Development of Federal Alternative Jet Fuels (AJF) R&D Strategy

Research, Development, Demonstration, and Deployment Challenges, Opportunities, and Strategic Way Forward

Background, Status Update and Next Steps

Members of Interagency Coordination Group
(USDA, DOC, DOD, NASA, FAA, DOE, EPA, NSF, DOS) and STPI

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Presentation Outline

- Background
- Snap-Shot of Current Status
- Next Steps

Strategy Development Team (9 federal departments/agencies)

USDA	Harry Baumes, Bill Goldner
DOC	Dan Friend
DOD	Bret Strogen, Tim Edwards
DOE	Zia Haq
EPA	Aaron Levy
FAA	**Mohan Gupta (Co-chair)**, Nathan Brown
NASA	**Barb Esker (Co-chair)**
NSF	Greg Rorrer
DOS	Dan Birns
STPI	Bhavya Lal and Emily Sylak-Glassman

Drivers and Challenges for Alternative Jet Fuels

Drivers

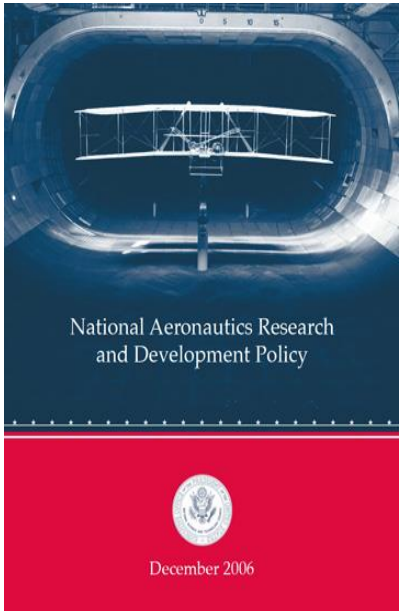
- Energy Security
- Environmental Sustainability
- Social and Economic Benefits

Overarching R&D Challenges

- Feedstocks
  - Varieties and geographical diversity
  - Production and yield efficiency
  - Sustainable and dependable supply
- Conversion efficiency and commercial scale production
- Jet fuel specificity and demand for byproducts
- Cost-competitiveness
- ASTM approval for performance, safety and operability
- Environmental sustainability and resource demand

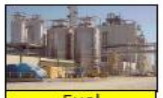
Relation to National Aeronautics Research & Development Plan (NARD)

Developed under the sponsorship of the National Science & Technology Council, Aeronautics S&T Subcommittee (ASTS)



NARD Plan focuses on 17 aeronautics goals in four areas –

- Mobility, Security, Safety and Environment and Energy
- Energy Availability, Efficiency & Environmental Protection
  - Goal 1: "Enable new aviation fuels derived from diverse & domestic resources to improve fuel supply security & price stability"

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

Currently, there is no <u>common</u> actionable R&D strategy that mobilizes the community to help meet these challenges by leveraging federal and non-federal capabilities.

Development of Federal Alternative Jet Fuels R&D Strategy

Intended Purpose

Identify opportunities and strategically address challenges associated with Research, Development, Demonstration, and Deployment (RD3) along the development path of alternative jet fuels.

National AJF R&D Strategy – A mechanism to

- **Articulate** *Aspirational yet Achievable* Objectives, *Measurable* Performance Metrics and Timeline to achieve the goal
- **Mobilize** the federal and non-federal stakeholders community towards achieving the common goal and objectives
- **Understand** industry needs and align federal strategic R&D efforts to address RD3 challenges along the alternative jet fuels supply-chain
- **Integrate**, align and coordinate interagency activities
- **Promote** increased collaboration
- **Enhance** technology transfer

OSTP Guidance (April 2013)

Engage non-federal community in development of the Strategy to strengthen buy-in and technology partnership/transfer.

Process for Information Collection

- Workshop with federal agencies on Challenges and Barrier
- OSTP meeting with industry representatives
- Phone interviews of federal and non-federal stakeholders
- Stakeholders' input via on-line questionnaire using an extensive list of challenge
- Workshop with non-federal stakeholders
- Post-workshop meeting with federal agencies to analyze/synthesize workshop discussions
- Frequent updates and discussion with the ASTS leadership
- Review of draft strategy document by stakeholders community

Overarching Statement of the Strategy:

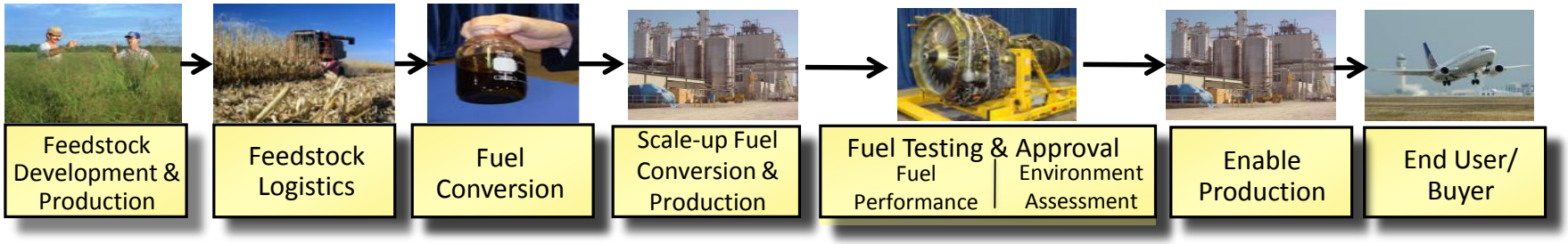
This strategy sets out prioritized Federal R&D goals and objectives to address key scientific and technical challenges that inhibit the development, production, and use of economically viable alternative jet fuels that would provide environmental and social benefits relative to conventional fuels while enhancing U.S. energy security.

Purposely not specific to individual agency's goal and/or efforts on AJF.

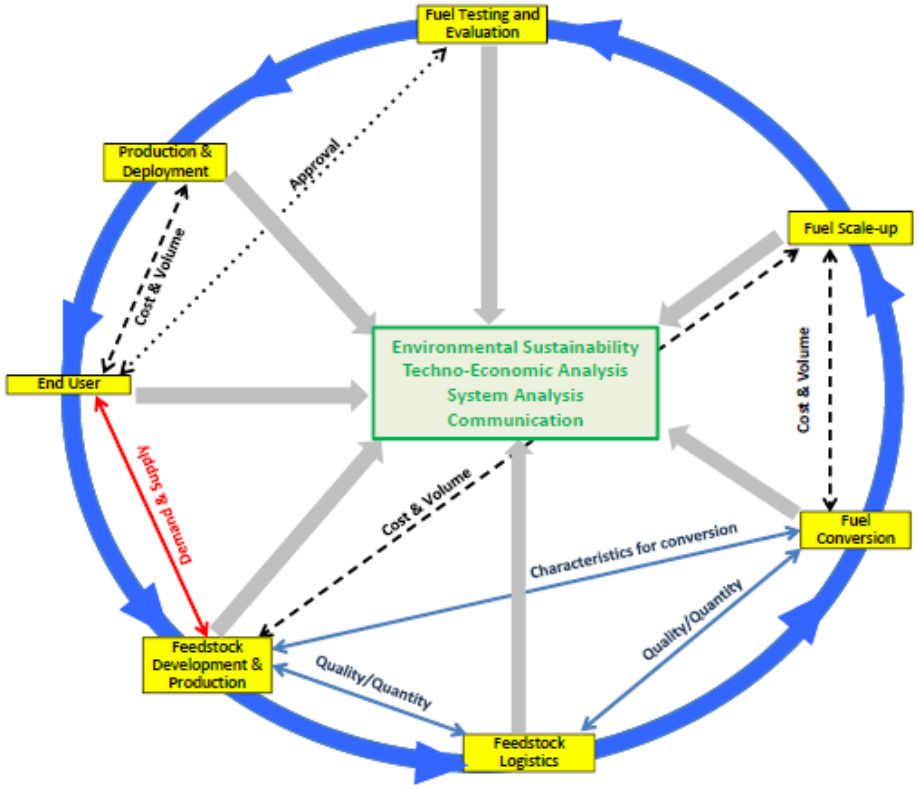
Stakeholders Input on the Strategy Scope

- Coordinate & guide the Federal AJF R&D enterprise
- Mobilize non-federal stakeholders through coordination and collaboration mechanisms
- Provide a common guiding path for the broader national AJF R&D community
- Include R&D issues associated with Demonstration and Deployment
- Recognize and address R&D barriers along the development path as a whole and at the interfaces
- Recognize and address R&D issues to the extent possible within international context
- Recognize (but not address) the role of non-R&D policies (e.g. RFS), economic & financial constraints and international policy & regulations

Alternative Jet Fuels: Development Path



Interconnectivity and Non-linearity in Development Path



Document Outline

- Introduction
- Purpose and Scope
- AJF Development Path
- R&D Goals and Objectives
  - Feedstock Development, Production, and Logistics
  - Fuel Conversion and Scale-Up
  - Fuel Testing and Evaluation
  - Integrated Challenges
- Non-Technical Challenges
- Federal Coordination
- Public-Private Partnerships
- International Coordination
- Conclusions
- Appendix 1 Agency-Specific Contributions to Research and Development of Alternative Jet Fuels
- Appendix 2 Multi-Agency Activities that Contribute to Research and Development of Alternative Jet Fuels
- Appendix 3 Federal AJF R&D Goals and Objectives
  - R&D Goals and Objectives: Feedstock Development, Production, and Logistics
  - R&D Goals and Objectives for Fuel Conversion and Scale-Up
  - R&D Goals and Objectives for Fuel Testing and Evaluation
  - R&D Goals and Objectives for Integrated Challenges
- Abbreviations

Document length ~ 31 pages

Example – Goals & Objectives Table (multiple time horizons)

R&D Goals and Objectives: Feedstock Development, Production, and Logistics

Feedstock Development, Production, and Logistics Goals	Near-Term (<5 years)
Feedstock Development **(FG1) Increase crop yields (tons/acre), reduce production inputs (including water use, land, and nutrient use) and costs (in terms of dollars or megajoules/ ton), and improve feedstock conversion characteristics** **(DOC, DOE, NSF, USDA)**	(FG1NO1) Benchmark readiness of existing regional feedstock (FSRL) and identify new and diverse feedstocks with regard to potential delivery at requisite quantity, quality, and cost for extant or emerging conversion platforms (DOE, USDA) (FG1NO2) Identify public and private sources for regional feedstock candidates and catalog characteristics to understand where research gaps exist (DOE, NSF, USDA) (FG1NO3) Set up feedstock improvement programs/partnerships to facilitate accelerated crop improvement (DOE, USDA) (FG1NO4) Leverage existing feedstock improvement programs and genetic/genomic information (DOE, USDA) (FG1NO5) Evaluate/characterize agriculture/forest residuals (DOE, USDA) (FG1NO6) Develop risk management tools such as crop insurance to promote dedicated bioenergy crop production (USDA)

R&D Goals and Objectives for Fuel Conversion and Scale-Up

R&D Goals	Near-Term (<5 years)
(S1) Enable the discovery, development, enhancement, and scale-up of conversion processes with improved yield, efficiency, and energy requirements that lead to cost-competitive alternative jet fuel **(DoD, DOE, NSF, USDA)**	(S1NO1) Improve conversion yields for promising processes by increasing the lifetime of catalysts, removing oxygen efficiently, and producing fuel precursors that can be easily converted to jet fuel (DOE, NSF) (S1NO2) Develop new and effective pre-treatment technologies that improve the ability of biomass to be converted to AJF, including co-processing in existing petro-based refineries (DOE, NSF) (S1NO3) Develop and demonstration of integrated fuel conversion facilities at commercial scale that produce jet fuel as a component of their product slates (DoD, DOE, USDA)
(S2) Develop new and innovative carbon capture and sequestration technologies that substantially reduce greenhouse gas emissions during conversion of coal, natural gas, and biomass into jet fuel **(DoD, DOE, NSF, USDA)**	(S2NO1) Develop a proof of concept evaluation and testing at bench scale to determine overall conversion process efficiencies, energy requirements, and product characteristics (DOE, NSF)
(S3) Develop conversion technologies that can produce jet fuel from multiple feedstocks in a distributed manner **(DoD, DOE, NSF, USDA)**	(S3NO1) Determine the feasibility of co-feeding biomass, waste, and other feedstocks for conversion process at demo and pilot scales (DOE)

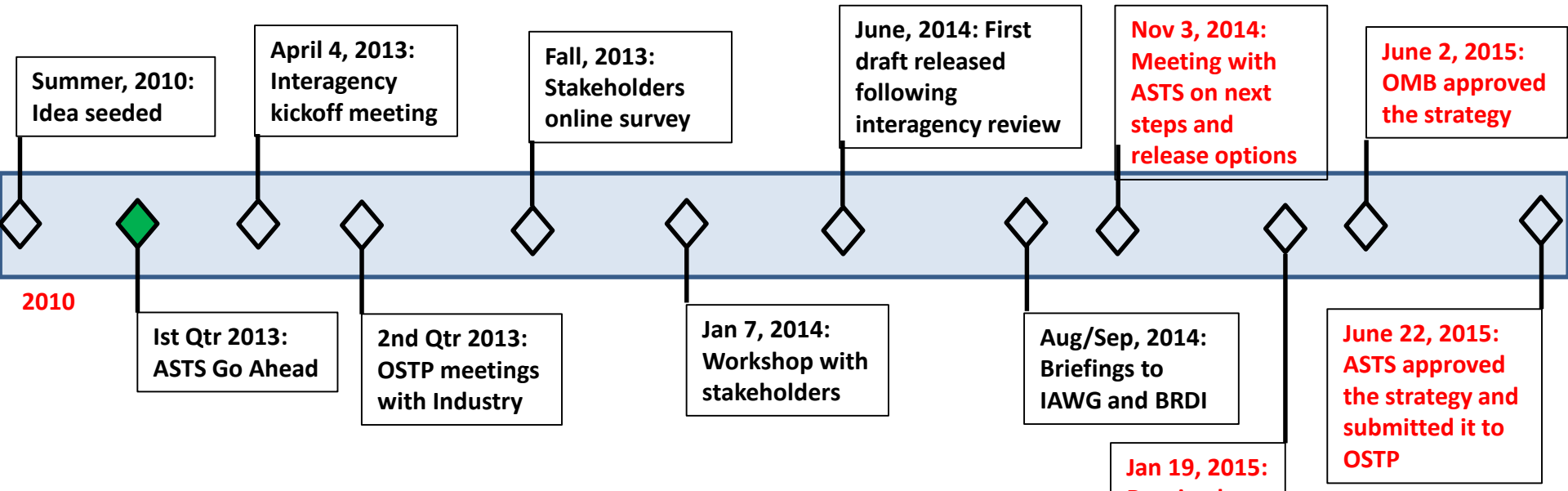
R&D Goals and Objectives for Fuel Testing and Evaluation

R&D Goals	Near-Term (<5 years)
(Q1) Facilitate civil and military approval of additional AJF pathways by enabling efficient evaluation for performance and safety through the advancement of certification and qualification processes and the collection and analysis of data **(DoD, DOT, NASA)**	(Q1NO1) Support capability to perform all testing required by ASTM D4054 and military specifications, including fuel property testing, component/rig testing, and aircraft engine testing to complete evaluation for viable alternative jet fuel pathways (DoD, DOT) (Q1NO2) Establish a coordinated process to track and monitor progress of ASTM and military alternative jet fuel task forces, conduct data review and testing activities, and establish schedules and prioritize projects leveraging tools such as the FR[illegible] (D[illegible]) (Q1[illegible]3) Explore novel approaches for approval of alternative jet fuels with test and evaluation requirements commensurate with the blend percentages (DoD, DOT) (Q1NO4) Characterize the conventional U.S. jet fuel supply to better understand the jet fuel property baseline and variations to enable statistical assessment of alternative jet fuel appropriateness and benefits (DOT) (Q1NO5) Advance fuel composition and combustion performance modeling, experimentation, and analysis (DoD, DOT, NASA)

R&D Goals and Objectives for Integrated Challenges

R&D Goals	Objectives: Near-Term (<5 years)	Mid-Term (5–10 years)	Far Term (>10 years)
(C1) Advance understanding of and improve the environmental sustainability of AJF production and use **(DOC, DOT, EPA, USDA)**	(C1NO1) Advance the scientific understanding of environmental impacts of AJF production and use on all relevant scales, including those related to life-cycle emissions that impact climate change and environment (DOC, DOT, EPA, USDA) (C1NO2) Improve capabilities to assess natural resource requirements for AJF production and use on regional and national scales (DOC, DOT, USDA) (C1NO3) Compile, assess, and disseminate definitions, protocols, data, and tools in support of environmental sustainability analysis (DOC, DOT, EPA, NSF)	(C1MO1) Contribute to internationally recognized approaches to AJF environmental sustainability assessment through quantitative sustainability analysis (DOC, DOT, EPA, USDA) (C1MO2) Develop best practices for collecting and analyzing AJF life-cycle inventory data aligned with each stage of fuel and feedstock readiness (DOE, DOT, EPA)	(C1LO1) Develop improved tools and approaches for environmental sustainability assessment applicable across all stages of the supply chain and generalizable to all AJF pathways (DoD , DOT, EPA, USDA)

Strategy Development Timeline, Current Status and Next Steps



Current Status

COT/NSTC is currently reviewing the strategy document

- This review may result in some revisions
- Expecting to hear about the review in near future

Next Steps

- Will work with OSTP and STPI for official release of Federal Alternative Jet Fuels R&D Strategy
- Anticipating strategy release soon after the COT approval