BIOMASS 2012

Aviation Bio-fuels: Are You Getting On Board

July 11, 2012

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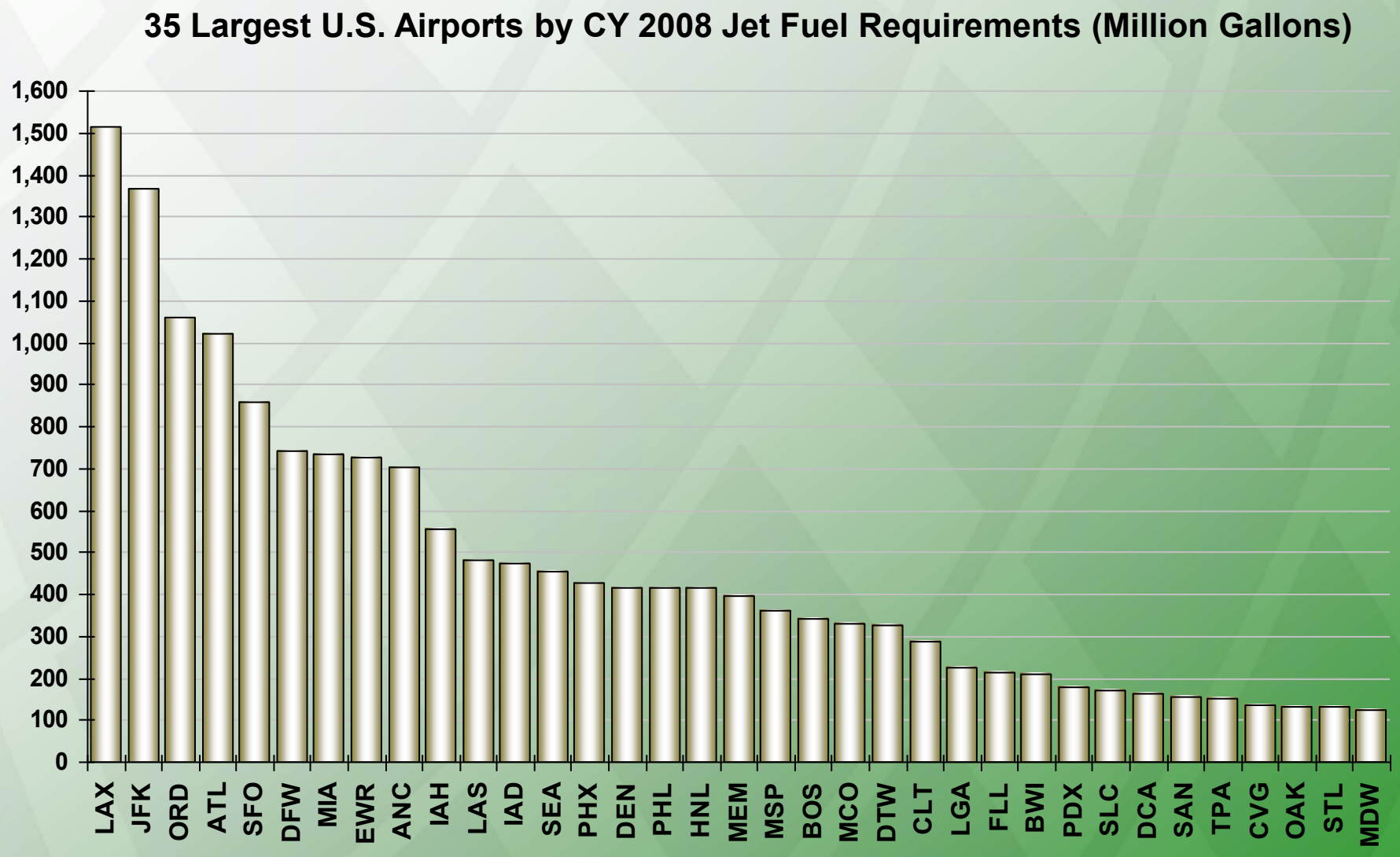
UNITED

Aviation is a Ready Made Market for Bio-Fuels.

- Highly concentrated demand nodes
- Highly concentrated users
- Aviation has no alternative source of energy
- Economic benefits
- No changes needed for airplanes/airports/pipelines
- Environmental benefits

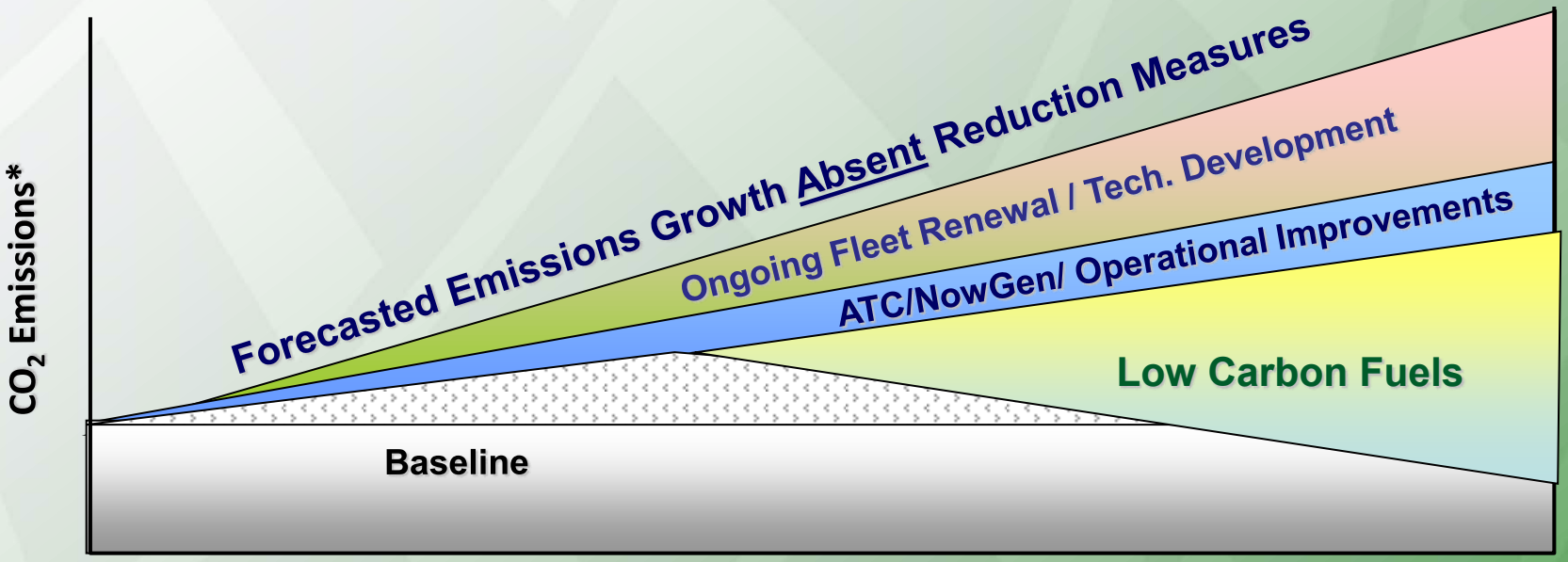
Concentrated Demand – 85% of Fuel at 35 Largest Airports



Jet Fuel Distribution Infrastructure Already in Place

Approximately 90% of Jet Fuel Uplifted at U.S. Airports Moves Via Pipeline

Aviation Taking Action on CO_2



Carbon-Neutral Growth and Reduction Timeline **2050**

- United worldwide – global sectoral approach
- Sustainable bio-fuels a key part of the solution

Low-Carbon Fuels Critical to Voluntary Environmental Commitments of Worldwide Aviation Industry

1. Improve fuel efficiency by 1.5% p.a. in 2009-2020
2. Achieve carbon-neutral growth ("CNG") from *2020*
3. Reduce sector emissions by 50% from 2005 to

Airline Criteria for Alternative Fuels

- Reliable (Must meet ASTM Fuel Specifications)
- “Drop-In” Fuel
- Cost Competitive
- Environmentally better than conventional jet on an LCA basis

Many Sustainable Biofuel Test Flights Conducted

Feb. 2008

Virgin Atlantic
Coconut and Babassu

Dec. 2008

Air New Zealand
Jatropha

Jan. 2009

Continental
Algae and Jatropha

Jan. 2009

Japan Airlines
Camelina, Jatropha, Algae

Apr. 2010

F/A-18
Camelina

Extensive Laboratory and Ground Tests Completed

United performed the first commercial flight using bio-fuels in the US on 10/31/2011

Commercial Off-take Agreements Key to Progress

- A4A Airlines Jointly Executed LOI's

Rentech - Fischer-Tropps	ULSD/Jet	Municipal Waste /Woody Bio-mass
AltAir- HEFA	Jet	Camelina/Tallow
Solena- Fischer-Tropps	Jet	Municipal Waste

Commercial Off-take Agreements Key to Progress

- United Executed LOI's

Solazyme – HEFA	Jet	Plant Starch /Sugars/Algae Oil
GEVO – ATJ	Jet	Corn/Cellulose
Imperium- HEFA/ATJ	Jet	Seed oils/Cellulosics
Fuel Supply Agreement		
XXXXX- HEFA	Jet	Tallow/Oil Seed

The Collective Goal is to Minimize Risk for All Involved

1. Construction – what is cost and time to complete?
2. Technology – what if the technology does not work, or if it fails to yield the promised production efficiency?
3. Feedstock – was it available at any cost, let alone at the presumed cost?
4. Policy – if the project's viability depends on government policy/assistance, will that policy remain constant throughout the facility's economic life?
5. Financial – were the economic assumptions (e.g., cost of debt and equity, cost of production, selling price of all of the fuel products) realized?
6. Engineering – was the engineering and design of the plant appropriate?
7. Management – what experience does management have and what happens if it proves inadequate for the task?

Airlines Programs to Mitigate Financial Risk While Supporting Commercialization

- Off-take agreements with multiple parties
- Cost plus contracts with caps & floors
- Contracts indexed to conventional fuel prices
- Fixed price contracts with reduction for incentives that are then shared.
- Warm idle option – cover debt costs, when feedstock costs prevent fuel from being competitive
- Options to pursue other markets when feedstock costs make fuel too expensive relative to conventional

Programs Being Employed to Achieve Price Targets

- RIN's – Renewable Identification Number (EPA program to incentify production of low carbon fuels
- Use fuel on EC Flights
- Off-take agreement to reduce financing costs
- Credit Bio-fuel with the value of petroleum hedge
- Utilize airline owned storage assets to blend fuel
- Increase Scale.

The Midwest Aviation Sustainable Biofuels Initiative (MASBI) Overview

The purpose of MASBI is to bring major stakeholders together from across the biofuels supply chain to generate regional economic growth through the development of an advanced biofuels market for the aviation industry

Goals

- Commercialization of aviation biofuels in the Midwest region
- Economic development, job growth, and workforce development
- Establish Midwest as a clean energy focus in the nation
- Leverage existing incentives and programs

Output

- Regional feasibility study on Midwest potential in aviation biofuels
- Regional roadmap and action plan for market development

Scope and Duration

- 9-12 months with four stages of activity: stakeholder engagement, research, report drafting, synthesis and promotion
- Program Manager
- Stakeholders may collaborate on completion of the study acting on recommendations made

MASBI
Midwest Aviation Sustainable Biofuels Initiative

Stakeholder Organization

Boeing, UOP
Honeywell, O'Hare, Clean Energy Trust

Steering Committee

- Sets direction and goals of project and are responsible for its success
- Highest investment of time and resources
- Primary funders of stakeholder process
- Signs contract of participation

Federal Agencies,
NGOs, and Academic Institutions

Advisory Committee

- Comprises ~15 members from airports / city governments, federal agencies, academic institutions, and NGOs
- Develops integrated strategy and recommendations, synthesizes research output
- Signs advisory committee contract of participation
- No fee

Stakeholder Network

~40 participants

- Larger body of participants that provide industry specific point-of-view, develop research and participate in meetings
- Selected and invited by Steering Committee
- Revenue generating organizations fee to participate ~$5,000; NGO & government entities free participation
- Signs contract of participation

Funds provided by stakeholders will directly cover the costs of the initiative including the Program Facilitator expenses, website development, report production, meetings, etc.

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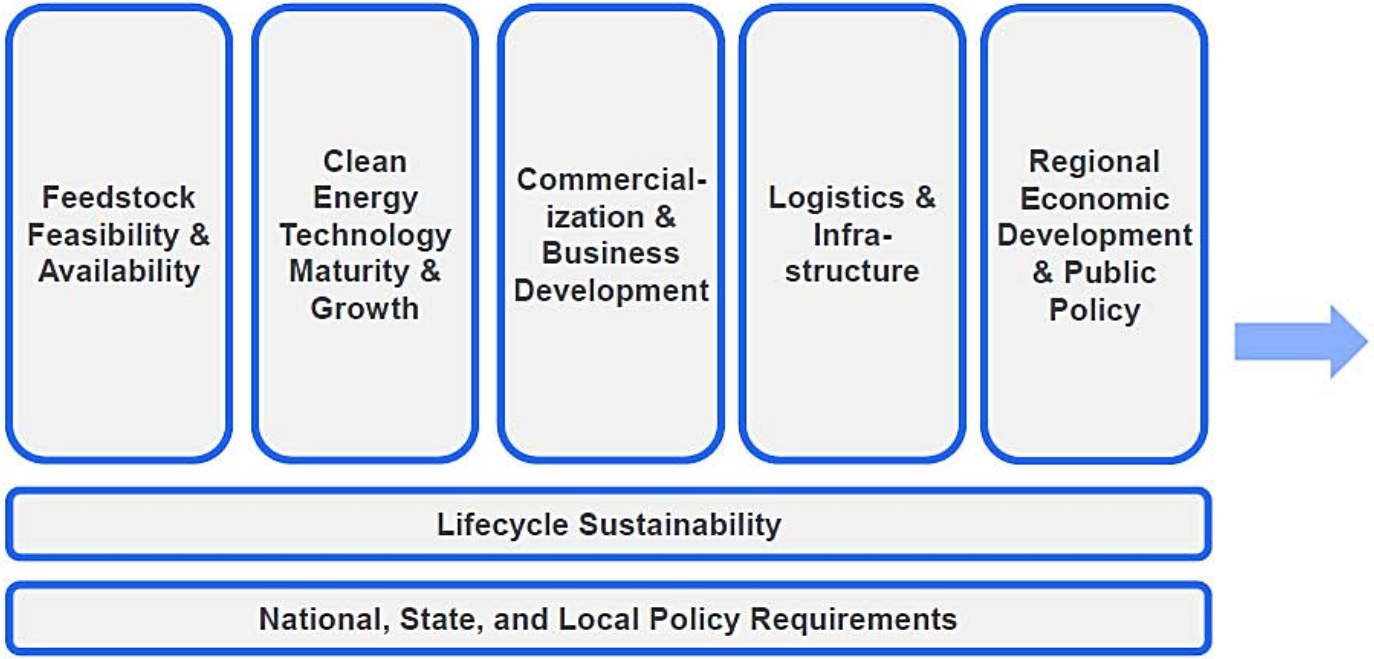
MASBI Value Chain and Outcomes



MASBI Outcomes

1. Sustainable Aviation Fuel Supply
2. Economic Growth and Tax Revenue
3. Job Creation
4. Climate Change Impact Reduction

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Illustrative Value Chain of Stakeholders

Research Focus of Working Groups

WG	Goal	Research Focus	Steering Committee Lead
I	**Determine availability & development potential of feedstock in the Midwest**	• Existing levels of feedstock production, including first and second generation • Feedstocks with most potential • Historical and predicted commodity pricing trends	Boeing
II	**Assess clean energy technology maturity & growth potential in the Midwest**	• Inventory of current biotech companies • Technologies demonstrating the most potential • Inventory of technologies seeded at academic institutions	UOP Honeywell
III	**Assess funding availability & cost effective business model development**	Demand evaluation: • Level of demand for Midwest biofuels • Origination of demand • Demand seasonality and influential factors Funding streams: • Sources of private investment • Barriers to increased investment • Types of funding needed to mature companies	United Airlines
IV	**Assess infrastructure development needed to create a viable Midwest aviation biofuel economy**	• Regional infrastructure needs to support desired/anticipated market growth • Regional refining capacity	City of Chicago Department of Aviation / O'Hare
V	**Assess regional economic impact & policy mechanisms needed to incentivize market development**	• Policies in other areas that could serve as a model • Regional economic impacts of a developed biofuel industry • Potential for job creation and new company growth • Ripple effects onto supporting industries	Clean Energy Trust

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Areas of Recommendations Expected

The regional initiative would seek to identify:

- Commercialization initiatives
- High potential pilot or demonstration projects
- Promising local feedstocks and technologies
- Promising research and development efforts at Midwest research centers
- Supply chain gaps or barriers to growth that could be removed with better funding or policy
- Policies and funding incentives that encourage market growth that are currently in place and also in need of being developed

…that could be pursued following successful launch and completion of the feasibility study and action plan

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