



Findings & Recommendations

2013



“Advanced biofuels are important to the aviation industry’s sustainability, both as a way to diversify our fuel supply and lower our carbon footprint. Development of this new, clean energy industry drives innovation in the American economy, benefits the environment, creates jobs, and strengthens the communities we serve.”

– Jimmy Samartzis, United Airlines

The U.S. military and commercial aviation industry together consume more than 20 billion gallons of jet fuel a year. Nearly three billion gallons are consumed by airlines in the Midwest. The cost of jet fuel has more than tripled since 2000, and jet fuel demand in the Midwest is expected to increase by 9% by 2020. For every 5% of Midwestern petroleum jet fuel that can be replaced by biofuels, approximately 3,600 jobs will be created and an estimated 700,000 tons of carbon dioxide on average will be avoided annually.

FOREWORD

MASBI found that a coordinated effort by both private and public interests would be one of the most effective ways to move the Midwest biofuels industry forward and take a pivotal step toward diversifying the nation’s energy supply.

We are proud to release our final report of the Midwest Aviation Sustainable Biofuels Initiative (MASBI). This has been a year-long collaboration that brought together experts representing the entire aviation biofuels value chain from over 40 different public, private, and non-profit organizations. This report highlights an action plan to accelerate the commercialization of biofuels for aviation.

The journey to develop an aviation biofuels industry began in 2006. Aviation is interested in the development of alternatives to petroleum-based jet fuels to address its largest operating cost and most significant impact on the environment. Progress has been achieved in certifying conversion technologies, proving advanced biofuel use in aircraft, and developing sustainability standards. However, significant challenges remain in achieving commercial-scale production of aviation biofuels at prices that airlines can afford to pay.

The benefits of building this industry extend beyond aviation. Developing a commercial market for aviation biofuels has the potential to create jobs, generate economic growth, further contribute to U.S. innovation, and fulfill the nation’s energy security needs.

Commercial aviation in the Midwest consumes nearly three billion gallons of jet fuel per year and has an established infrastructure in place for the efficient delivery of aviation fuels. The Midwest boasts a rich history of agricultural development, clean technology innovation, research institutions, and a vibrant investment community. Midwest governments and policymakers have recognized the importance of the advancement of the biofuels industry. These factors combined highlight the region’s potential.

The recommendations of the MASBI report, if enacted, will accelerate the development of this industry.



Sincerely,

MASBI Steering Committee Members


Jimmy Samartzis



Billy Glover



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A Honeywell Company


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OVERVIEW

The Midwest Aviation Sustainable Biofuels Initiative (MASBI) is an effort by 40-plus organizations across the aviation biofuels supply chain to develop recommendations to achieve the potential economic, environmental, and energy security benefits that can be delivered from a robust sustainable aviation biofuels industry in the Midwest.

MASBI was led by United Airlines, Boeing, Honeywell's UOP, the Chicago Department of Aviation, and the Clean Energy Trust. In addition, Argonne National Laboratory chaired an Advisory Council, which included government agencies and non-profit institutions. This summary outlines the initiative's key findings and recommendations to develop this industry while also considering environmental, social, and economic sustainability. This initiative, the result of a yearlong study by MASBI researchers, builds on crucial steps taken by the industry since 2006 that have resulted in approved pathways, drop-in fuels, certification to fly aircraft commercially powered by advanced biofuels, and more than 1,500 completed commercial flights to date.

With its significant airline presence and agricultural resources, the Midwest holds the promise of potentially contributing to advancements in the aviation biofuels industry. Aviation, feedstock, technology, academic, and policy stakeholders in the Midwest are taking coordinated action to influence the development of this industry. A commercial aviation biofuels industry will result in substantial benefits to the region, country, and the

aviation industry as a whole. As the Midwest consumes nearly three billion gallons of fuel per year, for every 5% of petroleum jet fuel that can be offset by biofuels, nearly 3,600 jobs will be created and 700,000 tons of carbon dioxide emissions will be avoided annually. MASBI's recommendations, summarized below, are important next steps that can propel the aviation advanced biofuels industry toward generating some of the nearly 20 billion gallons of jet fuel required to support U.S. commercial aviation.



RESEARCH AND DEVELOPMENT (R&D)

There has been substantial private and public investment in agricultural R&D. Work has included fundamental understanding of crop properties and their interaction with the environment. This ongoing R&D effort enables a highly productive farm sector to support growing food and feed demand. Agricultural products R&D has also supported the growth of a mature first-generation biofuel industry of ethanol and biodiesel. To address the technical requirements for drop-in aviation, marine, and diesel fuels sustainability criteria, there has been a growing amount of public and private R&D investment in biomass conversion that is capable of producing renewable fuels that are molecularly identical to conventional fuel products.



Oil seed crops naturally produce oils that are chemically predisposed for the production of diesel fuel, thereby requiring additional steps in production and cost to produce jet fuel. The opportunity exists for R&D investment in designing oil seeds that would produce a suitable feedstock for aviation biofuels, thereby reducing production complexity and cost.

The market for blending ethanol with gasoline is nearing the 10% blend wall, thus saturating the gasoline market. This is increasing interest in converting biomass to advanced biofuels such as diesel and jet fuel. The U.S. boasts significant agricultural resources that can contribute to lignocellulosic fuel production, but that are dependent on technology advancement and certification.

RECOMMENDED ACTIONS

1. Improve feedstock production capacity through agricultural innovation. Identify and promote potential additional biofuel production capacity generated by increased yield due to breeding and innovative planting, such as crop rotation, and double and cover cropping with crops such as camelina, which can be produced between food crop rotations.

- 2. Tailor feedstocks to jet fuel.** Develop advanced feedstocks tailored for jet fuel production, including the development of an oil seed crop with chemical properties predisposed for jet fuel production.
- 3. Investigate the impacts of uncertainty on production.** Investigate the effects of uncertain conditions, such as changing policy, weather, seasonal intermittency, and co-products on the techno-economic performance of conversion technologies.
- 4. Advance technologies to convert lignocellulosic biomass.** Biomass made up of lignin, cellulose, and hemicellulose (wood, residue biomass such as corn stover) is a very large-volume sustainable feedstock source. Increase investment in bio/catalytic pathways to produce jet fuels from depolymerized biomass, cellulosic sugars, or simple alcohols.

PRODUCTION

The Midwest is home to a robust and growing refining technology industry for both conventional and alternative fuels and has been instrumental in developing and bringing to market promising new technologies. Small, distributed production offers a path to commercialization that reduces risk and increases opportunities for commercial success. However, the approval of new fuels is lengthy and costly, creating an economic barrier to entry for new technologies.

For some technology pathways, there are strong economic drivers initially to produce personal care items, chemicals, and surface transportation fuels, rather than renewable jet fuel, which can be lower-margin but is particularly attractive because of its concentrated buyers and high-volume demand. These markets present opportunities rather than challenges as producers refine their technology, feedstock supply, and production while achieving profitability.



“ The Midwest is a vital contributor to the nation’s economy and the global air transport system. Developing sustainable new energy sources for aviation provides economic opportunities and builds on the region’s legacy of leadership. ”

– Billy Glover, Boeing

“ We are fortunate to have the engagement of commercial leaders interested in building a supply chain for sustainable jet fuel. This is an important emerging industry for the Midwest that can be a significant economic driver for decades to come. ”

– Amy Francetic, CEO, Clean Energy Trust





With upstream blending and existing petroleum infrastructure, there are sound logistics in place in the Midwest to support the development of this industry. The existing infrastructure allows for a relatively quick and cost-effective integration of biofuels into the logistics network.

➤ RECOMMENDED ACTIONS

- 5. Identify means to expedite approvals by the ASTM International and the Environmental Protection Agency.** For the former, identify means to speed up the process in critical areas, such as generation of test data to evaluate the performance of proposed fuels and engine testing. Expediting this can speed up time to market of new conversion technologies.
- 6. Allow producers to optimize product portfolios.** The production of renewable diesel as part of the refiner's product portfolio should be fully supported, allowing for improved renewable jet fuel supply and improved overall economics of biofuel production.

FINANCING

Feedstocks are the largest contributor to cost and are the primary sustainability driver in biofuel production. Current prices are too high for cost-competitive aviation biofuel production. New crops developed for advanced biofuels face challenges for adoption and scalability, but have the potential to reduce feedstock costs in the long run. Additionally, primary food crops have an economic advantage over many energy crops, helping to protect food supply. New feedstocks are expected to complement food crops, be used as rotational crops, or begin as waste streams.

Given the current market prices for feedstocks, government policies are necessary for the development of the renewable jet fuel industry. Institutional investment in biofuels has decreased and, due to policy renewal and uncertainty surrounding the possible sunset of tax incentives, investors devalue government credits when calculating returns. As a result, they perceive the industry to be high risk, requiring greater returns on investment. More direct involvement by the aviation community as a strategic partner in commercial opportunities likely will help win institutional backing in the early years of the industry's development.

➤ RECOMMENDED ACTIONS

- 7. Balance risk and reward for early adopters of technology.** Aviation biofuel is technically ready to scale commercially. At this early stage of development, stakeholders should consider entering agreements with the aim to balance risks with partners, thereby accelerating the rate of industry growth. For example, airlines could consider innovative pricing structures and long-term off-take agreements, investors could require lower cost of capital on investments, feedstock providers could enter into long-term supply agreements with better than market pricing, fuel producers could consider alternative margins, and refiners could consider slightly higher volumes of jet fuel. If all stakeholders are willing to compromise and consider the needs of partners, the industry will reach its potential sooner.
- 8. Demonstrate industry demand with aviation jet fuel purchase guidelines.** Aviation stakeholders operate within a constrained operational and economic environment. Likewise, producers have their own sets of constraints. Each side is frequently unaware of the limitations of the other. Aviation industry stakeholders could articulate a series of purchase guidelines to initiate and inform discussions that would result in both sides setting respective parameters and identifying places of overlap where their commercial needs meet.



9. Create a pool of capital to invest in biofuels.

Private financiers are either reluctant to finance biofuel projects or require rates of return that are too high. Aviation industry stakeholders could collaborate with other advanced biofuel consumers, including government or commercial entities, to develop structures allowing for efficient capital raising and vertical integration, such as investment in the biofuel supply chain.

POLICY

Current biofuel policy measures are often short term and don't address fundamental inequities in the treatment of fossil fuels and biofuels. Biofuels production relies on long-term capital-intensive investment. Government policy must complement this private investment by providing long-term, reliable market signals as the industry grows to commercial scale.



➤ RECOMMENDED ACTIONS

- 10. Create longer-term policies that enable investment and production.** Create a stable long-term policy environment, which is critical for the development of the renewable jet fuel industry and to encourage investment.
- 11. Level the playing field.** The fossil fuels industry has relied on and continues to receive government subsidies, policies, and support that foster growth. The aviation biofuels industry should be afforded similar opportunities for growth. For example, allow master limited partnerships (MLP) for renewable jet fuel, which are currently limited to the conventional petroleum industry.

12. Fully fund the Defense Production Act Title III for the production of biofuels.

Government action to develop new sources of energy has historically been an effective approach. The U.S. government and in particular the U.S. Navy has been instrumental throughout its history in transitioning from wind to coal to nuclear energy. The U.S. Government's effort to support aviation and marine advanced biofuels is important, and the Defense Production Act Title III program sponsored by the U.S. Departments of Agriculture, Energy, and Navy should be fully funded.

13. Build regional demonstration facilities supported by municipal and state policy.

In the short term, focus biofuel development on smaller facilities that will not exhaust local feedstock supply. Simultaneously, leverage coordinated municipal, state, and national policies to maximize opportunity. For example, allow state bonds to be sold to support the construction of production facilities.

SUSTAINABILITY

Reduced carbon and particulate emissions are a major potential benefit of advanced biofuels when compared to petroleum. However, to realize these positive externalities, biofuels must be produced in a sustainable way. If production is not carried out with sustainability at the forefront, the desired environmental benefits may be lost or minimized, and the resultant fuel may drive negative impacts.

➤ RECOMMENDED ACTIONS

- 14. Incorporate sustainability standards and advance certification.** Ensuring sustainable production of biofuels is critical to the integrity of this industry, and incorporating sustainability criteria and standards is the responsibility of all its participants, from feedstock providers and fuel producers, to airlines and governments. These criteria should be consistent with, and complementary to, emerging internationally-recognized standards, such as those being developed by the Roundtable on Sustainable Biomaterials. Third-party certification also could help ensure that greenhouse gases, land use, water use, and other sustainability criteria are appropriately considered.

MASBI participants are diverse and cover the entire value chain.

Steering Committee



- Iowa Farm Bureau Federation
- Midwestern Governors Association
- National Wildlife Federation
- Natural Resources Defense Council
- Ohio Aerospace Institute
- U.S. Department of Agriculture
- U.S. Department of the Navy
- World Wildlife Federation

Stakeholders

- Air BP
- Airlines for America
- Buckeye Partners
- Cleveland Airport
- Elevance
- Fredrickson & Byron P.A.
- Gas Technology Institute
- GE Aviation
- Gevo
- Global Clean Energy Holdings
- Iowa State University
- Kansas Alliance for Bioenergy
- Kansas State University
- LanzaTech
- Magellan Pipeline
- Metron Aviation
- Monsanto
- Northwestern University
- Paradigm BioAviation LLC
- Purdue University
- Renewable Energy Group
- SkyNRG
- Solazyme
- Sun Grant Initiative/SDSU
- University of Illinois
- University of Nebraska-Lincoln
- Virent
- Western Illinois University

Program Manager



Advisory Council



- Algal Biomass Organization
- Carbon War Room
- Clean Air Task Force
- Civic Consulting Alliance
- Commercial Aviation Alternative Fuels Initiative
- Consumer Energy Alliance
- Environmental Law and Policy Center
- Federal Aviation Administration
- Illinois Farm Bureau Federation

Observers

- Illinois Department of Commerce
- Illinois Governor's Office
- Stern Brothers

* Advisory Council members advised and informed the Steering Committee and Stakeholders on, among other things, existing policy, funding options, and environmental topics related to MASBI. Their involvement does not represent their explicit support of the recommendations, nor their advocacy of specific policy recommendations. All participants are dedicated to and fully supportive of the development of a sustainable commercial aviation biofuels industry in the Midwest.

* Stakeholders participated in the workshops and contributed their high-level knowledge, including their particular expertise, in at least one MASBI Work Group, and contributed to the development of findings and recommendations included in the MASBI final report.

“ Building on the strengths and resources available in the Midwest, and with the continued efforts of our partners, this region can chart the course for sustainability leadership in the aviation industry. ”

– Jim Rekoske, Honeywell’s UOP

“ As the aviation industry plans for future growth, sustainability must be considered every step of the way. Advances in aircraft technology and sustainable biofuels will position our industry to reduce emissions while maintaining a competitive advantage. ”

– Rosemarie S. Andolino, Chicago Department of Aviation



Midwest Aviation
Sustainable Biofuels Initiative

www.masbi.org

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