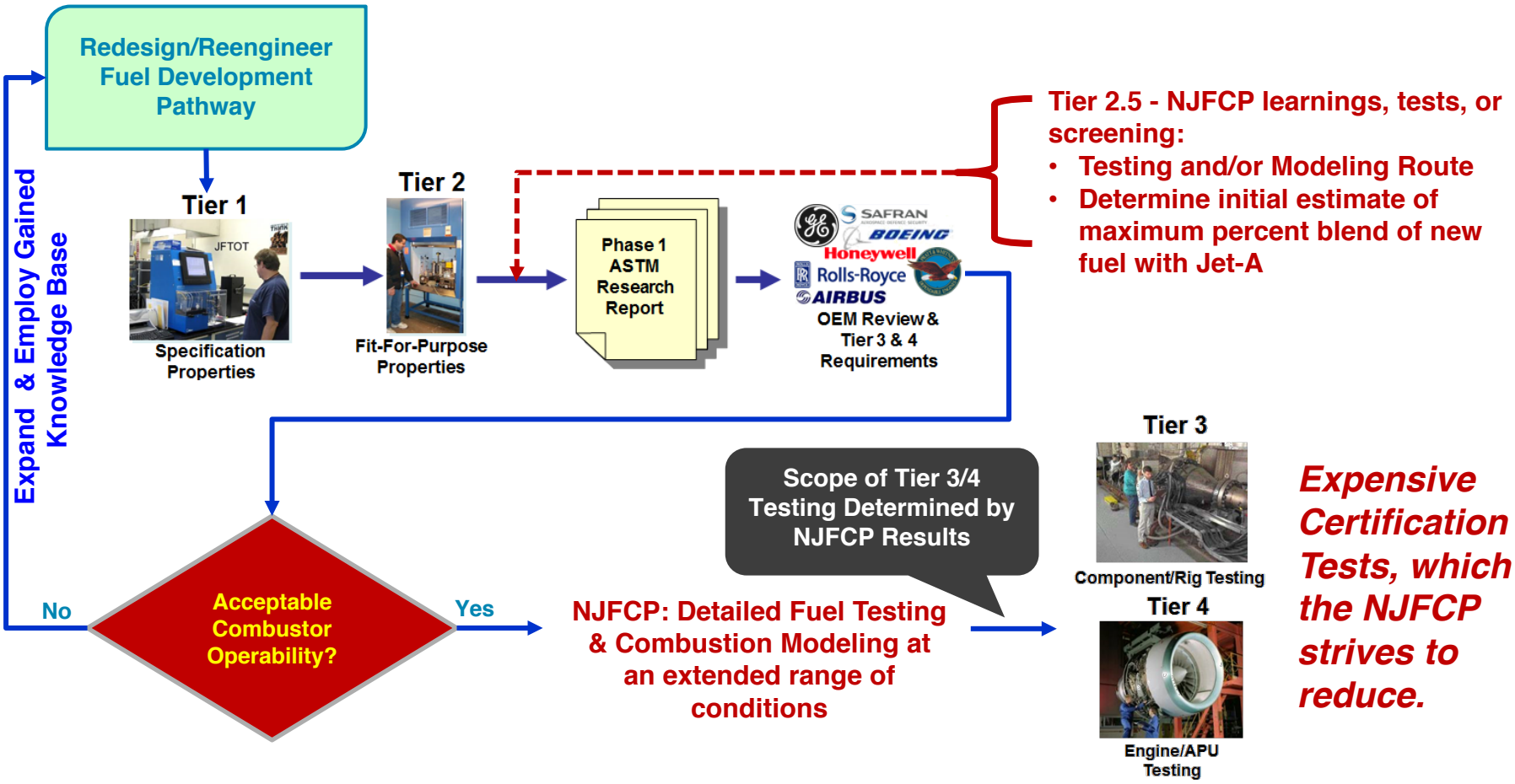
Vision

Develop an experimental and analytical capability to facilitate OEM's evaluation of fuel physical and chemical properties on engine operability and to streamline ASTM fuels approval process.

IMPACT

Early fuel screening (Tier 2.5), targeted Tier 3 and 4 tests, and increased OEM confidence

Overview and Potential Impact of NJFCP



NJFCP Executive Summary (testing)

Lean Blowout (key certification criteria):

- Fuels with distillation, viscosity, and DCN (in particular) extremes observed to exhibit deleterious performance characteristics.
- For most rigs, Lean Blowout (LBO) was found to correlate with DCN (new result relative to prior studies)
  - OEMs have identified this as a major NJFCP benefit

Ignition (key certification criteria):

- Initial fuel screening at relevant conditions suggests that high initial distillation temperatures and properties associated with poor spray atomization lead to deleterious performance.
- Initial NJFCP results are consistent with prior experimental studies

NJFCP Executive Summary (modeling)

Chemical Kinetics:

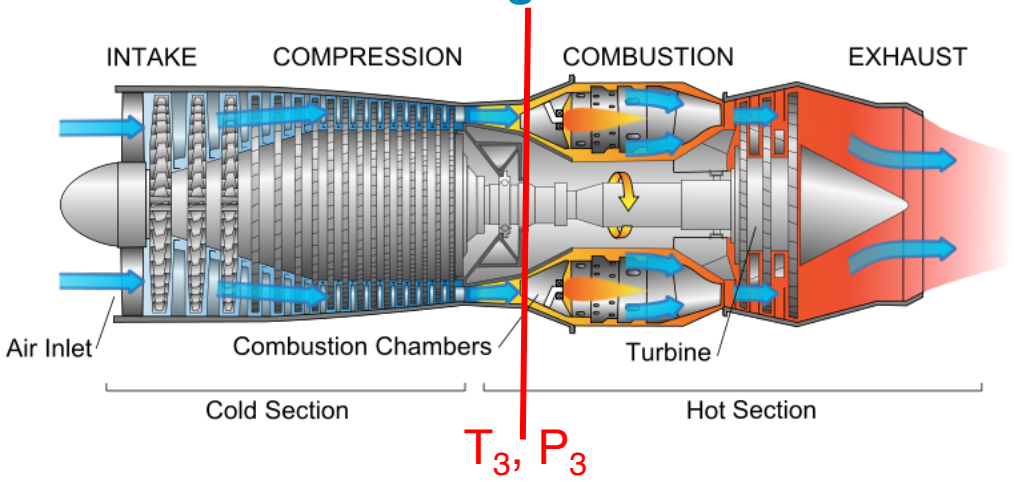
- Progress achieved connecting fundamental shock tube results to test rig Lean Blowout results.
- Additional *in situ* hydrocarbon species measurements have enabled greater model fidelities.
- Chemistry model approach for jet fuels validated and documented

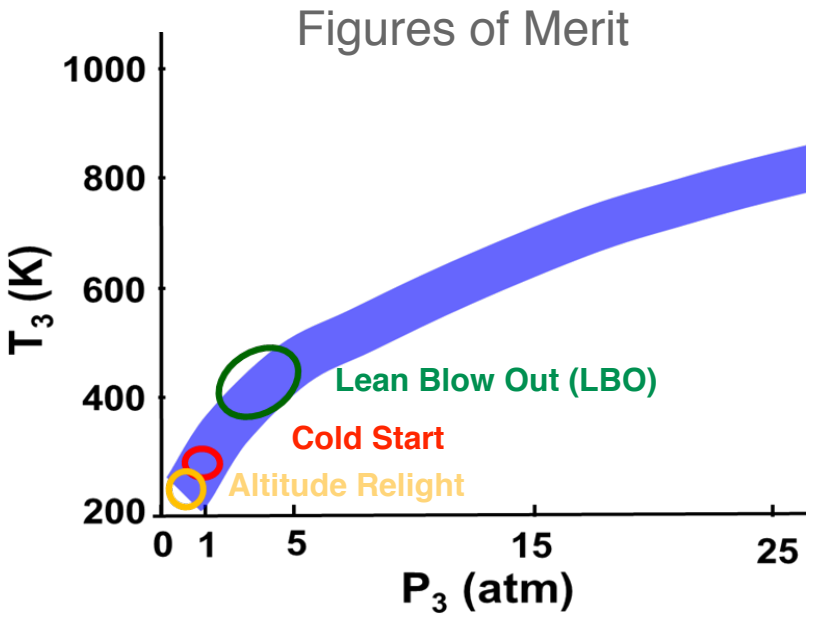
Computational Fluid Dynamics (CFD):

- Teams are iterating towards predicting Lean Blowout trends for selected NJFCP fuels.
- CFD combustion model developed into OEM common format routine (CFR) for alternative jet fuel evaluation in OEM hardware.

Fuel impacts on Combustor Figure of Merit (FOM)

Gas Turbine Engine Schematic





Topic Areas for FOM Evaluation:

1. Chemical Kinetics
2. Lean Blowout (LBO)
3. Ignition
4. Spray
5. Computational Fluid Dynamics (CFD) Modeling
6. Common Format Routine (CFR)

ASCENT Overall Summary

- Mission – Provide the scientific underpinning for the regulatory activities of the FAA Office of Environment and Energy
- Draws upon experts from around the country who collaborate worldwide
- Works within a network of federal and international agencies
- Plays a critical role the implementation of alternative jet fuels to decarbonize the aviation industry

QUESTIONS