Sustainable Aviation Fuel (SAF): In Brief

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Introduction

Within the last year, multiple commercial airlines have announced sustainable aviation fuel (SAF) purchase agreements.[1] Airlines report they are purchasing SAF, in part, to "address the climate crisis" and to comply with international standards that would reduce the aviation sector's carbon footprint.[2] SAF—in short, sustainable fuel (e.g., advanced biofuel) used for aircraft—production is limited.[3] As such, airlines and others have requested federal assistance to spur SAF development and adoption.[4]

Both Congress and the Executive Branch have taken action to support SAF. Legislation pertaining to SAF (e.g., S. 4038, S. 2263, and S. 1608) has been introduced in the 117th Congress. In addition, the Build Back Better Act as passed by the House (BBBA; H.R. 5376) would establish a SAF tax credit, among other things. Congress has previously supported SAF. For example, renewable jet fuel is an approved fuel that may be used to meet the annual Renewable Fuel Standard (RFS) mandate.[5] Moreover, in September 2021, the Biden Administration established a Sustainable Aviation Fuel Grand Challenge "to inspire the dramatic increase in the production of sustainable aviation fuels to at least 3 billion gallons per year by 2030," among other things.[6]

This report discusses SAF—what it is, potential challenges and opportunities for adoption, production and cost, stakeholder positions, selected legislation that would support SAF including tax incentives, and other issues for Congress.

Sustainable Aviation Fuel (SAF)

The U.S. Department of Energy (DOE) defines SAF as "a biofuel used to power aircraft that has similar properties to conventional jet fuel but with a smaller carbon footprint."[7] For use in civil aircraft, SAF must adhere to certain aviation fuel technical international standards, including ASTM D7566-21 and ASTM D1655-21c.[8] The ASTM D7566 standard allows for the blending of

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[1] Phil Rosen, "Delta, JetBlue, United Give Sustainable Aviation Fuel a Lift," GreenBiz, October 19, 2021, https://www.greenbiz.com/article/delta-jetblue-united-give-sustainable-aviation-fuel-lift.

[2] Airlines for America, "U.S. Airlines Announce 3-Billion-Gallon Sustainable Aviation Fuel Production Goal," September 29, 2021, https://www.airlines.org/news/u-s-airlines-announce-3-billion-gallon-sustainable-aviation-fuel-production-goal/.

[3] Catherine Boudreau and Stephanie Beasley, "Airlines Get Lift from Corporate Allies in Shift to Sustainable Fuels," *Politico*, May 4, 2021, https://www.politico.com/news/2021/05/04/airlines-corporate-sustainable-fuels-485320.

[4] Tom Otley, "Government Support Essential for Sustainable Aviation Fuel Goals: Delta CEO," *Business Traveller*, March 17, 2022, https://www.businesstraveller.com/business-travel/2022/03/17/government-support-essential-for-sustainable-aviation-fuel-goals-delta-ceo/.

[5] Environmental Protection Agency (EPA), Renewable Fuel Standard Program, "Approved Pathways for Renewable Fuel," https://www.epa.gov/renewable-fuel-standard-program/approved-pathways-renewable-fuel.

[6] The White House, "Fact Sheet: Biden Administration Advances the Future of Sustainable Fuels in American Aviation," September 9, 2021, https://www.whitehouse.gov/briefing-room/statements-releases/2021/09/09/fact-sheet-biden-administration-advances-the-future-of-sustainable-fuels-in-american-aviation/.

[7] Office of Energy Efficiency and Renewable Energy, Bioenergy Technologies Office, "Sustainable Aviation Fuels," https://www.energy.gov/eere/bioenergy/sustainable-aviation-fuels.

[8] ASTM International, "Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons," ASTM D7566-21, last updated July 15, 2021, https://www.astm.org/d7566-21.html; and ASTM International, "Standard Specification for Aviation Turbine Fuels," ASTM D1655-21c, last updated December 15, 2021, https://www.astm.org/d1655-21c.html..

up to 50% of bioderived components in SAF.[9] There are seven technology pathways allowed under ASTM D7566, each with their own maximum blend limit, which can range from 10-50%.[10] SAF co-processing—the simultaneous processing of "renewable feedstocks with crude oil-derived middle distillates in petroleum refineries"—is allowed under ASTM D1655.[11] The ASTM D1655 standard currently allows "co-processing of up to 5% by volume of fats and oils" as feedstocks. The Federal Aviation Administration (FAA) reports an ASTM task force was formed to test an increase in co-processing feedstock blend from 5% to 30%.[12] Thus far, it is not clear if there will be a common fuel blend standard for SAF (e.g., E10—a fuel mixture consisting of 10% ethanol and 90% gasoline—for passenger cars).

SAF presents opportunities and challenges. Selected opportunities include that SAF is a "drop-in fuel" (i.e., compatible with existing engines and fueling infrastructure),[13] can be made from a variety of feedstocks,[14] and can have lower lifecycle greenhouse gas emissions than conventional jet fuel.[15] Selected challenges include SAF production cost, limited federal policies regarding its use, and a rigorous process needed to document its environmental impact (e.g., greenhouse gas emission reduction). There could be land use and feedstock implications if SAF production is encouraged, potential issues which might also be considered.

SAF Production and Cost

Limited information is available about SAF production. One source of information is the U.S. Environmental Protection Agency (EPA) public data for the RFS, which reports that approximately 5.1 million gallons of renewable jet fuel was accounted for in 2021 (under the biomass-based diesel pathway).[16] The U.S. Department of Transportation reports that U.S. carriers' domestic consumption of airline fuel was 9.9 billion gallons in 2021.[17] The FAA reported in March 2022 that there was one commercial U.S. SAF production facility in operation.[18]

[9] ASTM International, "ASTM Aviation Fuel Standard Now Specifies Bioderived Components," news release, July 1, 2011, https://newsroom.astm.org/astm-aviation-fuel-standard-now-specifies-bioderived-components.

[10] The International Air Transport Association (IATA), "Sustainable Aviation Fuel: Technical Certification," fact sheet, https://www.iata.org/contentassets/d13875e9ed784f75bac90f000760e998/saf-technical-certifications.pdf.

[11] Commercial Aviation Alternative Fuels Initiative (CAAFI), "Co-Processing Provision Approved and Added to ASTM 1655 Annex A1, Enables Renewable Feedstocks in Jet Fuel," news release, April 18, 2018, https://www.caafi.org/news/NewsItem.aspx?id=10408.

[12] Federal Aviation Administration, *Sustainable Aviation Fuels (SAF): Update to FAA REDAC E&E Subcommittee*, report to the FAA Research, Engineering and Development Advisory Committee, Subcommittee on Environment and Energy, PowerPoint presentation, March 22, 2022, https://www.faa.gov/sites/faa.gov/files/2022-03/508.20220322_1545_Brown_Oldani_SAF_Update_v04.pdf.

[13] Neste, "For the First Time, Sustainable Aviation Fuel Has Been Delivered to New York Using Existing Petroleum Pipelines," news release, June 15, 2022, https://www.neste.com/releases-and-news/renewable-solutions/first-time-sustainable-aviation-fuel-has-been-delivered-new-york-using-existing-petroleum-pipelines.

[14] Air Transport Action Group (ATAG), *Beginner's Guide to Sustainable Aviation Fuel*, Edition 3, November 2017, https://aviationbenefits.org/media/166152/beginners-guide-to-saf_web.pdf.

[15] U.S. Environmental Protection Agency, "Lifecycle Greenhouse Gas Results," https://www.epa.gov/fuels-registration-reporting-and-compliance-help/lifecycle-greenhouse-gas-results.

[16] U.S. Environmental Protection Agency, "RINs Generated Transactions," https://www.epa.gov/fuels-registration-reporting-and-compliance-help/rins-generated-transactions.

[17] Bureau of Transportation Studies, "Airline Fuel Cost and Consumption (U.S. Carriers—Scheduled), January 2000-May 2022," https://www.transtats.bts.gov/fuel.asp?pn=0&display=data4.

[18] Federal Aviation Administration, *Sustainable Aviation Fuels (SAF): Update to FAA REDAC E&E Subcommittee*, report to the FAA Research, Engineering and Development Advisory Committee, Subcommittee on Environment and

SAF production costs vary. The National Renewable Energy Laboratory (NREL) reports in its 2020 Transportation Annual Technology Baseline an alternative jet fuel price at $3.38-$5.63 per gasoline gallon equivalent (gge), and the conventional jet fuel price at $1.95/gge.[19] The U.S. Energy Information Administration (EIA) reports the annual spot price for kerosene-type jet fuel for the U.S. Gulf Coast region was $1.86/gallon for 2021 (the monthly spot price for May 2022 was $3.90/gallon).[20] In February 2022, the International Air Transport Association (IATA) noted that the price of SAF is "about two and a half times the price of jet kerosene."[21] There are numerous factors to consider when comparing the cost to produce conventional jet fuel with the cost to produce sustainable aviation fuel. DOE reports that "[p]ublic–private partnerships and collaborations across agencies may accelerate [SAF] cost reductions by ensuring a diverse set of stakeholders are involved early in the solution to ensure it can address barriers for industrywide use."[22] Lastly, it is not clear if the current rise in crude oil and petroleum product prices will affect production costs or increase cost competitiveness.[23]

SAF Stakeholders

Numerous parties may be interested in the various policy decisions related to SAF development and deployment. These stakeholders may include agricultural commodity groups (i.e., those that provide the feedstock), feedstock competitors (i.e., those that use the same feedstock to produce non-SAF products), SAF producers (i.e., those that produce the fuel), infrastructure facilities (e.g., pipeline companies, airports), SAF emission accountants, refiners, and others.

There are multiple SAF organizations with their own goals. For instance, under the First Movers Coalition, airlines commit to replace at least 5% of their conventional jet fuel demand with SAFs that reduce lifecycle GHG emissions by 85% or more when compared with conventional jet fuel by 2030, among other things.[24] The Clean Skies for Tomorrow Coalition exists, in part, "to advance the commercial scale of viable production of sustainable low-carbon aviation fuels (bio and synthetic) for broad adoption in the industry by 2030."[25] The Sustainable Aviation Buyers Alliance (SABA) reports it will "accelerate the path to carbon-neutral air transport by driving investment in [SAF], catalyzing new and additional SAF production and technological

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Energy, PowerPoint presentation, March 22, 2022, https://www.faa.gov/sites/faa.gov/files/2022-03/508.20220322_1545_Brown_Oldani_SAF_Update_v04.pdf.

[19] The National Renewable Energy Laboratory (NREL), "Annual Technology Baseline: Jet Fuel," https://atb.nrel.gov/transportation/2020/jet_fuel.

[20] U.S. Energy Information Administration (EIA), "Petroleum and Other Liquids: Spot Prices," release date June 29, 2022, https://www.eia.gov/dnav/pet/PET_PRI_SPT_S1_A.htm; and EIA, "U.S. Gulf Kerosene-Type Jet Price Spot Price FOB," release date June 29, 2022, https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EER_EPJK_PF4_RGC_DPG&f=M.

[21] Anmar Frangoul, "Sustainable Aviation Fuel Costs More but Consumers Will Be Willing to Pay, IATA Chief Says," February 11, 2022, pp. https://www.cnbc.com/2022/02/11/sustainable-aviation-fuel-costs-more-but-consumers-willing-to-pay-iata.html.

[22] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, *Sustainable Aviation Fuel: Review of Technical Pathways*, DOE/EE-2041, September 2020, https://www.energy.gov/sites/prod/files/2020/09/f78/beto-sust-aviation-fuel-sep-2020.pdf.

[23] U.S. Energy Information Administration (EIA), "Petroleum and Other Liquids: Spot Prices," release date June 29, 2022, https://www.eia.gov/dnav/pet/PET_PRI_SPT_S1_A.htm.

[24] First Movers Coalition, "Aviation Commitment," https://www3.weforum.org/docs/WEF_Aviation_2021.pdf.

[25] Clean Skies for Tomorrow Coalition, "Mission Possible Platform," https://www.weforum.org/projects/clean-skies-for-tomorrow-coalition.

innovation, and supporting member engagement in policymaking."[26] And the Business Aviation Coalition for Sustainable Aviation Fuel seeks both "to address a 'knowledge gap' on the availability and safety of SAF" and "to advance the proliferation of alternative jet fuels at all the logical touchpoints: the manufacturers, the ground handlers and the operators, at the regional, national and international levels."[27]

SAF and BBBA

The House passed the BBBA (H.R. 5376) in November 2021. Section 90006 would provide the National Aeronautics and Space Administration with $225 million for aeronautics research and development on sustainable aviation. Section 110007 would provide the Department of Transportation with $247 million to provide grants for projects relating to the production, transportation, blending, or storage of SAF, among other things.

BBBA Section 136203 would establish a tax credit of $1.25 per gallon of SAF. If enacted, the credit could be claimed for SAF, including fuel that is blended with kerosene.[28] In addition to meeting other technical requirements, SAF must have a lifecycle greenhouse gas emission reduction percentage of at least 50%, when compared to petroleum-based jet fuel. For SAF achieving emissions reduction percentages in excess of 50%, the tax credit amount would increase by $0.01 per gallon for each additional percentage point in lifecycle greenhouse gas emission reduction (making the maximum potential per gallon credit $1.75). SAF producers would be required to be registered with the Department of the Treasury for their fuel to be tax-credit eligible. The proposed tax credits would be coordinated excise tax and income tax credits, similar to the tax credits for biodiesel and alternative fuels. Credits would be available for SAF sold or used starting in 2023 through December 31, 2026. After 2026, SAF could be eligible for the new clean fuel productions credits proposed in Section 136805. The Joint Committee on Taxation (JCT) estimated that the SAF tax credit would reduce federal tax revenue by $90 million between fiscal years 2022 and 2027.[29]

SAF Tax Incentive Proposals

Other legislation introduced in the 117th Congress would provide tax credits for SAF. An income tax credit for SAF is one of several SAF policies proposed in the Sustainable Aviation Fuel Act (S. 1608). The credit proposed in S. 1608 would be $1.50 per gallon for fuel with a 50% reduction in lifecycle greenhouse gas emissions, with a credit of up to $1.75 per gallon for fuels achieving greater emissions reduction. For the purposes of this legislation, lifecycle greenhouse gas emissions calculations would include any induced land-use change emissions (defined, in part, as "emissions resulting from the conversion of land to the production of feedstocks").

The Sustainable Skies Act (S. 2263/H.R. 3440) would provide a tax credit of $1.50 per gallon for SAF with a 50% reduction in lifecycle greenhouse gas emissions, with a credit of up to $2.00 per gallon for fuels achieving greater emissions reduction. The $1.50 base credit amount would be reduced to $1.15 per gallon in any year the biodiesel tax credit is not in effect. The credit would be available for fuel sold or used after the date of enactment and on or before December 31, 2031.

[26] Sustainable Aviation Buyers Alliance (SABA), "SABA's Mission," https://rmi.org/saba/.

[27] The Business Aviation Coalition for Sustainable Aviation Fuel, "About," https://www.futureofsustainablefuel.com/.

[28] "The Build Back Better Act," Section 136203, *Congressional Record*, November 18, 2021, p. H6509.

[29] "The Build Back Better Act," Section 136805, *Congressional Record*, November 18, 2021, p. H6529.

Issues for Congress

Consideration of several issues could help inform congressional decision-making around potential federal policy or support for SAF. For instance, Congress may examine the development of advanced biofuels for road vehicles during the late 2000s, potentially to evaluate to what extent the issues that arose at that time might be similar to what the SAF industry could face today (e.g., feedstock availability, feedstock costs, feedstock competition, fuel costs, private financing availability, and infrastructure). Congress might consider the SAF data needed to measure progress and impacts of potential SAF policies. For example, S. 4038 would require EIA to report on U.S. production and foreign imports of SAF to include the type, origin, and volume of feedstocks used for the SAF, among other things.[30] Another issue for consideration might center around what "sustainable" means for the aviation sector. One potential question could be if SAF might be a "bridge" to a more advanced aviation fuel or technology (e.g., electrified aircraft).[31] Congress could also review international standards that could require the use of more SAF (e.g., standards set by the International Civil Aviation Organization or ICAO). Potentially separate from the environmental considerations, another question is whether SAF has the potential to reduce aviation fuel costs and dependence on foreign oil sources in the long-term by creating a substitute for conventional jet fuel.

Additional Resources

CRS In Focus IF11696, *Aviation, Air Pollution, and Climate Change*, by Richard K. Lattanzio.

CRS Report R43325, *The Renewable Fuel Standard (RFS): An Overview*, by Kelsi Bracmort.

CRS Report R46835, *A Low Carbon Fuel Standard: In Brief*, by Kelsi Bracmort.

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[30] Sen. Dianne Feinstein, "Senators Introduce Bipartisan Bill to Boost Production, Use of Renewable Diesel, Sustainable Aviation Fuel," press release, April 7, 2022, https://www.feinstein.senate.gov/public/index.cfm/press-releases?ID=AEF39DCE-B703-4B9F-98ED-BB0BF6ACD749.

[31] The National Renewable Energy Laboratory, *Electrification of Aircraft: Challenges, Barriers, and Potential Impacts*, NREL/TP-6A20-80220, October 2021, https://www.nrel.gov/docs/fy22osti/80220.pdf.

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