



Sustainable Aviation Fuel Grand Challenge Roadmap

*To enable the production of 3 billion gallons of SAF
per year by 2030 and 35 billion gallons by 2050*



The SAF Grand Challenge

MEMORANDUM OF UNDERSTANDING
SUSTAINABLE AVIATION FUEL GRAND CHALLENGE

Among the
THE U.S. DEPARTMENT OF ENERGY,
THE U.S. DEPARTMENT OF TRANSPORTATION and the
THE U.S. DEPARTMENT OF AGRICULTURE

September 9, 2021



https://www.energy.gov/sites/default/files/2021-09/S1-Signed-SAF-MOU-9-08-21_0.pdf

SAF Grand Challenge Roadmap Overview: Agenda

- Context for the SAF Grand Challenge
 - What we need to be successful
 - Administration support
- Enabling Industry To Build Out SAF Supply
 - Roadmap purpose and scope
 - Roadmap structure
 - Roadmap action areas and workstreams
- Highlighted Federal Agency Actions
 - With impact on 2030 goal
 - With impact on 2050 goal
- Next Steps

What We Need To Be Successful!

- Create an environment where producers choose to produce and sell SAF
 - Legislative action to reduce cost and risk
- A coordinated approach to federal actions that derisks technology, supply chains, and markets, and reduces barriers
 - Actions that support near-term production
 - Ongoing innovation to support future production
 - Data and analysis to support markets for SAF through strong policies
- Industry to build and purchase SAF supply

SAF Grand
Challenge
Roadmap

Administration Support for New SAF Incentives

“I’ve set a goal of zero-carbon for aviation sector, for example, by 2050. I’ve spoken with the leading heads of all major airlines. It’s going to require billions of gallons of sustainable aviation fuel. And you simply can’t get to net zero by 2050 without biofuels.”

*“To bring that future within reach, **I proposed a sustainable aviation fuel tax [credit]** that we brought together — the governments, the agencies, aircraft manufacturers, airlines, fuel producers, airports — **to advance cleaner and more sustainable fuels for American aviation.** That’s how we’re going to get there. And we can.”*

<https://www.whitehouse.gov/briefing-room/speeches-remarks/2022/04/12/remarks-by-president-biden-on-lowering-energy-costs-for-working-families/>



BRIEFING ROOM

Remarks by President Biden on Lowering Energy Costs for Working Families

APRIL 12, 2022 • SPEECHES AND REMARKS

POET Bioprocessing - Menlo
Menlo, Iowa

Commitments To Collaborate Among Agencies

- DOE, DOT, and USDA will collaborate with EPA to expedite regulatory approvals of SAF with significant life cycle GHG reductions (from the MOU)¹
- EPA and DOE will collaborate to identify data collection needs, assess technical information, and take other steps designed to expedite the regulatory approval process to support newly developed fuels and feedstocks that may be viable for inclusion as able to generate Renewable Identification Numbers (RINs) under renewable fuel in the Federal Renewable Fuel Standard (RFS) (from the White House fact sheet)²
- The parties and EPA, along with other relevant agencies, will define and agree on the appropriate science-based methodology for establishing life cycle emissions reductions (from the MOU)¹

¹ https://www.energy.gov/sites/default/files/2021-09/S1-Signed-SAF-MOU-9-08-21_0.pdf

² <https://www.whitehouse.gov/briefing-room/statements-releases/2021/09/09/fact-sheet-biden-administration-advances-the-future-of-sustainable-fuels-in-american-aviation/>

SAF GC Agency Roles in MOU

DOE

- Continue investments and develop expertise in sustainable technologies to develop cost-effective, low-carbon liquid fuels and enabling coproducts from renewable biomass and waste feedstocks
- Continue a significant multi-year SAF scale-up strategy committed to in FY21
- R&D aimed at creating new pathways toward higher SAF production
- Advance environmental analysis of SAF
- Collaborate with EPA to expedite regulatory approvals of SAF with significant life cycle GHG reductions

DOT/FAA

- Develop overall strategy to decarbonize aviation
- Coordinate ongoing SAF testing and analysis
- Work with standards organizations to ensure safety and sustainability of SAF
- Continue International technical leadership
- Promote end use of SAF
- Support infrastructure and transportation systems that connect SAF feedstock producers, SAF refiners, and aviation end users
- Collaborate with EPA to expedite regulatory approvals of SAF with significant life cycle GHG reductions

USDA

- Continue investments and build expertise in sustainable biomass production systems
- Decarbonize supply chains
- Invest in bio-manufacturing capability and workforce development
- Community and individual education
- Provide outreach and technology transfer to producers, processors, and communities to accelerate adoption and participation
- Commercialization support
- Collaborate with EPA to expedite regulatory approvals of SAF with significant life cycle GHG reductions

Next Step: Develop SAF Grand Challenge Roadmap

https://www.energy.gov/sites/default/files/2021-09/S1-Signed-SAF-MOU-9-08-21_0.pdf



SAF Grand Challenge Roadmap

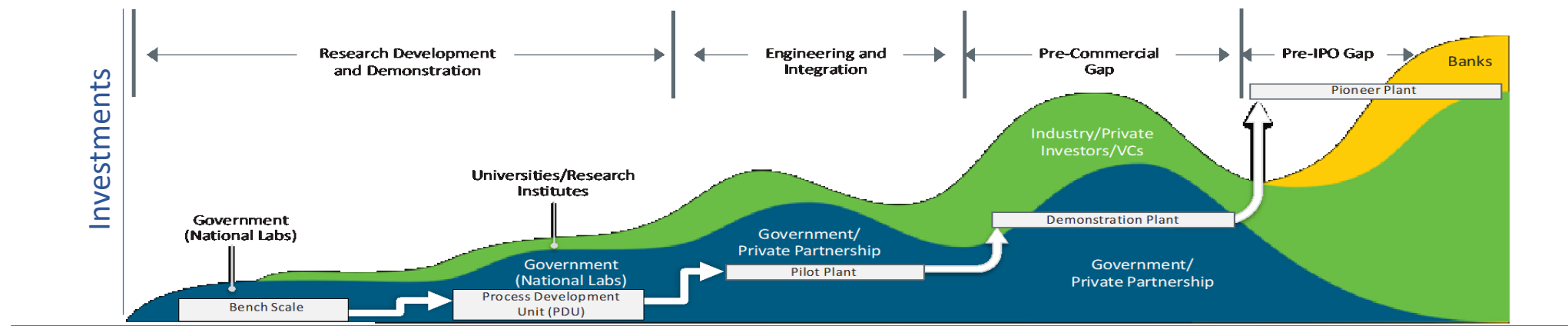
To enable the production of 3 billion gallons of SAF per year by 2030 and 35 billion gallons by 2050

SAF GC Roadmap Scope

Objective: Create a multi-agency plan of federal agency actions that will support stakeholders to build the SAF supply

Derisk technology, supply chains and markets, and reduce barriers:

- Leverage existing government research, development, demonstration, and deployment support
- Accelerate new research, development, demonstration, and deployment support
- Implement a supporting policy framework



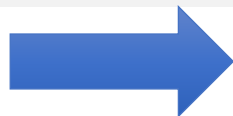
SAF GC Roadmap Scope (cont.)

To achieve the SAF GC goals, U.S. federal government agencies will:

1. Collaborate and coordinate with the aviation industry, fuel producers, agriculture, research, academia, state/local governments, and others
2. Coordinate activities in research, development, and demonstration to catalyze technology innovation, public-private partnerships, policy frameworks, and investments needed to address barriers
3. Incorporate input from all key stakeholders to ensure alignment of government and industry actions and coordination of government policies
4. Update the roadmap, informed by technological progress, market developments, and analysis activities—this roadmap is the beginning of an evolving, collaborative, and necessarily dynamic process

SAF GC Roadmap – Structure

Six Action Areas



1. Feedstock Innovation
2. Conversion Technology Innovation
3. Building Regional SAF Supply Chains
4. Policy & Valuation Analysis
5. Enabling End Use
6. Communicating Progress & Building Support

Action Area Example: Feedstock Innovation

Description: *Conduct R&D on sustainable feedstock supply system innovations across the range of SAF-relevant feedstocks and identify optimization to reduce cost, reduce technology uncertainty and risk, increase yield and sustainability, and optimize SAF precursors.*



Workstreams

Workstreams define critical activities within action area

Anticipate 4 to 6 workstreams per action area. **Examples below:**

WORKSTREAM FI.1: Understand resource markets and availability

Develop databases and market analysis for commodity and commercially available feedstocks under increased demand for SAF, and assess and analyze the factors effecting the availability of non-commodity/commercial feedstocks

DELIVERABLE: An understanding of the supply and demand dynamics for feedstocks under the proposed production levels for SAF and development of common databases for SAF feedstocks.

IMPACT: Identification of feedstock availability and limitations for SAF conversion technologies and supply/cost curves

KEY THEMES: Reduce cost, Expand production

WORKSTREAM FI.2: Maximize sustainable lipid (FOGs) supply for 2030

Given near term relevance of SAF conversion of lipids to meeting 2030 goals, take a coordinated approach to lipid feedstock R&DDD to support expansion to meet 2030+ goal, development of a lipid multi-generational Project Plan; coordination of USG support for near term lipid crop expansion (e.g. oilseed cover crops)

DELIVERABLE: More lipids available for HEFA conversion pathway

IMPACT: Increase the probability for the production of 3 BG/year SAF by 2030

KEY THEMES: Expanded SAF production (for 2030 goal)

Action Area: Feedstock Innovation (FI)

Support and conduct R&D on sustainable feedstock supply system innovations across the range of SAF-relevant feedstocks and identify optimization to reduce cost, reduce technology uncertainty and risk, increase yield and sustainability, and optimize SAF precursors.

Feedstock Innovation Workstreams

FI.1 Understand resource markets and availability across all SAF feedstocks

FI.2 Maximize sustainable lipid supply for 2030

FI.3 Increase production of biomass resources and collection of wastes and residues

FI.4 Improve feedstock supply logistics (harvest/collection, transport, storage, preprocessing)

FI.5 Increase reliability of feedstock handling systems

FI.6 Improve sustainability of biomass and waste supply systems



Action Area: Conversion Technologies and Processes (CI)

Support and conduct R&D, through pilot scale, on unit operations (and integration thereof) from the receipt of biomass at the refinery gate through to finished fuel for technology improvements/carbon intensity reductions. The effort includes processes that are already commercial, such as HEFA or nearing commercialization (alcohol to jet), and considers work on processes that will be ready for commercialization beyond 2030, but need to be developed now.

Conversion Workstreams

- CI.1** Decarbonize, diversify, and scale current fermentation-based fuel industry
- CI.2** Develop options to increase production and reduce C.I. of ASTM-approved pathways
- CI.3** Develop bio-intermediates and pathways for compatibility with existing capital assets
- CI.4** Develop innovative unit operations and pathways
- CI.5** Reduce risk during scale-up and operations



Action Area: Building Regional Fuel Supply Chains (SC)

Support SAF production expansion through regional supply chains ensuring R&D transitions from pilot to large scale, field validation and demonstration projects, validating supply chain logistics, enabling public-private partnerships, developing bankable business models, and collaboration with regional, state, and local stakeholders.

Supply Chains Workstreams

- SC.1** Build and support regional stakeholder coalitions through outreach, extension, and education
- SC.2** Model SAF supply chains
- SC.3** Support demonstration of regional SAF supply chains
- SC.4** Invest in SAF production infrastructure to support industry deployment



Action Area: Policy & Valuation Analysis (PA)

Provide data, tools, and analysis to support policy decisions and maximize social, economic, and environmental value of SAF including evaluation of existing and new policies.

Policy & Valuation Analysis Workstreams

PA.1 Improved environmental models and data for SAF

PA.2 Conduct techno-economic and production potential analysis

PA.3 Evaluate feedstock, technology, and production potential

PA.4 Inform SAF policy development

WORKSTREAM PA.1: Develop improved environmental models and data for SAF

Develop and utilize modeling capabilities, data, and analyses to quantify SAF GHG and other environmental impacts. This will ensure environmental integrity and appropriately account for SAF benefits.

DELIVERABLE: Enhanced environmental analysis and crediting capabilities.

IMPACT: Increased eligibility of new SAF pathways and crediting under existing and future incentive mechanisms.

KEY THEMES: Reduce cost, enhance sustainability, expand supply.

ACTIVITY	START
ACTIVITY PA.1.1: Develop data, analyses, and methods to support inclusion of SAF pathways within existing state, national, and international policies.	2022
ACTIVITY PA.1.2: Convene Greenhouse Gas (GHG) life-cycle analysis (LCA) and modeling working group to support needs of the SAF Grand Challenge, in line with the SAF Grand Challenge MOU.	2022
ACTIVITY PA.1.3: Engage community on needs to create market pull by enabling book-and-claim crediting mechanism.	2022
ACTIVITY PA.1.4: Conduct coordinated research on non-CO2 environmental impacts on air quality and climate change.	2022
ACTIVITY PA.1.5: Fund evaluation of co-benefits (soil organic carbon, water, jobs).	2022

PRELIMINARY – Activity lists under development

Action Area: Enabling End Use (EU)

Facilitate the end use of SAF by civil and military users by addressing critical barriers, including efficient evaluation of fuel engine performance and safety, advancement of certification and qualification processes, expansion of existing blend limits, and integration of SAF into fuel distribution infrastructure.

Enabling End Use Workstreams

- EU.1** Support SAF evaluation, testing, qualification, and specification
- EU.2** Enable use of drop-in unblended SAF and SAF blends up to 100%
- EU.3** Investigate Jet A fuel derivatives offering performance or producibility advantages
- EU.4** Integrate SAF into fuel distribution infrastructure



Action Area: Communicating Progress & Building Support (CP)

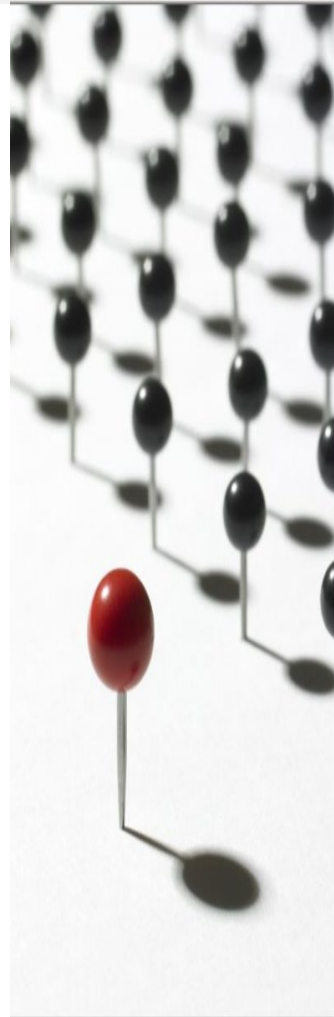
Monitor and measure progress against SAF GC goals, provide public information resources, and communicate the public benefits of the SAF GC to critical stakeholders and the public.

Communicating Progress & Building Support Workstreams

CP.1 Conduct benefits assessment/impact analysis of the SAF Grand Challenge

CP.2 Measure progress of the SAF Grand Challenge

CP.3 Communicate public benefits of the SAF Grand Challenge





SAF Grand Challenge Roadmap 2030 & 2050 Impacts

*To enable the production of 3 billion gallons of SAF
per year by 2030 and 35 billion gallons by 2050*

Highlighted Workstreams That Impact 2030 Goals

- Refine feedstock volume estimates (FI.1)
- Maximize sustainable lipid supply for 2030 Introduction (FI.2)
- Decarbonize, diversify, and scale current fermentation-based fuel industry (CI.1)
- Build and support regional stakeholder coalitions through outreach, extension, and education (SC.1)
- Invest in SAF infrastructure to support industry deployment (SC.4)
- Develop improved environmental models and data for SAF (PA.1)
- Inform SAF policy development (PA.4)
- Enable use of drop-in unblended SAF and SAF blends up to 100% (EU.2)
- Integrate SAF into fuel distribution infrastructure (EU.4)
- Measure progress of the SAF Grand Challenge (CP.2)

Highlighted Workstreams That Impact 2050 Goals

- Conduct RD&D on scaling and sustainability of biomass, waste, and residue feedstocks (FI.3, FI.6)
- Conduct RD&D on feedstock logistics and handling reliability (FI.4, FI.5)
- Derisk scale-up through R&D and integrated piloting of critical pathways by 2030 (CI.1-4)
- Build and support regional stakeholder coalitions through outreach, extension, and education (SC.1)
- Model and demonstrate sustainable regional supply chains for critical pathways by 2035 (SC.2, SC.3)
- Continue to invest in industry deployment (SC.4)
- Continue to inform SAF policy development (PA.4)
- Support SAF approvals (EU.1)
- Continue to measure progress and communicate benefits of the SAF Grand Challenge (CP.2)

Next Steps

- Assimilate additional stakeholder input
- Finalize roadmap draft (June 2022)
- Publish roadmap (August–September 2022)
- Build public/private implementation teams around action areas and workstreams
 - Identify and develop specific activities/timelines
 - Leverage existing and new stakeholder groups to implement activities

Thank You!

Nate Brown – Nathan.Brown@faa.gov

Zia Haq – Zia.Haq@ee.doe.gov

Bill Goldner – William.Goldner@usda.gov



Additional Information



SAF GC Roadmap Detailed Scope and Context

This roadmap provides details of specific activities by United States government agencies to support industry in achievement of the goals set forth in the Sustainable Aviation Fuel (SAF) [\[1\]](#) Grand Challenge [\[2\]](#):

- *Achieve a minimum of a 50% reduction in life cycle greenhouse gas emissions (GHG) compared to conventional fuel.*
- *Enable scale-up of the production and use of SAF to 3 billion gallons by 2030*
- *Enable scale-up of the production and use of SAF to 35 billion gallons to meet 100% of domestic aviation fuel demand by 2050 [\[3\]](#)*

Federal government agencies will collaborate and coordinate with the aviation industry, fuel producers, agriculture, research, academia, state/local governments, and others to accelerate growth of a domestic SAF industry that utilizes U.S. manufacturing capacities, a U.S. workforce, contributes to U.S. energy security, and supports a just transition to a low-carbon aviation future.

Agencies will coordinate activities in research, development, demonstration, and deployment, to catalyze technology innovation, public-private partnerships, policy frameworks, and investments needed to address barriers to the realization of the SAF Grand Challenge goals. This roadmap has and will continue to incorporate input from all key stakeholders to ensure alignment of government and industry actions and coordination of government policies. This roadmap is the beginning of an evolving, collaborative, and necessarily dynamic process. Regular updates will be informed by technological progress, market developments, and analysis activities.

[\[1\]](#) Sustainable aviation fuels (SAF)—drop-in synthesized hydrocarbon fuels from waste streams, renewable energy sources, or gaseous carbon oxides—will play a critical role in addressing U.S. climate change goals for the aviation sector

[\[2\]](#) Memorandum of Understanding Sustainable Aviation Fuel Grand Challenge: https://www.energy.gov/sites/default/files/2021-09/S1-Signed-SAF-MOU-9-08-21_0.pdf

[\[3\]](#) Fact Sheet: Biden Administration Advances the Future of Sustainable Fuels in American Aviation: <https://www.whitehouse.gov/briefing-room/statements-releases/2021/09/09/fact-sheet-biden-administration-advances-the-future-of-sustainable-fuels-in-american-aviation/>