

The Value Proposition of Sustainable Alternative Jet Fuel (SAJF)

DOE Bioeconomy 2017

Plenary V: Creating and Communicating the Value Proposition for the Bioeconomy

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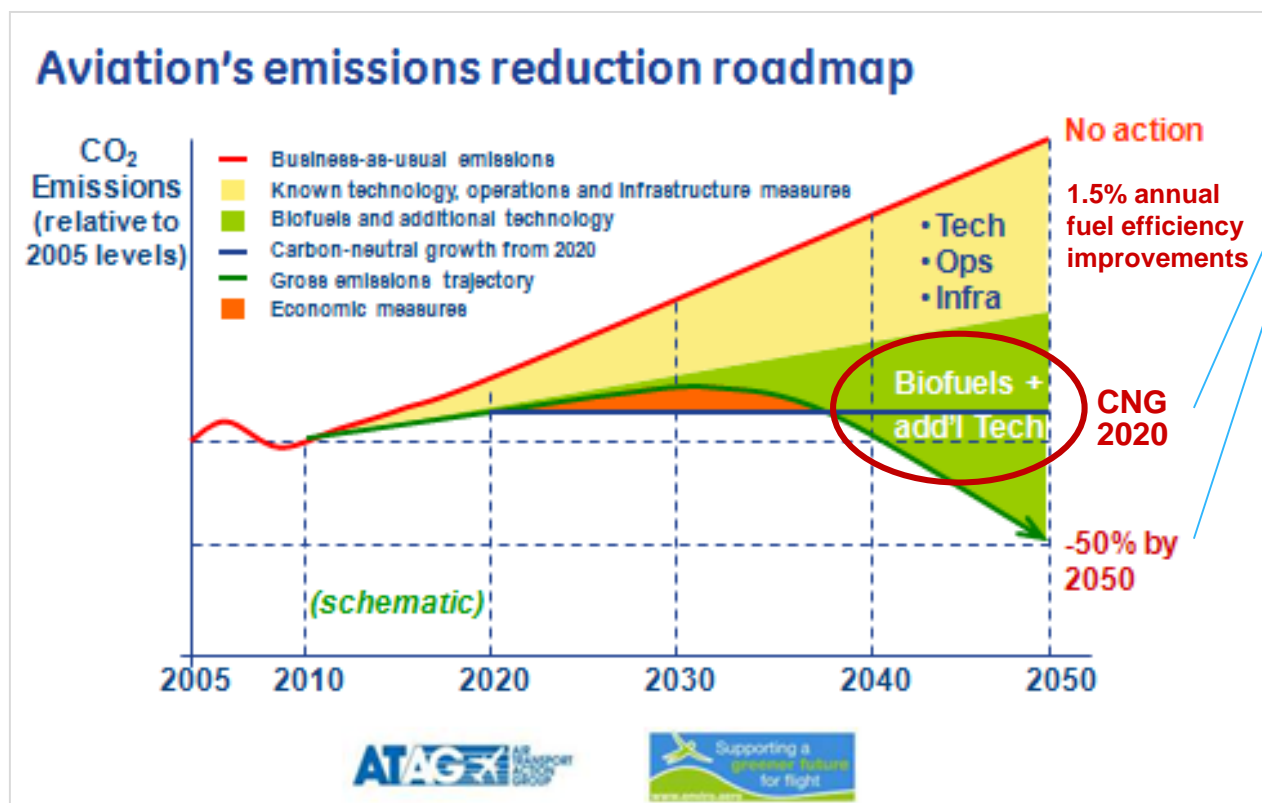
First flight from continuous commercial production of SAJF, 10Mar'16. Fuel from AltAir Fuels, Paramount, CA (HEFA-SPK 30/70 Blend). Now being delivered to LAX fuel-farm for everyone's upload

12Jul'17

Commercial Aviation's CO₂ commitments

To decouple carbon growth from demand growth

SAJF a key component of GHG containment strategy



These 3 industry commitments are currently being converted into regulation through an ICAO/CAEP “basket of measures”:

- * CO₂ Standards
 - * CORSIA MBM – will monetize carbon
- Similar commitment from BizAv & DOD

Why Aviation cares about SAJF

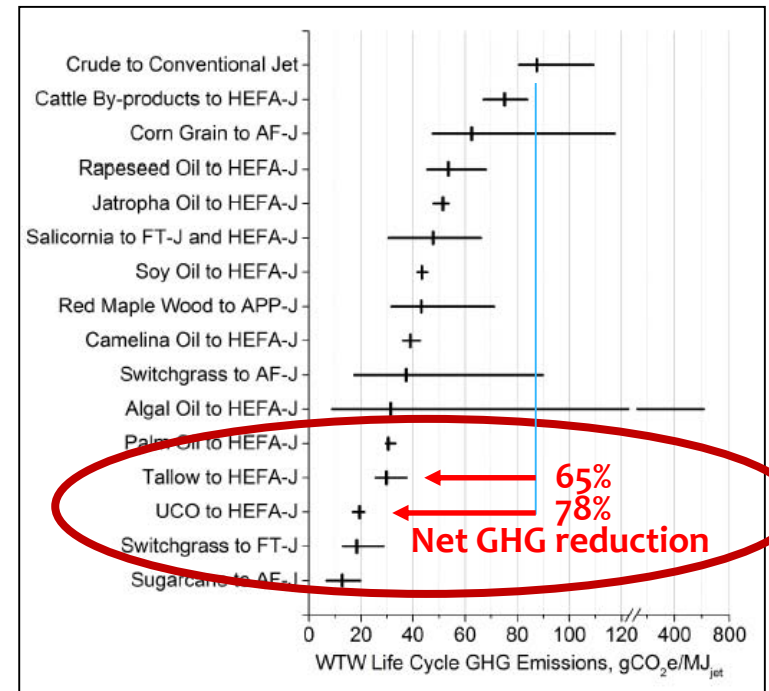
Sustainable Alternative Jet Fuel, a.k.a. biofuel, biojet

Aviation commitments

- * **Decouple carbon growth**
- * **No other viable options !**

Industry alignment on SAJF value proposition

- * **Net carbon relief !**
- * **Supply surety, Price stability**
- * **Energy security**
- * **Lower “criteria pollutants”**
- * **Improved energy mass density**
- * **Minimal infrastructure impact**



SAJF works! Challenges, yes ... but abundant options!

- * **Multiple feedstocks, conversion technologies, entrepreneurs**

Going forward

- * We will continue to need jet fuel for several decades, and our demand is growing
 - * Other transport fuel sectors at start of significant flux
- * Established that SAJF is viable as drop-in
- * Making progress with multiple feedstocks, conversion processes, producers
- * SAJF is challenged by higher production costs than petro-jet at today's oil price

Move forward by leveraging additional adjacencies

SAJF Adjacency benefits!

Informed by our work of the last decade

- * **Enable improved sustainability of a key societal need:**
 - * **Safe, efficient, high-speed, long-range transport of people and goods**
- * **Contribute to the stability & growth of two sectors critical to U.S. GDP and balance-of-trade:**
 - * **Agriculture / Silviculture**
 - * **Aviation Equipment**
- * **Precipitator for bio-based byproduct expansion**
- * **Rural economic development & Enviro Services**

SAJF Benefits!

Environmental Services - Purpose-grown feedstocks

Created through use of cover crops, dual-cropping, coppices, buffers, off-season rotationals, perennials, forest management, ...

- * Improvements in biodiversity
- * Enhanced pollinator health
- * Reduction in nutrient leaching – improvement in water quality
- * Reduced wind and water erosion (from fallow exposure)
- * Weed and pest control - Reduction in herbicide and pesticide use
- * Soil carbon sequestration
- * Soil remediation, soil restoration

SAJF Benefits!

Environmental Services – Other hydrocarbon feedstocks

Created through utilization of waste streams, byproduct streams, or recycling

- * Reducing landfill usage, and its subsequent environmental challenges
- * Enhancing rates of recycling for valued resources
- * More appropriate manure management
- * Nutrient recovery, and enhanced water quality
- * Direct CO₂ recovery, and/or Capture of other GHG gases

SAJF Benefits!

Economic & Rural Development

- * **Direct, Indirect, and Construction jobs**
 - * Distributed broadly, many in proximity to the feedstocks
 - * Similar to results demonstrated by EtOH, bio-diesel and HDRD industries
 - * Farm, storage, transport, pre-processing, processing, distribution, ...
- * **Production of industrial equipment**
- * **Incremental farm and forestry revenue while mitigating other costs**
- * **Re-utilization of marginal lands**
- * **Improving efficiency through intensification**
- * **Yield enhancements**
- * ...

SAJF Opportunities!

Utilization of life's ubiquitous "waste streams"

* MSW



* Sanitary waste

* Food production waste

* Ag residues

* Food processing residues

* Manure / bedding

* Industrial waste

* Off-gasses

* Lipid / Sugar / Lignocellulose

Initial Results

Wet WtE resources have the equivalent energy content of about one quad or 7 billion diesel gallon equivalent (DGE) per year.

• Wet WtE resources include:

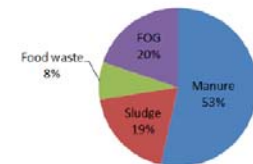
- Animal manure
- Fats, oils, and greases (FOG)
- Wastewater sludge
- Food waste

• **About half of this potential is generated by animal manure**

• Food waste, while relatively small at the national level, may be an important blending agent in highly concentrated locations.



Wet WtE Resource Potential



Milbrandt et al. 2017. Pending publication. *Biomass and Bioenergy*.

5 | Bioenergy Technologies Office

U.S. DEPARTMENT OF
ENERGY | Energy Efficiency & Renewable Energy

SAJF Opportunities!

Lipids potentially enabling of significant production ...

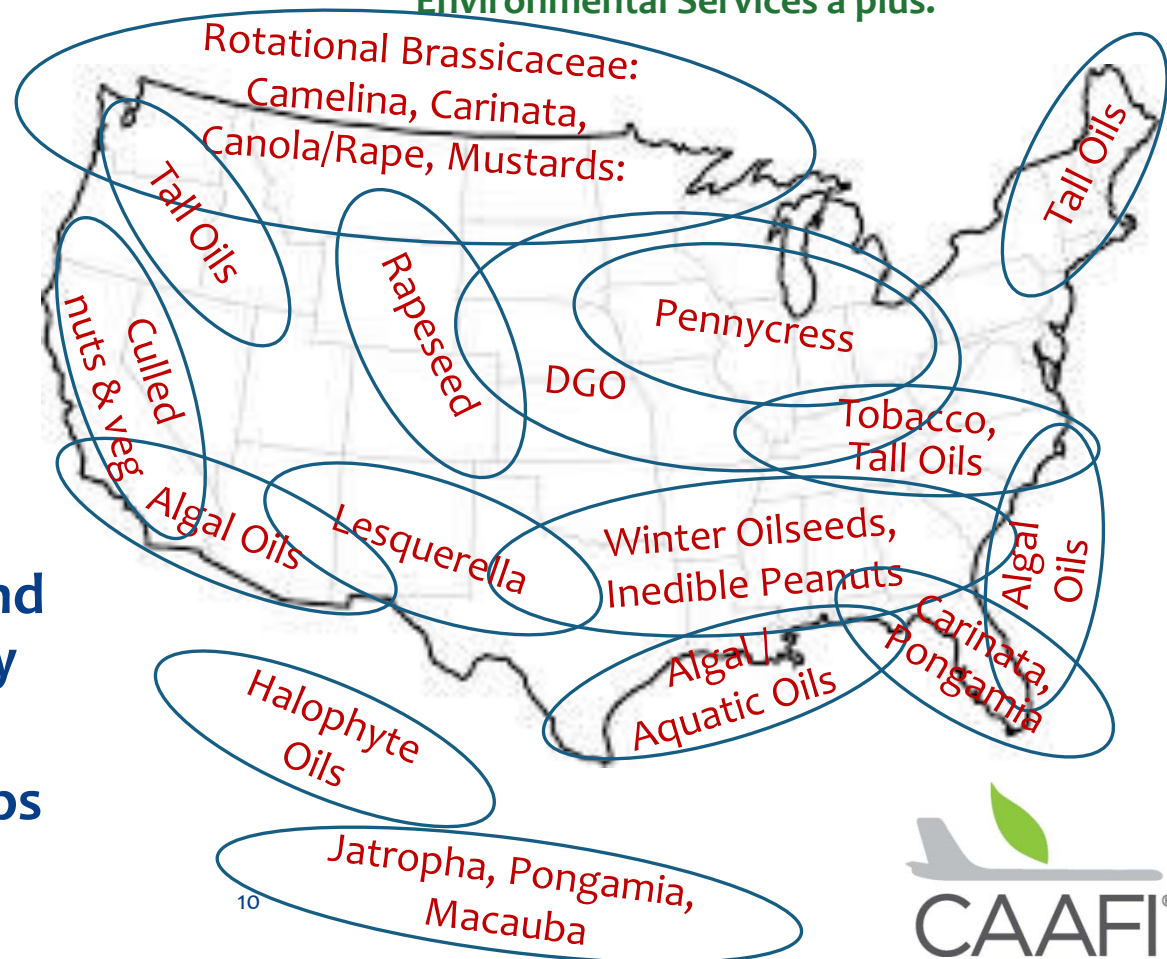
Multiple:

- * Conversion processes
- * Feedstock developers
- * Producers
- * Low LUC/ILUC agri-based feedstocks
- * Waste F.O.G.
 - * White Grease, Poultry Fat, Tallow
 - * UCO / Yellow Grease
 - * Brown Grease, Biosolids

Easier supply chain scale-up leveraging biodiesel and HDRD production capacity

Lowered H2 cost & availability (from NG) helps

Targeting most sustainable solutions:
Low, or Zero, impact LUC/ILUC & F-v-F solutions;
Environmental Services a plus.



SAJF Opportunities!

- * Leverage the biosciences to improve biomass and biochem processing to bring down cost
- * Enable a major play for biochar: for soil amendment and carbon sequestration
- * Addressing other major challenges:
 - * Replacements for blighted citrus
 - * Reducing import of rubber via domestic sources
 - * Impact of paper decline on forestry holders
 - * Introduce oilseeds with improved oil/protein yield
 - * Soy – introduced to US in 1765, only productionized since 1930
 - * Canola – double negative cultivar of rape, productionized in 1980

Summary

- * **It's not difficult to create the value proposition**
 - * **Certainly more success examples would help**
 - * **Monetization of the benefit is often lacking**
- * **The bigger challenge is in effectively communicating the value proposition in a manner that facilitates action, in the face of:**
 - * **An incumbent, threatened industry**
 - * **A non-level policy playing field**
 - * **Active social apathy**
 - * **Disinformation, or lack of agreed information**
 - * **Infighting within the renewable industry**

Food for thought

American Petroleum Institute



The American Petroleum Institute is the largest U.S. trade association for the oil and natural gas industry. It claims to represent about 650 corporations involved in production, refinement, distribution, and many other aspects of the petroleum industry.



Official website



Wikipedia



LinkedIn

Founded: Mar 20, 1919

Tax ID: 13-0433430

Assets: \$128.27 million USD

Income: \$334.18 million USD

Headquarters: Washington, D.C., United States

CEO: Jack Gerard (Since 2008)

- Vs -

American Bioeconomy Institute ?



A very broad group of people focused on improving the economic, social, and environmental sustainability of society!

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