



**CAAFI 2014  
General Meeting  
& Expo**

**Government Partners'  
Activities Update**

Moderated by: Steve Csonka, Executive Director,  
CAAFI

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**CAAIFI 2014  
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**Lourdes Maurice,**

Executive Director for Environment  
and Energy, FAA

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# Overview of FAA Alternative Jet Fuel Efforts

By: Dr. Lourdes Maurice  
Executive Director  
Office of Environment and Energy  
Federal Aviation Administration

Date: January 28, 2014



Federal Aviation  
Administration



# Aviation Environmental Challenges

NOISE



AIR QUALITY



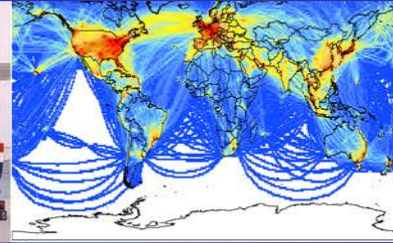
WATER QUALITY



ENERGY



GLOBAL CLIMATE



- Aviation impacts community noise, air quality, water quality, energy usage, and climate change
- Environmental impacts from aviation emissions could pose a critical constraint on capacity growth
- Alternative jet fuels could reduce the environmental impact of aviation:
  - Carbon neutral growth by 2020 compared to 2005
  - 1 billion gallons of renewable jet fuel in use by aviation by 2018
  - Absolute reduction of significant air quality impacts, notwithstanding aviation growth



Federal Aviation  
Administration

# U.S. Climate Action Plan for Aviation

*The U.S. is pursuing a multipronged approach to address greenhouse gas emissions from aviation*

- Aircraft and engine technology improvement
- Operational improvements
- Alternative fuels development and deployment
- Policies, environmental standards, and market based measures
- Scientific understanding through research, modeling and analysis



Federal Aviation  
Administration

# Challenges for Sustainable Alternative Fuels

- Feedstock availability
- Competitive cost for alternative fuel
- Approved for performance/safety
- Environmentally sustainable
- Commercially produced



# Current FAA Alternative Jet Fuel Activities

- **Testing**

- Material compatibility
- Certification / Qualification
- Emissions measurements

- **Analysis**

- Environmental sustainability
- Techno-economic analysis
- Future scenarios

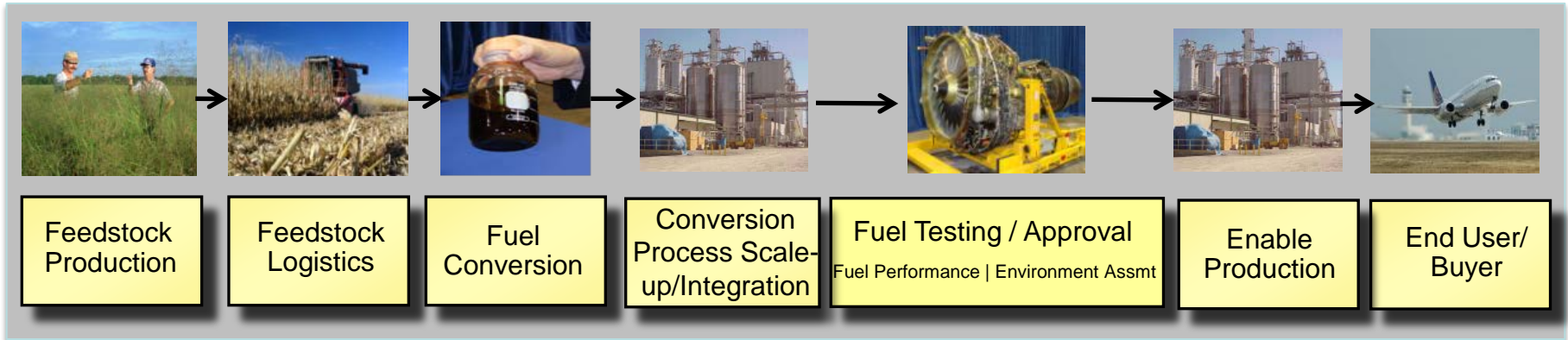
- **Coordination**

- Public-Private
- State & Regional
- International



# Coordinating Agency Efforts across Supply Chain

## Facilitating Deployment and Investment



Agriculture: Biomass Crop Assistance Program & Crop Insurance Program

Energy & Defense: R&D grants

Agriculture & Energy: R&D grants

FAA & Defense: C/Q Fuel testing

FAA, Defense, & NASA: Enviro Analysis

Agriculture, Navy, & Energy: Defense Production Act and Biorefinery Program

Defense & Airlines: fuel purchase

Agriculture: Feedstock Development Center Grants



FAA: Guidance for Airports

EPA: Renewable Fuel Standard





# Commercial Aviation Alternative Fuels Initiative

- Public-Private coalition for commercial aviation to engage the emerging alternative fuels industry
- Coordinate development of alt jet fuels:
  - Equivalent safety/performance (drop-in)
  - Comparable cost
  - Environmental improvement
  - Security of Energy supply
- Four teams for key issues:
  - Environment Team
  - Certification-Qualification Team
  - R&D Team
  - Business Team
- State and Regional Support
- International Cooperation



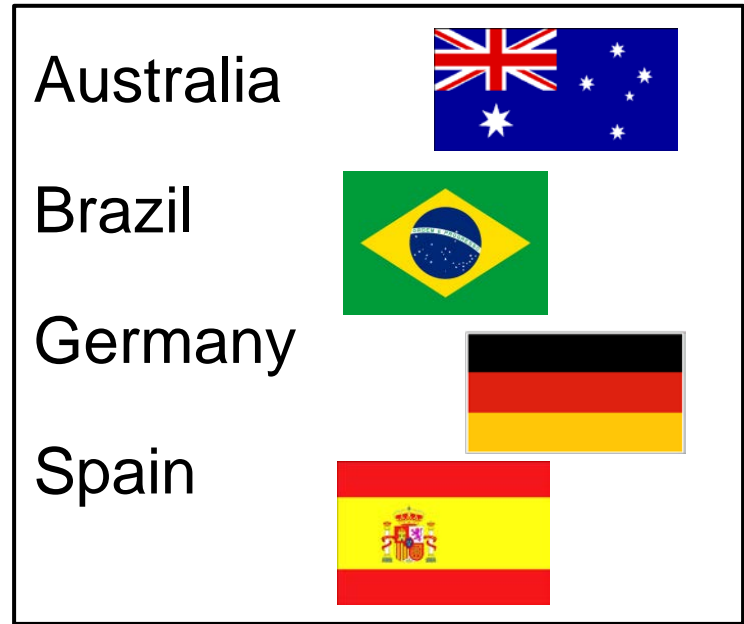
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We Connect the World



Federal Aviation  
Administration

# International Engagement

- Bilateral Cooperation Agreements
- Coordination with counterparts, and R&D organizations
- U.N. International Civil Aviation Organization



# New FAA Programs



## Aviation Sustainability Center (ASCENT)

- New CoE for Alternative jet fuel and Environment
- Ten technical areas covering alt fuels and environment
- WSU and MIT leading team of Universities



## Continuous Lower Energy, Emissions and Noise (CLEEN) II

- CLEEN I: 2010-2015 effort
- CLEEN II: solicitation 2014; program covers May 2015-2020.
- Reduce aircraft fuel burn, emissions and noise through technology & advance alternative jet fuels
- Spring 2014 Screening Information Request



# Summary

- Advancing use of alternative jet fuels is key for meeting U.S. environmental goals
- Testing & demo efforts accelerate alt fuel technology development
- Analysis efforts improve environmental impacts and economic quantification and decision-making
- Continuing coordination among government agencies, with private sector and across the supply chain is key to deployment
- International cooperation key to leverage diverse efforts
- Development of supply to meet needs is next big challenge





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**Harry Baumes,**

Director, Office of Energy Policy and  
New Uses, USDA

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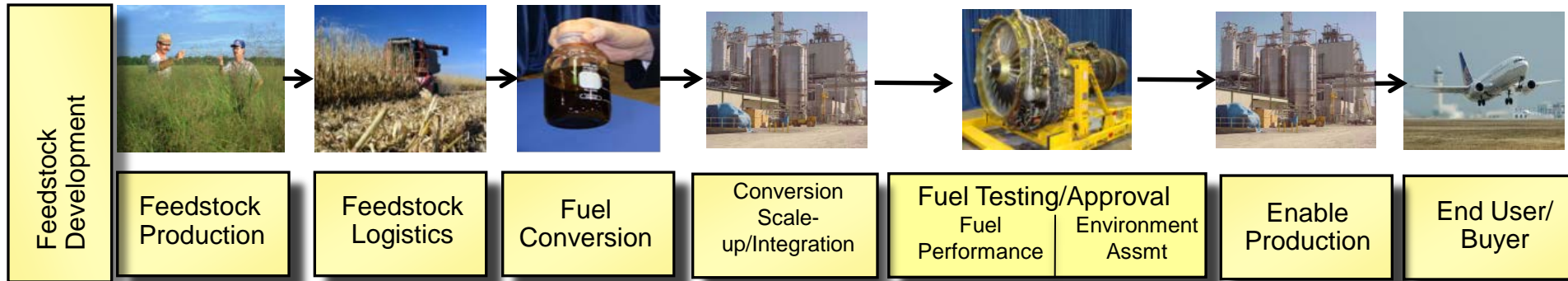
# **USDA – Activities Update**

**Harry S. Baumes, Ph. D.**  
**Director**  
**Office of Energy Policy and New Uses**

**CAAFI General Meetings**  
**Washington Marriott**  
**Washington, DC**  
**January 28 & 39, 2014**



# Supply Chain Approach for Alternative Jet Fuels



Feedstock Development & Production  
Research and Education

Feedstock pathways – Integration - Scale Up  
Commercial Production

End –Use  
Alternative Fuels



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## **USDA Efforts**

- **Research, Education, Extension/Tech Transfer**
- **Programs (including Title IX)**
- **Partnerships**





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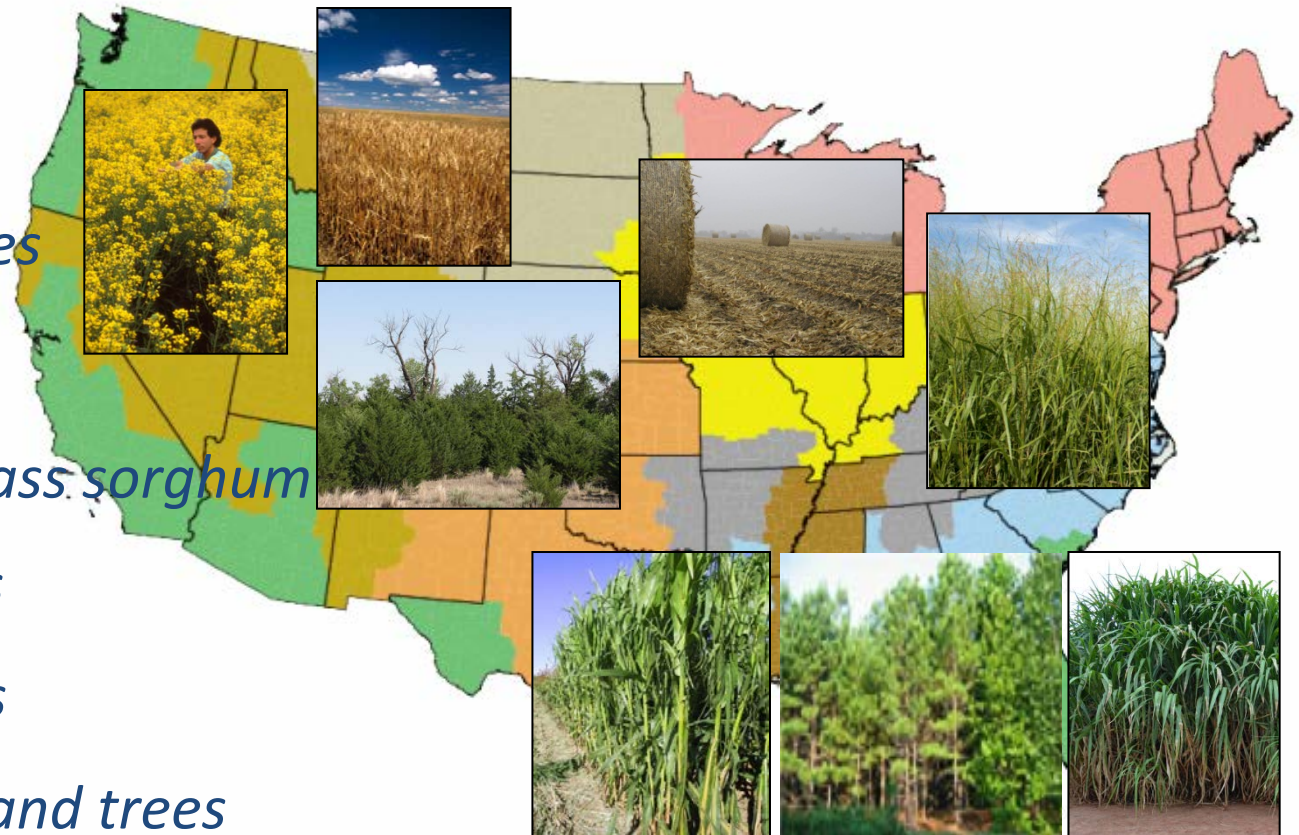
## **USDA Research Efforts**

- **Research**
  - **Biophysical and social sciences**
  - **5 Biomass Research Centers (ARS and FS Leadership)**
  - **National Institute of Food and Agriculture (NIFA)**
    - **Integrated research, education, Extension/tech transfer**
      - **Agricultural Food and Research Initiative (AFRI) – Regional Bioenergy Systems Coordinated Agriculture Projects(CAPS)**
- **Collaboration with EPA**
  - **RFS Volumes**
  - **Feedstock Pathways**



## Concentrate on Specific Regional Feedstocks

- *Crop residues*
- *Perennial grasses*
- *Energy cane*
- *Non-food biomass sorghum*
- *Lipid seed crops*
- *Woody Biomass*
- *Invasive rangeland trees*



*No one feedstock will meet all national biofuel needs*



## USDA Research Efforts

- **AFRI – CAPs**

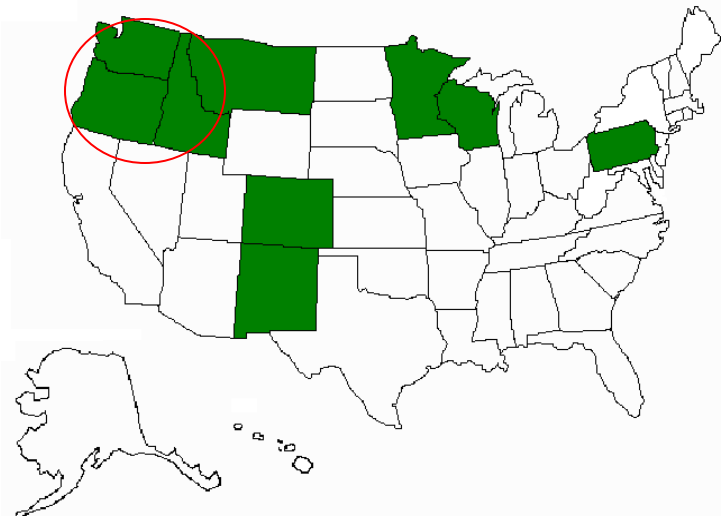
- The Agriculture and Food Research Initiative (AFRI) funds Coordinated Agricultural Projects (CAPs) that integrated research, extension, and education grants that address key problems of National, regional, and multi-state importance in sustaining all components of agriculture, including farm efficiency and profitability, ranching, **renewable energy**, forestry (both urban and agroforestry), aquaculture, rural communities and entrepreneurship, human nutrition, food safety, biotechnology, and conventional breeding.
- Challenge Area: Develop regional systems for the sustainable production of biofuels, biopower, and biobased products to enhance existing agricultural systems and provide alternatives to fossil-based fuel and products to extend the availability of these finite feedstocks and partially address environmental impacts.
- Five year consortia projects with transdisciplinary systems approach. Partnerships, economic, environmental, and social assessment.



# Northwest Advanced Renewables Alliance (NARA): New Vista for Green Fuels, Chemicals, and Products

## WA St U, \$40,000,000 (5 years)

- **41 Key Personnel representing 9 Universities, 3 Federal Partners, and 4 Industrial Partners from 9 States:**
  - *Renewable aviation fuel, value-added industrial chemicals*
  - *Woody biomass residues*
    - *Weyerhaeuser, other landowners*
    - *Bioconversion and fuel production*
    - *Gevo, Catchlight*





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## **USDA Programs**

- **Technical and Financial Assistance**
- **Farm Bill Title IX Programs**
  - **Federal Procurement of Biobased Products (9002)**
  - **Biorefinery Assistance Program (9003)**
  - **Repowering Assistance Program (9004)**
  - **Bioenergy Program for Advanced Biofuels (9005)**
  - **Rural Energy for America Program (REAP - 9007)**
  - **Biomass Research and Development (9008)**
  - **Biomass Crop Assistance Program (9011)**
  - **Community Wood Energy Program (9013)**



## Section 9003 - Biorefinery Assistance Program

### Investments in “First of its kind” commercial production

- **Loan Note Guarantees issued:**
  - Sapphire Energy, Inc., New Mexico, \$54.5 million **REPAID**
  - INEOS New Planet BioEnergy, Florida, \$75 million
- **Conditional Commitments awarded:**
  - Enerkem Corporation, Mississippi, \$80 million
  - Zchem, Oregon, \$232.5 million
  - Fiberight, Iowa, \$25 million
  - Fulcrum Sierra Biofuels, Nevada, \$105 million
  - Chemtex, North Carolina, \$99 million





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## USDA Partnerships

*Defense Production Act*

*Farm to Fleet Program*

*Biomass research and Development Initiative*

- Joint USDA/DOE initiative (BRDI) \$40M

*Interagency Groups*

- Interagency Working Group on Alternative Fuels
  - DOE
  - FAA
  - EPA



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# USDA Partnerships - continued

## *Public-private partnerships*

- Farm to Fly Initiatives (V1 and F2F2)
- CAAFI – Commercial Aviation Alternative Fuels Initiative
- MASBI – Midwest Aviation Sustainable Biofuels Initiative





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**THANK YOU**



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**Jonathan Male,**  
Deputy Director, BETO, DOE

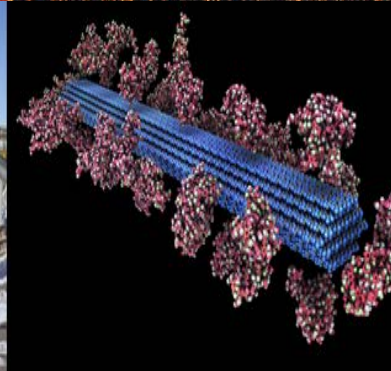
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U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy



# Commercial Aviation Alternative Fuels Initiative General Meeting

January 28<sup>th</sup>, 2013

Jonathan L. Male

Director, Bioenergy  
Technologies Office

# The Clean Energy Race: In It to Win It

**“The path towards sustainable energy sources will be long and sometimes difficult. But America cannot resist this transition, we must lead it. We cannot cede to other nations the technology that will power new jobs and new industries, we must claim its promise...”**

-President Obama, Inaugural Address, January 21, 2013



Official White House Photo by Lawrence Jackson

# Bioenergy Technologies Office

## Vision

- A viable, sustainable domestic biomass industry that:
- Produces renewable biofuels, bioproducts, and biopower
  - Enhances U.S. energy security
  - Reduces U.S. dependence on oil
  - Provides environmental benefits, including reduced GHG emissions
  - Creates economic opportunities across the nation

## Mission

Develop and transform our renewable biomass resources into commercially viable, high-performance biofuels, bioproducts, and biopower through targeted research, development, demonstration, and deployment (RDD&D) that is supported through public and private partnerships

## Strategic Goals

Develop commercially viable biomass technologies to enable the production of biofuels nationwide and reduce dependence on foreign oil through the creation of a new domestic bioenergy industry, thus supporting the Energy Independence and Security Act (EISA) of 2007 goal of producing 36 billion gallons per year of renewable transportation fuels by 2022

# Bioenergy Technologies Office Overview (BETO)

**Mission:** Through targeted RDD&D, enable sustainable, nationwide production of advanced biofuels that that will displace a share of petroleum-derived fuels, mitigate climate change, create American jobs, and increase U.S. energy security.

## Research, Development, Demonstration, & Deployment

## Cross Cutting

### Feedstock Supply

Develop sustainable, secure, reliable, and affordable biomass feedstock supply.

### Conversion R&D

Develop commercially viable technologies for converting biomass feedstocks into fungible, liquid transportation fuels, bioproducts and chemical intermediates

### Demonstration & Deployment

Demonstrate and validate integrated technologies with successful construction and operation of cost-shared pilot, demonstration, and commercial scale facilities

### Sustainability

Promote the positive economic, social, and environmental effects, while reducing potential negative impacts of biofuels

### Strategic Analysis

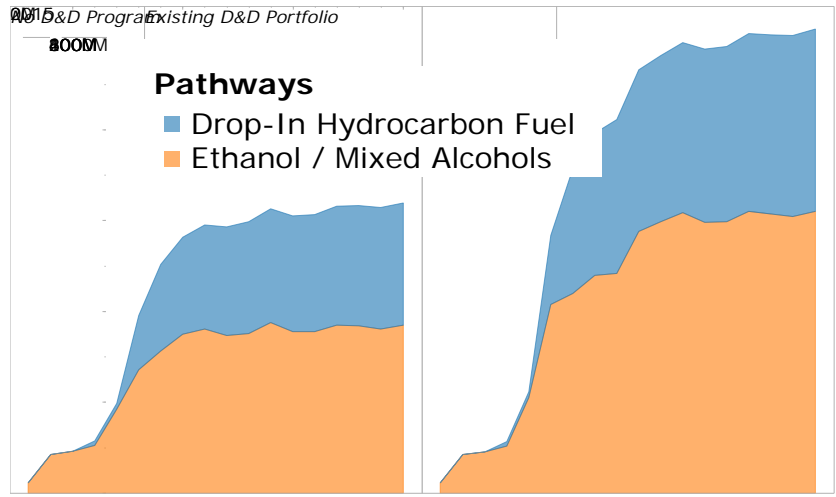
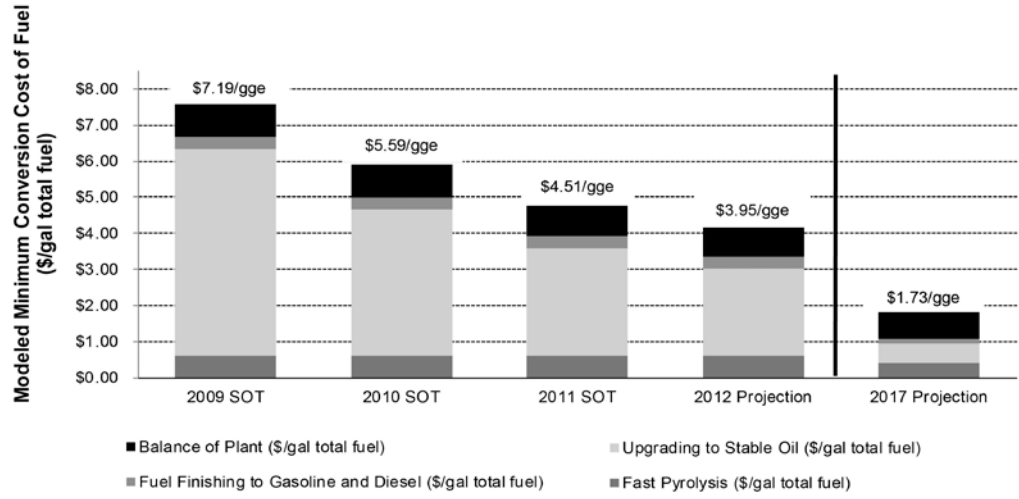
Provide context for decisions by establishing quantitative metrics, tracking progress toward goals, and informing portfolio planning and management

# BETO's Role

## RDD&D

- BETO supports R&D to prove out technical concepts, and overcome barriers to lower costs of advanced hydrocarbon biofuels making them cost-competitive with petroleum fuels
- BETO supports D&D to de-risk new technologies through validation of proof-of-performance at the pilot, demonstration and pioneer scale, in order to enable investor confidence for commercial investment

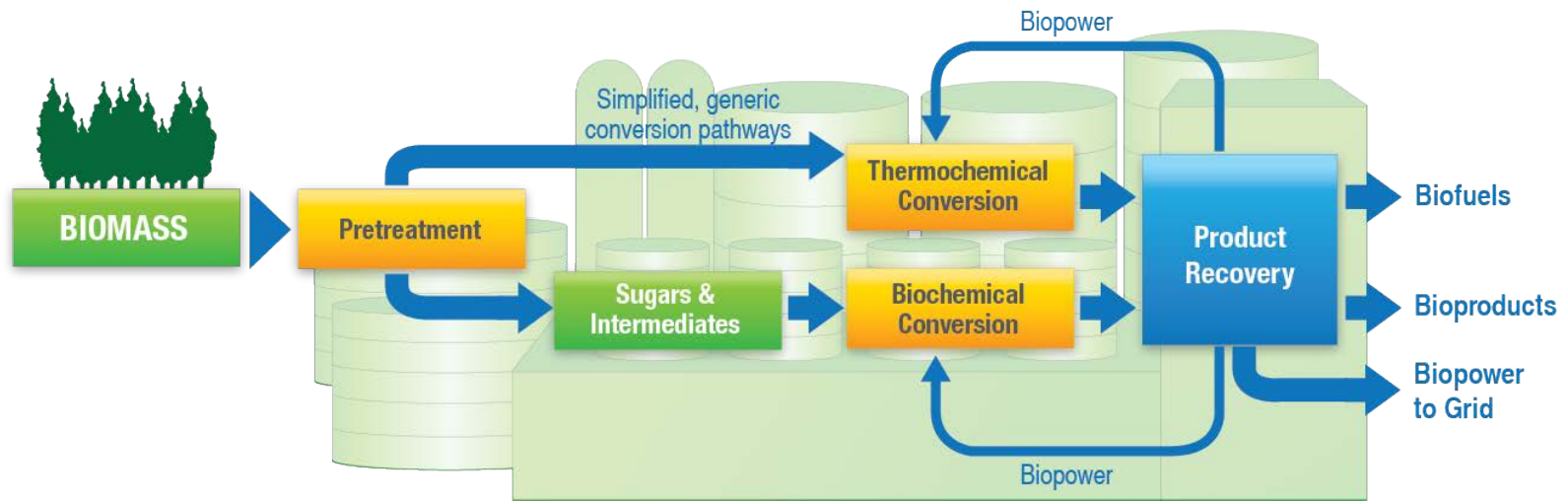
Example Design Case Projection for Conversion Cost of Woody Feedstock to Hydrocarbon Fuel (Fast Pyrolysis with Catalytic Upgrading)



# Innovation is Challenging and Involves Risks

De-risking of technologies is central to R&D into and through the D&D role, addressing greater integration and scale:

- BETO is focusing on advancing more technologies, including renewable diesel and jet fuels
- Technical, construction, operational and financial/market risks
- DOE needs new ways to communicate technical risk for hydrocarbon fuels



Biomass Key Challenges
<ul style="list-style-type: none"> <li>• Reliable supply</li> <li>• Consistent quality</li> <li>• Affordable delivery</li> </ul>

Pretreatment Key Challenges
<ul style="list-style-type: none"> <li>• Biomass feeding</li> <li>• Biomass sizing and moisture</li> <li>• Solids handling</li> </ul>

Conversion Key Challenges
<ul style="list-style-type: none"> <li>• Products yields</li> <li>• Construction materials</li> <li>• Catalysts</li> <li>• Fermentation organisms</li> </ul>

Product Key Challenges
<ul style="list-style-type: none"> <li>• Separations</li> <li>• Catalytic upgrading</li> <li>• Recycle loops</li> </ul>



# BETO IBR Portfolio and Hydrocarbon Fuels

- 11 integrated biorefinery projects are investigating hydrocarbons from biomass resources:
  - *Flambeau*
  - *New Page*
  - Haldor
  - *GTI*
  - REII
  - *Elevance*
  - Solazyme
  - ClearFuels
  - Amyris
  - Sapphire
  - UOP
- GTI and Elevance are R&D projects.
- 9 projects are pilot, demonstration, or commercial scale.



For more information visit:

[http://www1.eere.energy.gov/bioenergy/integrated\\_biorefineries.html](http://www1.eere.energy.gov/bioenergy/integrated_biorefineries.html)

# Aviation Biofuels

BETO is committed to strengthening the relationship between the DOE and the aviation sector in order to help advance the renewable jet fuel industry. Over the past few years, BETO has increased collaboration activities with the military, airline industry, and government partners including the Commercial Aviation Alternative Fuels Initiative (CAAIFI) and the Federal Aviation Administration (FAA).

As part of the increasing aviation fuels focus at the DOE, BETO staff will be supporting the following initiatives:

- National Alternative Jet Fuels Strategy Roadmap
- FAA Center of Excellence in alternative jet fuels
- Alternative Jet Fuels Workshop (a follow up to November 2012 effort)



# Natural Gas

- Recent Developments
  - BETO has received several requests from industry to investigate whether a combination of natural gas and biomass could be utilized to produce liquid transportation fuels (particularly aviation fuel) and products.
  - Two biofuels companies have announced their intention to abandon biomass as a feedstock and utilize natural gas to produce liquid fuels.
- DOE Workshop on Natural Gas-Biomass Technologies
  - BETO, in coordination with the Office of Fossil Energy and ARPA-E, hosted a one-day workshop addressing natural gas-biomass-to-liquids (GBTL) research needs and technology options in September, 2013.
  - Objective of this event was to obtain input from industry, academia, research establishments, and other experts on whether or not there is a role for DOE to conduct R&D and develop new process technologies.
  - On February 6<sup>th</sup>, BETO will host a [webinar](#) discussing the results of this workshop, and the summary report will be posted this spring.

# Demonstration and Deployment Workshop

BETO is interested in identifying the next step(s) in drop-in hydrocarbon biofuel production. A spring workshop is being planned to discuss, reassess, and prioritize the demonstration and deployment efforts needed to realize affordable, scalable, and sustainable production of hydrocarbon biofuels.

- D&D Strategy Workshop will be held on March 12-13, 2014 at Argonne National Laboratory's ANS conference center in Chicago, Illinois.
- Attendees will discuss the current state of technology and efforts needed to achieve affordable, scalable, and sustainable drop-in hydrocarbon biofuels.
- The outcomes of these discussions are expected to result in the following:
  - Determine how BETO can accelerate industry's efforts
  - Develop strategy and future plans
  - Led to a breakout session at the Biomass 2014 Conference on July 29-30<sup>th</sup>

For updates and further information, please visit the Demonstration and Deployment Workshop Web page

([http://www1.eere.energy.gov/bioenergy/demonstration\\_deployment\\_strategy\\_workshop.html](http://www1.eere.energy.gov/bioenergy/demonstration_deployment_strategy_workshop.html))

# FY2014 Priorities

- **Feedstock Logistics:** Reduce the feedstock logistics cost target for delivery to plant from \$55/dry-matter ton to \$53/dry-matter ton for loblolly pine
- **Algae and Advanced Feedstocks:** Reduce the modeled mature plant cost of open pond algal oil by \$2.35 to \$14.31/gasoline gallon equivalent (gge) by improving overall algal biomass productivity toward the \$3.00/gge in 2022 goal
- **Biochemical Conversion:** Define priority pathways for hydrocarbon fuel development and initiate two new programs beyond fuels: waste-to-energy and use of lignin and lignocellulosic sugars to produce carbon fibers
- **Thermochemical Conversion:** Reduce the modeled conversion cost from \$3.18/gge to \$2.70/gge for producing gasoline/diesel from biomass by way of pyrolysis or direct liquefaction technologies followed by catalytic upgrading
- **Incubator Program:** Support innovation by providing small businesses with increased access to BETO's funded capital and user facilities
- **Integrated Biorefineries:** Advance portfolio of innovative pilot-scale and demonstration-scale biorefineries for biofuel and bioproducts manufacturing
- **Analysis and Sustainability:** Conduct cross-cutting and systems-level analyses to inform program planning, decision-making, and R&D investments; evaluate sustainability metrics and promote best practices regarding productivity, land use, water, emissions, and social sustainability
- **Biopower/Cookstoves:** Emphasize R&D and validation of cookstoves; improve combustion and heat transfer processes through a competitive process

# Bioenergy Technologies Office Awards

## Innovative Pilot and Demonstration Scale Production of Advanced Biofuels

- On April 22<sup>nd</sup>, the Department of Energy announced the four projects selected for negotiation for the innovative pilot FOA for the production of advanced biofuels. Each project that was selected will be working to produce biofuels that meet military specifications for jet and diesel fuel.
- **Frontline Bioenergy LLCM, Ames, Iowa**
  - Up to \$4.2 million to produce FT liquids from woody biomass, municipal solid waste, and refuse derived fuel. These liquids will be upgraded to produce samples of biofuels that meet military specifications.
- **Cobalt Technologies, Mountain View, California**
  - Up to \$2.5 million to operate a pilot-scale integrated biorefinery to convert switchgrass to bio-jet fuel
- **Mercurius Biorefining, Inc., Ferndale, Washington**
  - Up to \$4.6 million to operate a pilot plant converting cellulosic biomass into drop-in bio-jet fuel and chemicals.
- **BioProcess Algae, Shenandoah, Iowa**
  - Up to \$6.4 million to produce hydrocarbon fuels meeting military specifications from an algae-based integrated biorefinery.



An F/A-18 Green Hornet Fighter plane operating on a 50/50 biofuels blend. Photo courtesy of the U.S. Navy.

# Next Steps: Technology Pathways Development

In 2012, eight technology pathways to hydrocarbon biofuels were selected based on the following criteria:

- Feasibility of achieving cost goal of \$3/gal
- Near/mid/long-term techno-economic potential
- Potential national impact
- Feedstock availability/flexibility
- Data availability across the full pathway
- Co-product economics
- Environmental sustainability

## Technology Pathways

Biological Conversion of Sugars to Hydrocarbons

Catalytic Upgrading of Sugars to Hydrocarbons

Ex-situ Catalytic Pyrolysis

In-Situ Catalytic Pyrolysis

Fast Pyrolysis and Upgrading

Syngas to Mixed Alcohols to Hydrocarbons

Whole Algae Hydrothermal Liquefaction

Algal Lipid Extraction Upgrading to Hydrocarbons

and develop design case reports for each pathway

# Aviation Biofuels Techno-Economic Analysis Workshop

**When:** November 27<sup>th</sup>, 2012 **Where:** Washington, DC

## Workshop Objectives

- Benchmark current and future cost-of-production and performance characteristics of biomass-based processes that can produce jet fuel

## Scope

- Processes
  - New pathways for aviation fuels
  - Biochemical conversion
  - Thermochemical conversion
  - Algae-derived methods
  - HEFA/HEFA algae
  - Gasification/FT
- Feedstocks
  - Productivity and handling





# Aviation Biofuels Workshop Summary

- Workshop provided a unique opportunity for stakeholders to discuss cost of biofuels production via multiple pathways.
- Challenge to make this knowledge accessible. Research results and data needs to be more broadly communicated; greater awareness of ongoing R&D is needed.
- As fuels are being qualified, costs should be considered. Fuel producers and key stakeholders should be brought into this process.
- Data from facilities under construction is difficult to obtain (IP, etc.), however, it is needed to provide a reality check.
- Common terms, units, and techniques are needed for techno-economic analysis to enable consistent comparison of technologies.
- Presentations at <http://www1.eere.energy.gov/biomass/meetings.html>, summary fact-sheet at <http://www.caafi.org>



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**Chris Tindal,**

Director for Operational Energy, Office  
of the DAS of the Navy for Energy, Navy

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# DEPARTMENT OF THE NAVY Advanced Biofuels Update



**Chris Tindal**  
Director for Operational Energy



*Pacific Ocean USS Princeton (CG 59) pulls oiler USNS Henry J. Kaiser (T-AO 187)*



*Royal Australian Navy S-70B Sea Hawk helicopter*

# 2012 GGF DEMONSTRATION



*SECNAV and CNO aboard USS Chafee*



*USS Princeton (CG 59) ,USS Nimitz (CVN 68)*



# DPA Title III Advanced Drop-In Biofuels Production Project

- As of June 19, 2013, 4 Phase 1 awards have been made
- Potential for 170 million gallons of drop-in compatible MILSPEC fuels (F-76, JP-5, JP-8) to start production by 2016
- Weighted average price in 2013 dollars < \$4/gal
- Project has \$100 million in FY12 funds from DOD, \$60 million in FY13 from USN that can't be reprogrammed
- USDA has contributed \$161 million in CCC funds
- Phase 2 awards set to begin July 2014
  - Construction and commissioning

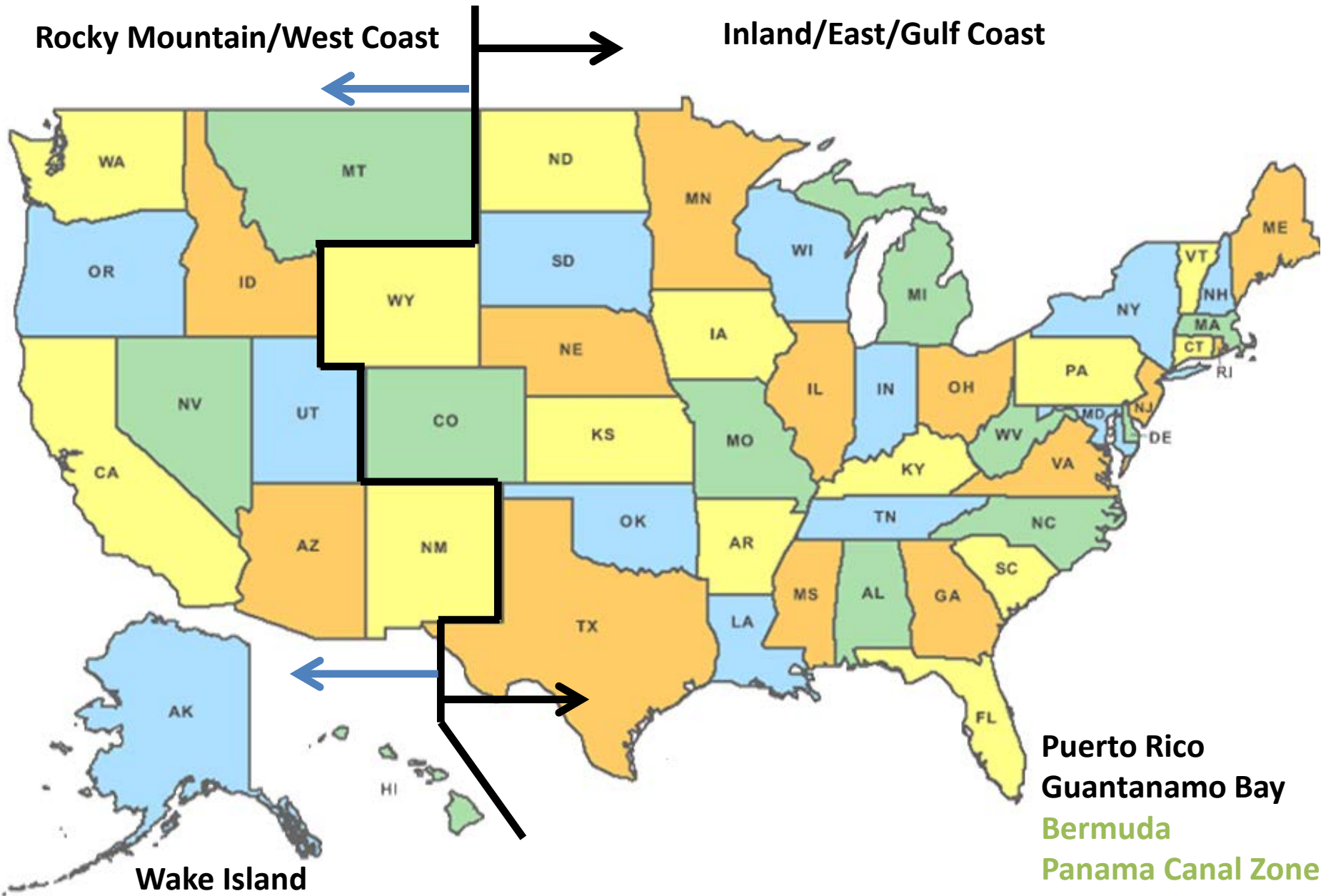


# Farm to Fleet Biofuels Initiative

- **Start on biofuels acquisitions for Great Green Fleet 2016 & SECNAV's 2020 goals (336 MM gal)**
- **Use DLA Energy bulk petroleum contracting to begin large-scale, domestic drop-in biofuel purchases for regular operational use**
- **USDA CCC funds can be used to help defray feedstock costs**
- **Solicitations pending (spring 2014)**
- **Deliveries scheduled to begin:**
  - **April 2015 with the Inland/East/Gulf Coast region**
  - **June 2015 for Rocky Mountain/ West Coast region**
  - **These two solicitations cover all 50 states**

Rocky Mountain/West Coast

Inland/East/Gulf Coast



Wake Island  
Kwajalein

Puerto Rico  
Guantanamo Bay  
Bermuda  
Panama Canal Zone



# Farm to Fleet Biofuels Initiative

- **10% blend target, 1 year contracts**
  - 10%  $\approx$  43 + 37 MM gal (neat) for each solicitation ( $\approx$  80 MM total)
  - JP-5 jet fuel and F-76 diesel fuel marine – FT and HEFA
- **CCC Eligibility**
  - Feedstocks consistent with CCC charter
- **Feedstock Preferences**
  - Navy is feedstock agnostic; targets finished fuel specifications
  - Not to interfere with food production
- **GHG emissions**
  - EISA 526 dictates same or better GHG emissions
- **Price: Will be biggest decision criteria; must be cost competitive**
- **Farm to Fleet Industry day January 30<sup>th</sup>**





# Farm to Fleet Industry Day

- The meeting will be held on Thursday, January 30, 2014, from 8:00 a.m. to 5:00 p.m.
- The meeting will be held at USDA Jefferson Auditorium, USDA South Building, 14th and Independence, Washington, DC 20250.
- This session is neither intended to offer government insight, nor to answer direct questions and receive comments on bulk fuel purchases held by DLA Energy. Questions related to DLA Energy bulk fuel contracting cannot be answered at this venue.



# Farm to Fleet Industry Day

- **The event is free, however all attendees must register for the Farm to Fleet Industry Day via email [Farm2Fleet.IndustryDay@gmail.com](mailto:Farm2Fleet.IndustryDay@gmail.com) with all of the following required information:**
  - **Name and Title:**
  - **Corporate Affiliation:**
  - **Address:**
  - **Phone Number:**
  - **Email:**
  - **Web Site:**
  - **Position on the Biofuels Production Value Chain: (i.e., feedstock provider, bio-refiner, blender, finished products distributor, subject matter expert, financier, etc.)**

# THANK YOU



**F/A-18E**  
**Mt. McKinley, Alaska**



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**Karl Simon,**

Director, Transportation and Climate  
Division, OTAQ, EPA

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