



# **Sustainable Aviation Fuel Targeted Opportunity Region**

Rocky Mountain Region – Colorado, New Mexico, Utah, and Wyoming



# Authors and Acknowledgment

## Authors

Joey Cathcart

Jason Humphrey

TJ Kirk

Aamir Shams

Yuchen Wu

Authors are listed alphabetically. All authors are from RMI unless otherwise noted.

## Contacts

Andrew Chen, [achen@rmi.org](mailto:achen@rmi.org)

TJ Kirk, [tkirk@rmi.org](mailto:tkirk@rmi.org)

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## About RMI

RMI is an independent nonprofit, founded in 1982 as Rocky Mountain Institute, that transforms global energy systems through market-driven solutions to align with a 1.5°C future and secure a clean, prosperous, zero-carbon future for all. We work in the world's most critical geographies and engage businesses, policymakers, communities, and NGOs to identify and scale energy system interventions that will cut greenhouse gas emissions at least 50 percent by 2030. RMI has offices in Basalt and Boulder, Colorado; New York City; Oakland, California; Washington, D.C.; and Beijing.

# Introduction



The world is demanding that the aviation sector adopt sustainable aviation fuel (SAF), creating a unique opportunity for the Rocky Mountain region. Of the many industrial hubs in the United States, this region possesses the relevant industrial networks and SAF scaling opportunities that could help the US aviation sector meet fuel targets. The region of focus consists of four states: Colorado, New Mexico, Utah, and Wyoming.

The Rocky Mountain region has appropriate demand centers, feedstock availability, and existing infrastructure, and is developing appropriate legislative incentives to spur local SAF development. This development will drive economic growth along with localized environmental benefits.

This report provides an introduction to SAFs, trends in the sector, and why the Rocky Mountain region's unique strengths in feedstock availability, infrastructure, transport, and demand could translate into a competitive SAF industry. It also provides an overview of the economic impacts and unpacks some of the key policy levers that could unleash SAF's potential in the Rocky Mountain region.



# SAF 101



## What Is SAF?

Jet fuel, which accounts for the lion's share of the aviation fuel market, has stringent requirements on composition and performance, making it critical that SAF be made from new sources and that production pathways meet the same standards. SAF is a drop-in replacement for petroleum-based jet fuel. It can be used in existing fuel delivery infrastructure and existing aircraft engines and reduces emissions now while technological leaps for new fuels or infrastructure take time to develop, such as in the cases of hydrogen- or electric-powered aircraft, or high-speed rail. Blending limits of SAF with conventional jet fuel can range from 5% to 50% depending on the feedstock and production process used.

The International Civil Aviation Organization (ICAO) describes SAF as “a renewable or waste-derived aviation fuel that meets sustainability criteria.”<sup>1</sup> Although the sustainability criteria can be complex and differ between methodologies, the widely accepted core characteristics of SAF include (1) that it generates fewer emissions than fossil jet fuel on a life-cycle basis, and (2) that, in the case of bio-based SAF, the biomass was not sourced from land with a high carbon stock. In addition to those criteria, SAF produced after 2024 will be bound by even more stringent rules on land use, food security, and human rights, among others.

Jet fuel can be considered sustainable when it meets the criteria set forth by a standard-issuing body. Two accepted forms of analysis are currently used to account for the life-cycle emissions of SAF: the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) and the Greenhouse Gases, Regulated Emissions, and Energy Use Technologies (GREET) model. The GREET modeling and methods, developed by Argonne National Laboratory,<sup>2</sup> direct the accounting of biofuel life-cycle emissions across the United States. SAF, with a lower carbon intensity than fossil jet fuel, can already be produced through several conventional pathways. ASTM International approves nine technologies for creating SAF, with hydroprocessed esters and fatty acids (HEFA) as the most immediately accessible.<sup>3</sup> Of the nine, HEFA is the only commercially deployed pathway for producing SAF. HEFA can be derived from tallow, crop residues and oils, woody biomass, and even municipal waste. These offer a consistent feedstock to be refined into SAF but are limited in supply and will not be the only solution needed to meet projected demand.

Fuel produced from the power-to-liquid (PtL) process is called eSAF, a drop-in synthetic fuel that can significantly lower carbon intensity when it is produced with renewable energy. Tried-and-true PtL processes, such as Fischer-Tropsch, are being repurposed to fill the technology gaps in the SAF industry.

Hydrogen and CO<sub>2</sub> are key inputs for SAF production in the pathways mentioned. Waste CO<sub>2</sub> utilization keeps the aviation fuel within sustainability criteria, while hydrogen can be produced with near-zero carbon when renewable energy is sourced. More pathways and innovations will likely develop as new industrial hubs improve the understanding of these processes.

Though the outlook for SAF is positive, barriers to deployment still exist. Currently, SAF production expenses result in market prices two to four times greater than those for traditional fossil jet fuel, limiting the potential for market-driven scaling. Long-term demand signals for SAF from airlines are increasing, but this price premium remains a major barrier to scaling up SAF.

Nonetheless, opportunities for stakeholders are emerging as production costs continue to drop. Pioneering retrofits of existing systems and industrial symbiosis that optimizes assets are mitigating the high up-front costs of developing SAF projects. Prices for key feedstocks like hydrogen and renewable energy are falling, which will lower operating costs and build a more robust supply chain for production.

## Shifting from Conventional Jet Fuel to SAF

The benefits of SAF cascade through the value chain and local environment. The most tangible benefit is air quality improvement. SAF contains fewer **aromatic components** than conventional jet fuel, helping it burn cleaner while reducing life-cycle carbon emissions. Travelers may notice immediate changes as fumes at the airport wane, but the advantages will lift the Rocky Mountain region through a variety of levers.

The resulting growth of the bioeconomy will allow jobs in certain traditional sectors to transition into new yet similar roles, while opportunities for new advanced jobs will open to the current and future workforce. Broader uses for agricultural feedstocks create a more dynamic and robust revenue stream for farmers. Growing techniques endorsed by GREET and CORSIA require responsible stewardship of land use, further promoting soil quality benefits and longevity.

Regional by-products and waste streams can be converted into value-generating fuels — a net positive for the economy rather than a burden to be managed.

## SAF Trends

The SAF market has recently experienced a series of shifts in the form of positive commitments and legislation from major biofuel-producing countries. The United States, EU, and United Kingdom carved out their own pathways for SAF development, including how to position demand in favor of domestic supply chains.

The EU and the UK have mandates positioned to meet a portion of the SAF demand by 2030. With the adoption of the IRA, the United States also offers incentives for competitive low-carbon SAF through Sections 40B and 45Z, hydrogen through Section 45V, and carbon capture through Section 45Q.

At the state level, California, Oregon, and Washington have adopted a low-carbon fuel standard (LCFS), and several other states, including Colorado and New Mexico, are considering an LCFS or similar policy. Colorado recently enacted a law that provides a state income tax credit for entities that use clean hydrogen to decarbonize high-value end uses, including aviation. The state has also introduced Tax Policy That Advances Decarbonization, which includes a SAF production facility tax credit. With these considerations and commitments, more will be required to fulfill the full need for a global SAF market.

On a global scale, the blending of mandates and production goals could see the SAF market dealing with 4.5 billion gallons of fuel by 2030, an over 28-fold increase from 2023. However, SAF production today remains well short of these demand projections.<sup>4</sup>

The US SAF market will have similar upward trends, with demand expected to exceed production supply. Domestic SAF facilities aim to produce 3 billion gallons of drop-in fuel by 2030, according to the Biden administration's Sustainable Aviation Fuel Grand Challenge. Currently announced SAF projects are expected to support only 2.2 billion gallons by then. Today's SAF production levels will need to scale severalfold across all technologies to approach the 27 billion gallons that could be in domestic demand by 2050.<sup>5</sup>

A majority (66%) of announced SAF projects will use HEFA derived from vegetable oils, waste oils, and other fats. Most of the remaining projects (27%) will use alcohol-to-jet (ATJ) processes for SAF. The near-term allocation of biomass feedstocks is therefore integral for SAF to proliferate in the United States.

# Strengths and Industrial Capabilities of the Rocky Mountain Region

The emerging SAF opportunity could contribute to the Rocky Mountain region's potential as a center of innovation and future industry. Its existing network of infrastructure and industry can make the region a vital hub for meeting SAF targets. Its foundations in manufacturing and adjacent industries, agriculture, and technology, along with its high feedstock availability, can transition into a successful bioeconomy network.

## Feedstock Availability

SAF can be produced through a variety of technologies using a wide range of feedstocks such as biomass, renewable fuels and electricity, hydrogen, and waste CO<sub>2</sub>. To be viable for SAF, feedstocks need to be effective in cost, sustainability criteria (including carbon content), and scalability. The Rocky Mountain region has the capacity to compete in a wide range of feedstocks, but it will require sustained and strategic investments in supply chain development to mature those pathways.

Biofuels, the most mature type of SAF, are being produced in the Rocky Mountain region, with most of the focus currently on ethanol produced from corn. As of 2021, the region accounted for about 160 million gallons of ethanol per year, or 1% of US ethanol production capacity.<sup>6</sup> The United States' total production is 15 billion gallons, over 55% of the world's ethanol.<sup>7</sup> The region accounts for about 1% of total US corn production and a negligible amount of soy production.<sup>8</sup>

If all 160 million gallons of ethanol currently produced in the Rocky Mountain region were used to make SAF, about 94 million gallons of SAF could be created, with other inputs and processes (namely alcohol-to-jet synthetic paraffinic kerosene, or ATJ-SPK) necessary along the way.<sup>9</sup> Throughout this process, this SAF would require an input of around 8,400 metric tons of hydrogen. This required hydrogen could represent a significant complementary demand signal as demand for SAF increases.

The significance of corn and soy as feedstocks has driven the ATJ and HEFA pathways to maturity, leaving less room for advancement. However, these crops' entrenched supply chains do not negate the food-versus-fuel dilemma often cited by biofuel opponents. Still, new opportunities for biofuel feedstocks continue to emerge as regulation and agricultural science improve knowledge on land management. Other feedstock pathways include agricultural residues and food waste, which are considered second-generation feedstocks. These are effective sources because of their lower life-cycle carbon and land-use competition compared with first-generation crops like corn and soy. Among Albuquerque, Denver, and Salt Lake City — the region's largest population centers — a combined 50,000 tons of used cooking oils are generated annually and could be used as feedstock for SAF. Additionally, the region currently hosts 16 meat processing facilities, nine rendering facilities, and two oilseed processing facilities.

Biomass feedstocks separated from edible agriculture supply chains are considered third generation and include sources like forest residues and other woody waste. These third-generation feedstocks have high potential for SAF refinement because their soil carbon benefits often attribute a negative carbon intensity.

The Rocky Mountain targeted opportunity region (TOR) holds significant biomass resources that could potentially be used as feedstock for SAF. Together, the states hold over 4 million tons of solid biomass resources, or 4.74% of nationwide biomass.<sup>10</sup> Four million tons of biomass could theoretically provide roughly 247 million gallons of SAF.<sup>11</sup>

## Exhibit 1 SAF feedstock availability in Rocky Mountain Region

Conversion Process/Pathway Maturity	Feedstock	Life-Cycle Analysis Carbon Intensity (g CO <sub>2</sub> e / MJ)	Feedstock Availability in Rocky Mountain Region
<b>HEFA/Mature</b>	Herbaceous Energy Crops	17.3–50.0	No
	Corn	45.4–56.8	High
	Palm Oil	34.7–63.1	No
	Soybean	25.6–42.3	No
	Tallow	19.9–28.8	Medium
	Used Cooking Oil	13.0–18.3	Medium
<b>Ethanol ATJ/Commercial Uncertainty</b>	Corn	100.5	High
	Waste Gas	29.4–42.3	High
	Agriculture/Forestry Residues	24.6–40.1	High
	Herbaceous Energy Crops	9.2–48.7	No
	Sugarcane	28.8–36.2	No
<b>Iso-Butanol ATJ/Commercial Uncertainty</b>	Corn	85.2–85.7	High
	Agriculture/Forestry Residues	22.8–41.7	High
	Sugarcane	29.7–36.4	No
	Herbaceous Energy Crops	18.4–50.1	No
	Molasses	35.7–36.4	No
<b>FT/Commercial Uncertainty</b>	Agricultural/Forestry Residues	5.3–25.1	High
	Municipal Solid Waste	9.5–86.2	High
	Herbaceous Energy Crops	-4.5–18.0	No
<b>SIP/Commercial Uncertainty</b>	Sugarcane	37.7–44.6	No
	Sugar beet	40.0–47.2	Low
<b>Power-to-Liquid/R&amp;D</b>	CO <sub>2</sub> + H <sub>2</sub> O + Renewable Electricity	Various	N/A

RMI Graphic. Source: RMI Analysis



Renewable natural gas (RNG) is a promising feedstock that can be captured and repurposed for SAF production. RNG is used to produce synthetic gas in the refining process, replacing the role of natural gas but with far less fossil carbon. RNG has a diverse and growing supply chain, sourced from landfills, wastewater treatment facilities, agricultural residues, livestock, and other biomass waste.

Large population centers generate municipal waste that must be managed effectively. It is common today for landfills to recover methane leakages and abate the gases through either flaring or recovery. As a better alternative to flaring, recovered landfill gas can be processed into RNG and sold. The region currently boasts a high capacity of landfill gas recovery, with approximately 75% of annual landfill waste being sent to a facility equipped for gas recovery through collection and/or flaring. States have evidently invested heavily in landfill gas collection and flaring, making the region's remaining landfills more likely to adopt RNG production through landfill gas recovery.<sup>12</sup>

Direct-use hydrogen for aircraft is a promising technology that could help reduce the carbon footprint of the aviation industry. Although the technology is not yet fully developed, it has the potential to be a game changer in the industry. Airbus, for example, expects green hydrogen to power its future zero-emissions aircraft when it reaches the market by 2035.<sup>13</sup>

It is important to note that other feedstocks exist and that new sources in the region may become apparent as SAF pathways mature and associated demand shifts. The abundance of feedstocks is only a part of a successful SAF value chain. Resources and crude wastes must be managed effectively down the value chain to have a viable SAF pathway.

## Existing Infrastructure

SAF plants require specialized infrastructure to ship, store, and process feedstocks into jet fuel. One of the key advantages of SAF is its versatility to fit into established supply chains, reducing the need for new infrastructure and capital while expanding the value of current systems.

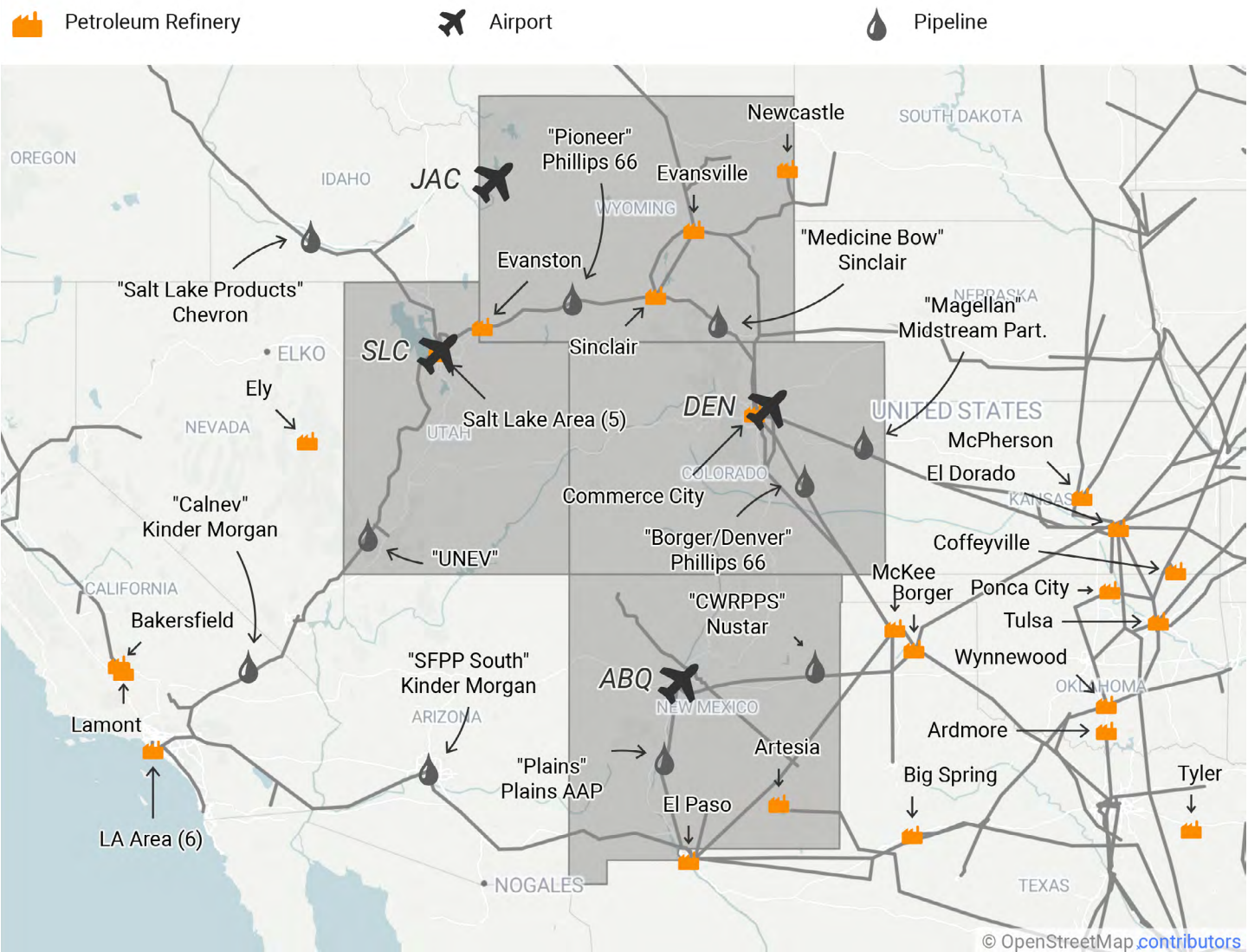
There are three ethanol production plants in Colorado, with an annual capacity of 160 million gallons, which can be leveraged for SAF refinement. Key infrastructure and learnings used in ethanol refining can be leveraged for a more profitable SAF production pathway (see Exhibit 2). Refineries in the Rocky Mountain TOR, and their related infrastructure, can also be leveraged with adequate planning. Suncor's Commerce City refinery currently supplies 33% of jet fuel for Denver International Airport (DEN), and the existing hydrotreating capacity can be repurposed for SAF production. This transition will likely cost less than building new facilities.

DEN is the busiest airport in United States by aircraft movement and the third busiest by passenger boardings, giving it the potential of high SAF demand in the pursuit of its sustainability goal of becoming the world's greenest airport. The adoption of SAF at DEN, one of United Airlines' largest hubs, will be an important avenue for the carrier to achieve its target of becoming 100% green by 2050, without relying on traditional carbon offsets. At the same time, Salt Lake City International Airport (SLC) in Utah and Telluride Regional Airport in Colorado also have the potential to become off-takers of SAF.

Connecting feedstocks and fuel to value chain partners also relies on extensive ground freight. Existing pipelines and rails in the Rocky Mountain TOR, including the BNSF Railway, can be leveraged as least-cost transportation options.

# Exhibit 2 Key Infrastructure in the Rocky Mountain TOR

## Legend



RMI Graphic. Source: [Energy Information Administration](#); RMI analysis

## Off-Take Agreements Can Ripen SAF Potential in the Rocky Mountain Region

Airlines are setting their own targets for introducing SAF into their portfolios and securing their supply lines through off-take agreements. Off-take agreements take place between fuel producers and buyers to establish a source of supply and demand. Delta Air Lines announced a target of 10% SAF in its flights by 2030, translating to 400 million gallons per year. To prepare, Delta secured an off-take agreement with biofuel company Gevo Inc. for 75 million gallons of SAF per year, just a fraction of Gevo's total annual agreements worth 375 million gallons.<sup>14</sup> Under another agreement, DG Fuels will supply Delta with 55 million gallons of SAF every year for seven years, totaling 385 million gallons, starting at the end of 2027.<sup>15</sup> The feedstocks for SAF are expected to be timber waste, corn stover, and cotton gin waste.

The global growth in SAF demand toward 2050 combined with limited regions producing SAF illustrates the need for a market-based system to deliver fuel benefits around the world. Registries for accounting SAF certificates are in place to solve the connection challenge and are quickly maturing as more SAF comes to market. SAF certificates are produced per ton of drop-in fuel, born out of SAF ideally consumed in local airports closer to the fuel blending point. Commercial and private customers can purchase these certificates to reduce their Scope 3 emissions from flights, even if the journey itself does not use SAF.

The logic of the market-based concept is similar to that of renewable energy credits: produce renewable energy in regions with the best availability of resources (hydro, wind, solar) and allow market players to purchase blocks for their own accounting. The system incentivizes efficient SAF production by removing the geographic boundaries from customer demand.

### Demand Potential

Airports in the Rocky Mountain TOR primarily rely on conventional fossil-based jet fuels, which is consistent with broader aviation industry trends. However, this low demand for SAF does not reflect a lack of potential; instead, it represents a unique opportunity for growth of and investment in SAF.

The SAF Grand Challenge, the result of a government-wide memorandum of understanding published by the US Department of Energy (DOE), Department of Transportation (DOT), and US Department of Agriculture (USDA), challenges the United States to build enough supply infrastructure to produce 3 billion gallons per year by 2030 and 35 billion by 2050.<sup>16</sup> The Federal Aviation Administration projects total jet fuel demand at about 24.3 billion gallons per year in 2030 and 36.4 billion in 2050,<sup>17</sup> meaning 3 billion gallons represents 12.3% of national demand in 2030 while 35 billion gallons represents 96.2% of national demand in 2050.

To meet these near-term and long-term objectives, supply and demand must scale together. Using DEN, the largest airport in the region, as a key example, RMI projects that total fuel demand in 2030 at DEN will be around 604 million gallons per year. Therefore, assuming scaling with the national 12.3% goal, DEN SAF demand should be about 74.6 million gallons in 2030.

At a broader scale, RMI projects that the Rocky Mountain TOR states accounted for 4.2% of national jet fuel demand in 2022, with the leading airports being DEN, SLC, and Albuquerque (ABQ). This demand represents roughly 720 million gallons in 2022 and is projected to grow to 921 million gallons in 2030 and 1,557 million in 2050. To meet SAF Grand Challenge targets of 12.3% in 2030 and 96.2% in 2050, the region's airports will demand about 113 million gallons of SAF in 2030 and 1,498 million gallons in 2050.



## Case Study: Salt Lake City International Airport (SLC)

Salt Lake City International Airport (SLC) has set a goal to “reduce criteria air pollutants and greenhouse gas emissions to improve public health and reduce environmental impact.”<sup>18</sup> A key partner for SLC in meeting this goal and deploying SAF will be Delta Air Lines, which represents about 70% of total traffic at the airport.<sup>19</sup> Delta has committed to net-zero carbon emissions by 2050 and has set a goal to replace 10% of its fossil-based jet fuel with SAF by the end of 2030.<sup>20</sup> According to RMI analysis, this SAF demand would roughly scale down to approximately 16.3 million gallons of SAF demanded by Delta at SLC in 2030.

While Delta’s goal is not attached to a specific region or airport, this demand represents an opportunity for SLC, Utah, and the Rocky Mountain TOR to engage with Delta as a key corporate partner and move the industry forward through shared goals. Demand signaling from corporate partners such as Delta can encourage supply to scale alongside; this represents massive economic and sustainability opportunities.





# Economic Impact

SAF development can present economic benefits for communities and the region. The value chain to deploy SAF provides a long-term fixed revenue stream and employment for regional stakeholders. While the emerging bioeconomy may partially drive its own development, meeting SAF deployment targets will require a skilled workforce, public-private partnerships, and unique industry collaborations.

## Job Creation Potential and Workforce Development Opportunities

The US Department of Energy's Bioenergy Technologies Office (BETO) assists in promoting awareness of and addressing gaps in the bioenergy workforce. The expertise that already exists in certain sectors can translate to many of the operations of SAF production.

The value chain to produce SAF is extensive and will require new job creation that expands across the economy. The new jobs will be available for the broader workforce, from early and midlevel career positions to advanced roles and specialists. BETO expects some of the highest job growth in the following areas:

- Biomass and hydrogen production and logistics
- Facility operation and quality control
- Research and development
- Feedstock production in farming communities
- Construction, engineering, and manufacturing

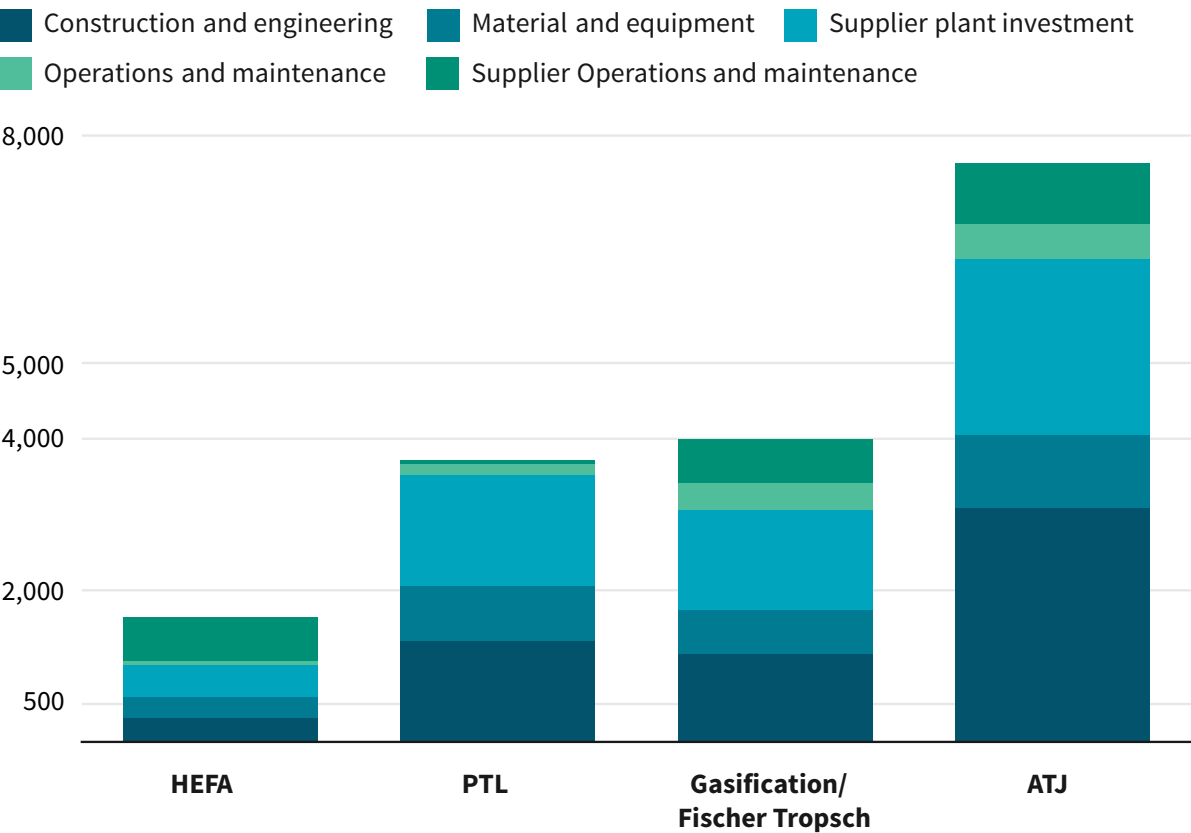
Job figures for biorefineries vary based on the technological pathway for SAF (see Exhibit 3). Employment projections for each pathway focus on up-front labor for development and fixed labor for operations and management. SAF production enables job creation across the value chain including feedstock sourcing, facility construction, facility operation, fuel certification, and aviation operations.

In general, an average SAF plant creates between 100 and 200 permanent jobs over the operational lifetime of the facility. Additionally, an average SAF plant creates between 800 and 1,000 direct and indirect jobs associated with design; engineering, procurement, and construction; and plant commissioning. For example, a recently announced SAF facility in Washington state projecting to produce about 30 million gallons per year expects to provide about 100 permanent new jobs and 600 construction jobs at an investment between \$600 million and \$800 million.<sup>21</sup> To meet the regional target of 113 million gallons of annual SAF production by 2030 to remain in line with the SAF Grand Challenge, about \$2 billion to \$3 billion will be needed.

Exhibit 3

Projected Job Creation Depending on SAF Plant Design and Delineated by Support Sector

Job figures for a simulated 50 million gallon/year SAF plant by value chain stakeholder



Note: Projections are dependent on SAF plant design.  
RMI Graphic. Source: Rhodium Group, <https://rhg.com/research/sustainable-aviation-fuels/>

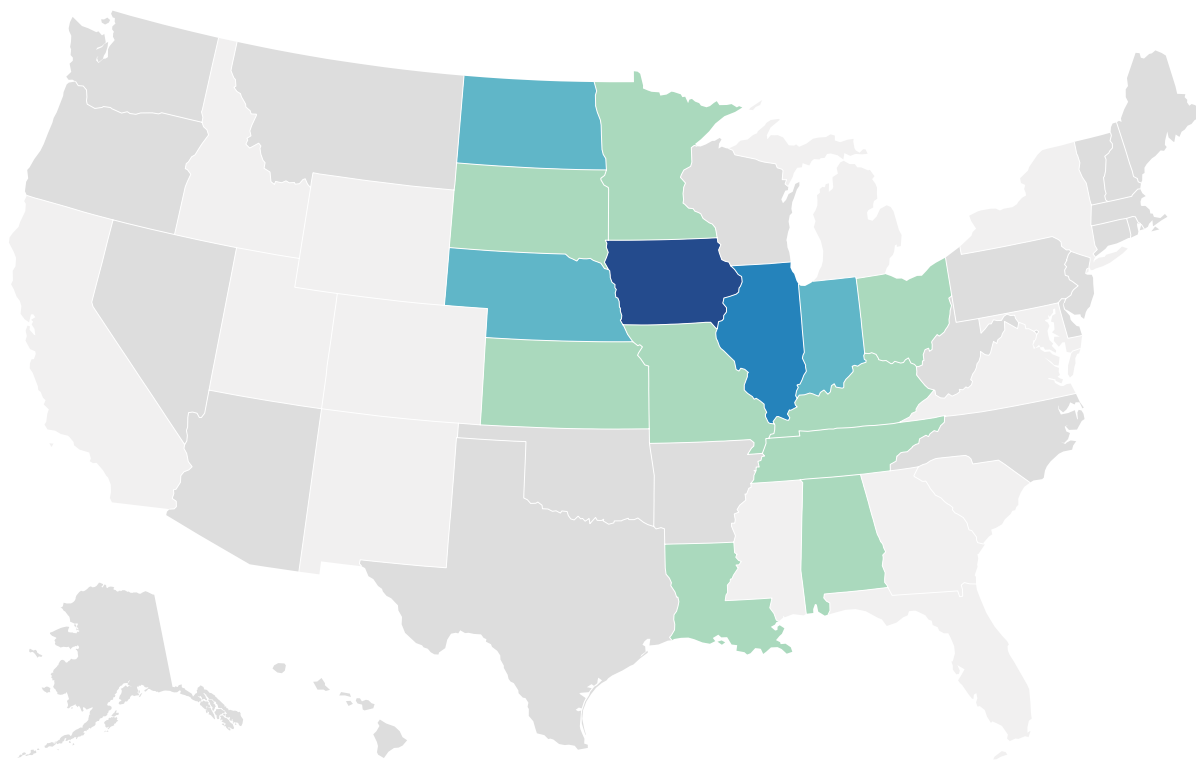
Currently, the four states have a limited number of biorefineries and biorefining jobs that can support the production of SAF, as seen in Exhibit 4. Within the region, Colorado is the only state that has existing starch and vegetable fats and oils manufacturing operations; however, employment is still below the national average for this category.<sup>22</sup> The region currently has no employment in fats and oils refining/blending, soybean processing, or wet corn milling operations. However, with the potential future expansion of SAF demand and production in the region, an increase in jobs related to the production and processing of feedstock may be supported.

## Exhibit 4

### Biofeedstocks Processing Industry Employment Statistics

Annual Average Employment Location Quotient (LQ) above 1.00 indicates above employment in the sector is above the national average.

< 1   1–3   3–6   6–10   ≥ 10



Analysis features data from NAICS code 31122 as a proxy for bio feedstock processing.

RMI Graphic. Source: [US Bureau of Labor Statistics](#)

As previously mentioned, hydrogen is a key input for SAF production. HEFA, as the most mature SAF production pathway, is expected to make up most SAF production by 2030. HEFA production requires about 0.15 kg of hydrogen per gallon of SAF. Assuming regional HEFA SAF production of 113 million gallons in 2030, nearly 17,000 tons of hydrogen will need to be produced. If all the hydrogen needed is produced through electrolysis powered by renewables, about 60 full-time equivalent (FTE) jobs are expected to be created from the installation of renewable assets such as wind and solar, and about 20 FTE jobs are expected to be created from the installation of electrolyzers. Similarly, about 80 FTE jobs are expected to be created from the operation and maintenance of renewable assets.

### Public–Private Partnerships and Research Institutions Driving SAF Innovation

A skilled, SAF-producing workforce needs an entire network of collaborations to scale. Public research partnerships are being used to drive innovation and knowledge centers for the industry. In January 2023, the DOE awarded \$118 million to 17 projects to accelerate the production of sustainable biofuels.<sup>23</sup> One of these projects is located at the University of Utah under the title “Entrained-Flow Biomass Gasification with Syngas Fermentation for Production of Sustainable Aviation Fuels.” This project is focused on demonstrating that “biomass can be efficiently processed in a pressurized entrained-flow gasifier to produce syngas suitable for production of SAF.”<sup>24</sup> In August 2023, the DOE funded a Wyoming-based CO<sub>2</sub>

direct-air-capture hub through the University of Wyoming and other public and private partners and is exploring using this captured carbon as an input into SAF production.<sup>25</sup>

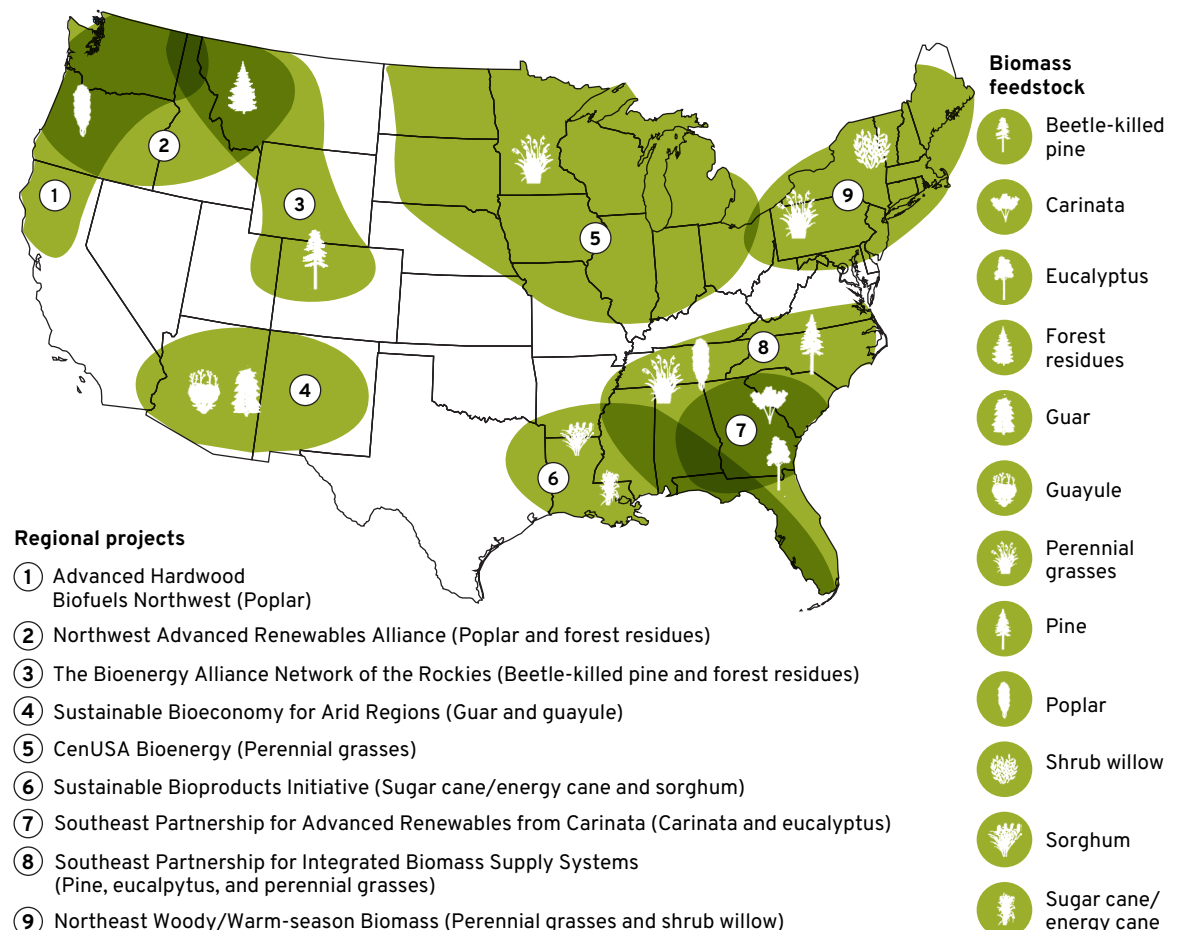
Additionally, the Rocky Mountain TOR is home to multiple premier federal research laboratories. The National Renewable Energy Laboratory, in Golden, Colorado, is supporting SAF research and innovation.<sup>26</sup> Los Alamos National Laboratory in New Mexico has a project through the Chemical Catalysis for Bioenergy Consortium working on SAF.<sup>27</sup>

The Agriculture and Food Research Initiative is a grant program of the USDA's National Institute of Food and Agriculture, with over \$183 million awarded for Coordinated Agricultural Projects (CAPs). The CAPs are targeted at rural regional development for, among other things, biofuel production from non-food-competitive agriculture. Of the several CAPs supported by the USDA, two span the region (see Exhibit 5).

The University of Arizona inaugurated the Sustainable Bioeconomy for Arid Regions (SBAR) Center of Excellence in September 2017, aiming to create a comprehensive strategy for feedstock development, production, and distribution in the southwestern region of the United States. The Bioenergy Alliance Network of the Rockies (BANR), led by Colorado State University, is investigating the use of trees affected by insect infestations as a renewable feedstock for the production of biofuels and biochar.<sup>28</sup>

## Exhibit 5

### Map of CAPs Funded Through the USDA



RMI Graphic. Source: [National Institute of Food and Agriculture](#)



## Case Study: Carbon Capture in Wyoming

CarbonCapture Inc. and its strategic partners have secured \$12.5 million in funding from the DOE to establish a major direct air capture (DAC) hub in southwestern Wyoming. The project's initial phase involves conducting a Front-End Engineering Design (FEED) study for a DAC facility capable of capturing 200,000 tons of CO<sub>2</sub> annually. The captured CO<sub>2</sub> will be used in two ways: either permanently sequestered in geological formations by Frontier Carbon Solutions or used as a feedstock for the production of SAF by Twelve, a SAF producer. Other key partners in the project include the University of Wyoming, Fluor, Carbon Direct, Intera, Electric Power Research Institute, Carbon-Based Consulting, Icarus, and Novus Energy Advisors.

The project aligns with the DOE's initiatives to establish multiple megaton-level regional DAC hubs and focuses on transforming captured CO<sub>2</sub> into valuable products while ensuring community benefits and alignment with local values.



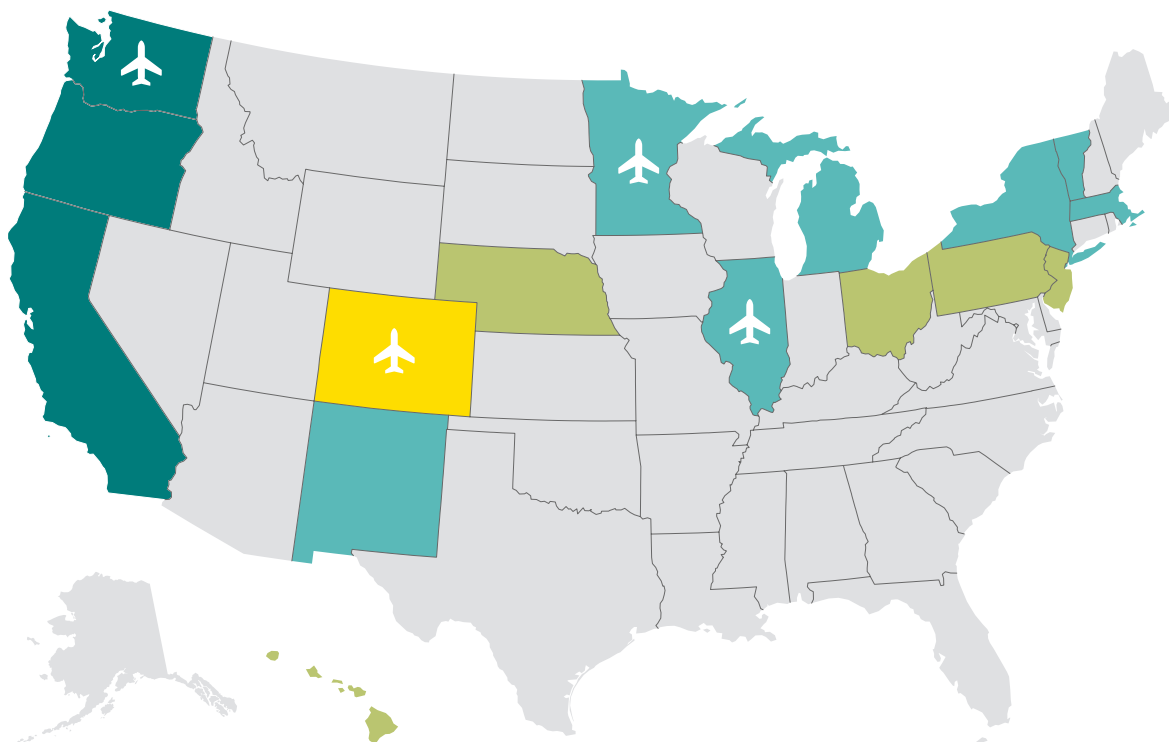
# Policy Landscape and Supportive Measures

Public policy has significantly influenced the growth of biofuels for transportation and the scaling up of renewable energy industries like wind and solar. In the United States, at the federal level, two policies are critical for a SAF market at scale: the Renewable Fuel Standard (RFS),<sup>i</sup> administered by the Environmental Protection Agency, and the IRA. The RFS has no provisions for power-to-liquid SAF and has mechanisms that lead to intersectoral competition. The IRA, when stacked with other credits, would narrow — though not completely close — the premium gap with conventional jet fuel. At the state level, only a few states have an LCFS that is conducive to the development and growth of a SAF market. More states are considering adopting similar standards; however, intersectoral competition is a key issue in these standards.

## Exhibit 6

### States' Progress on SAF Policy Including LCFS

■ LCFS or similar policy in force ■ Pending or failed LCFS or similar policy ■ No reported activity  
■ Conversations in progress on LCFS or similar policy ■ Previously considered LCFS



✈ = Direct incentives for SAF in the states of Washington, Colorado, Minnesota, and Illinois.

RMI Graphic. Source: RMI analysis of state policy offices

<sup>i</sup> The US RFS was created by the Energy Policy Act of 2005 and was later updated through the Energy Independence and Security Act of 2007. This regulation focused on renewable fuel for ground transportation, requiring a minimum amount of renewable fuel on an annual basis, increasing over time.

An **LCFS** is a rule designed to reduce greenhouse gas emissions and air pollution from transportation using a market-based mechanism that caps the carbon intensity of fuels. In the Rocky Mountain region, New Mexico had been considering LCFS policies that would include support of SAF, although there were some challenges mainly surrounding fuel prices. Most recently, the state has been considering a **Clean Transportation Fuel Standard** (CFS) that would regulate all fuel importers, refiners, blenders, and wholesalers. Similarly, Colorado is considering a CFS that would require fuel providers to reduce the carbon intensity of their fuel over time. These policies all have the potential to support SAF.

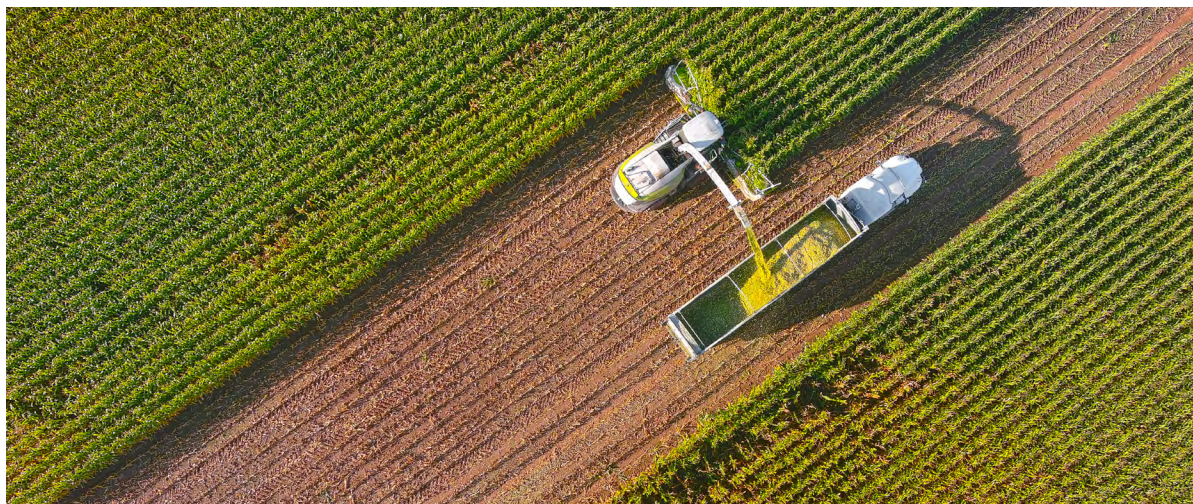
Colorado recently enacted **a law** that provides a state income tax credit for entities that use clean hydrogen to decarbonize hard-to-abate sectors, including aviation. The \$1/kg hydrogen ( $H_2$ ) tax credit will be provided for the end uses that utilize electrolytic hydrogen produced with less than 0.45 kg  $CO_2$ /kg  $H_2$ . For hydrogen produced with between 0.45 and 1.5 kg  $CO_2$ /kg  $H_2$ , the tax credit will be \$0.33/kg  $H_2$ . There are also strict rules regarding emissions accounting, including that the **hydrogen must be produced from new zero-carbon energy and matched on an hourly basis** with hydrogen production.

Signed into law by Governor Jared Polis in May 2023, Colorado's **Tax Policy That Advances Decarbonization** includes a SAF production facility tax credit. Starting this year, SAF producers are eligible to claim an income tax credit up to 30% of the cost to construct the production facility in 2024–26, 24% in 2027, 18% in 2028, and 12% in 2029–32. The aggregate amount of all tax credits issued shall not exceed \$1 million in 2024, \$2 million per year in 2025–26, and \$3 million per year in 2027–32.

Colorado also attempted to introduce a bill that would provide a **Sustainable Advancement in Aviation Tax Credit** for qualified investors and businesses for investment related to electric-powered aviation ground support equipment and the research, development, and production of SAF in the next nine years. The tax credit proposed to cover 30% of the qualified investment, with a maximum total of \$750,000 in 2024, \$1.75 million in 2025 and 2026, respectively, \$2.75 million in 2027, and \$4.75 million each year for 2028–32, respectively. However, this bill was derailed in May 2023.



# Challenges and Next Steps



The Sustainable Aviation Fuel Grand Challenge is aptly named due to the hurdles that need to be overcome to build this industry. Aside from the price premium incurred by SAF production, other barriers range from investment opportunities to moral arguments of food versus fuel.

## Identification and Analysis of Economic and Industrial Challenges to SAF Development in the Rocky Mountain Region

Several SAF feedstocks come from primary sources rather than waste or by-products. Corn that could otherwise be used as food is a key ingredient in many SAF blends and will continue to play an important role in ATJ fuel. There are also fears that arable, food-producing land could be converted for biofuel. These concerns unite environmentalists questioning land-use changes and agricultural producers worried about the impact on their animal feed supply.

Competition among sectors for sources of low-carbon feedstocks will be a hurdle for incentivizing SAF. Currently, the road sector uses most renewable fuels. Higher production costs associated with SAF output and more limited demand uptake are disincentives for producers to redirect feedstock to aviation. Nationally, and in many states, there is typically little intersectoral coordination — often reflected in their respective renewable fuel-related policies, which compounds the challenge.

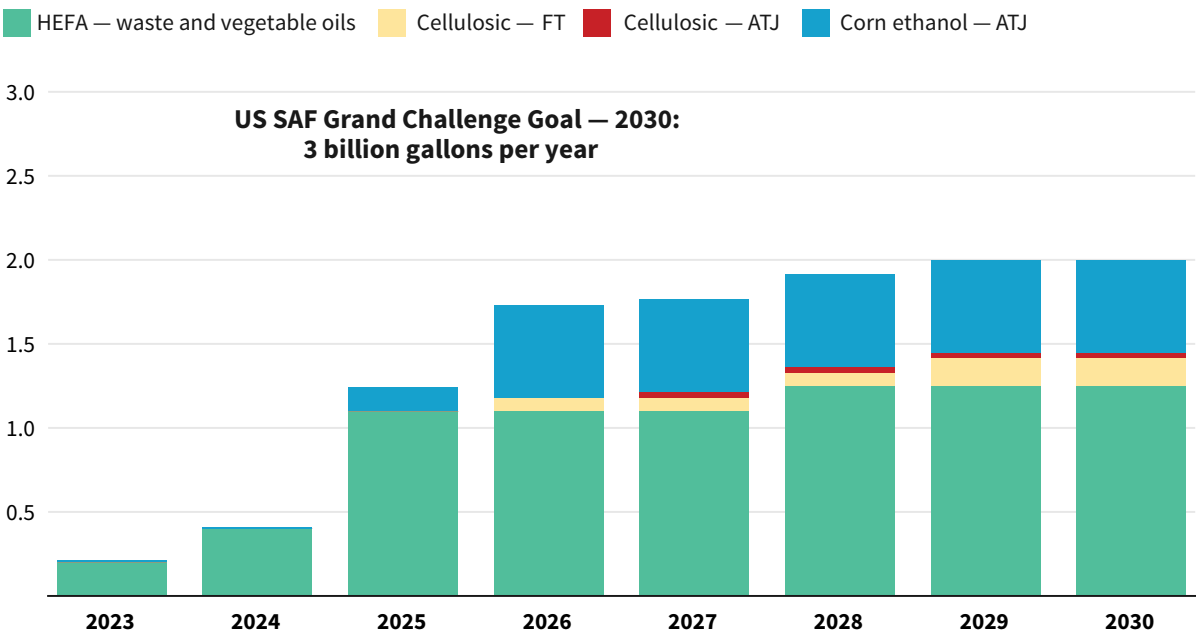
Pathways for refined SAF vary greatly in terms of technology readiness levels, with HEFA and ATJ already in production while many others await certification from ASTM. HEFA, using a more limited feedstock like waste fats, oils, and greases, can fill supply to an extent, but ultimately other technologies like PtL are needed to expand along with their respective supply chains.

The transition to SAF requires major investment. Although existing infrastructure may reduce some capital investment, it may be necessary to build or remodel entire processing facilities and develop entire supply chains. Current investments represent a small fraction of the required annual investment, and current announced investments are not on track to meet SAF Grand Challenge targets (see Exhibit 7).



Exhibit 7

Announced US SAF Capacity by Billions of Gallons (Bgal)



RMI Graphic. Source: RMI Analysis; S&P Global; SkyNRG, <https://skynrg.com/safmo2023/>

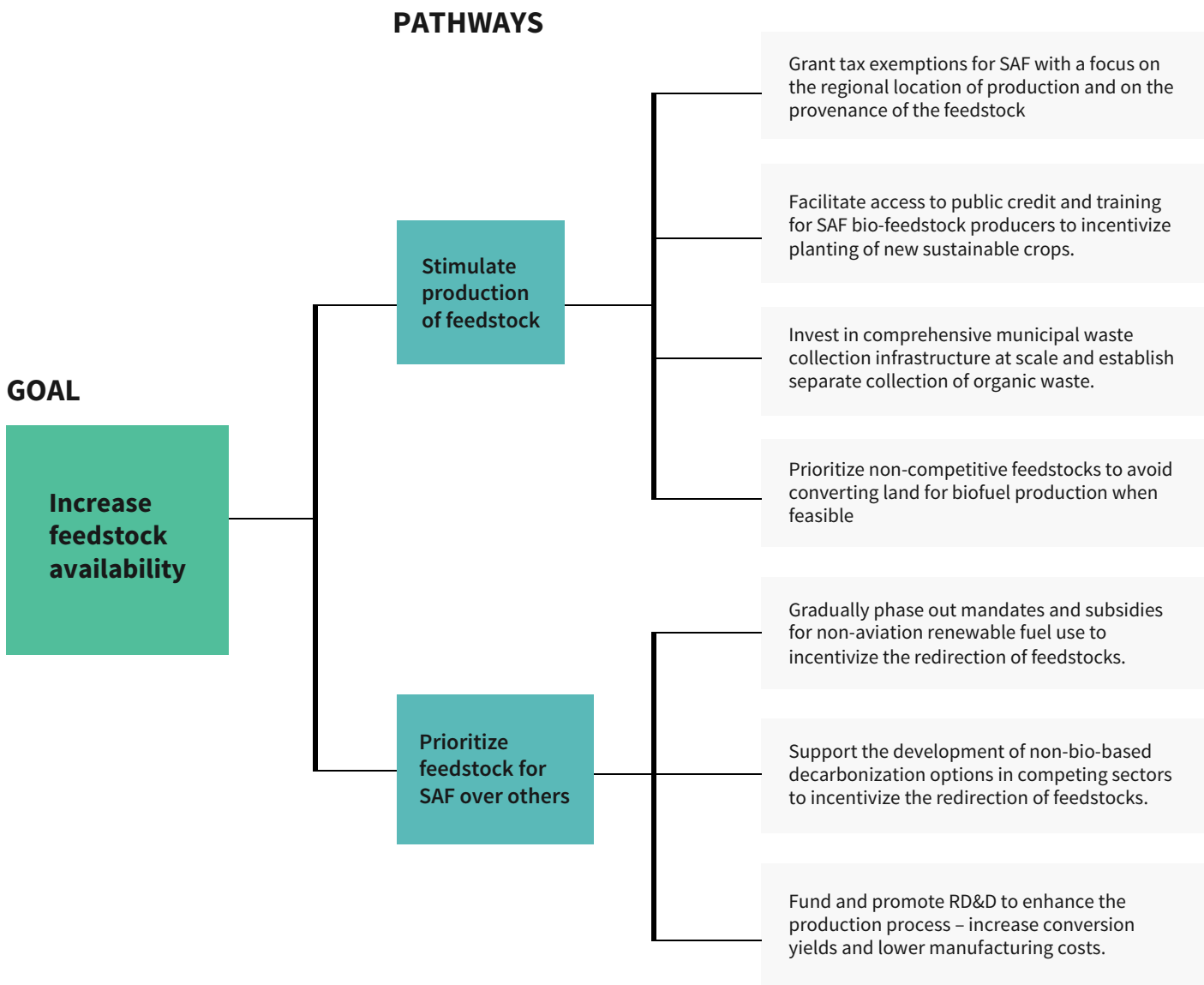
Strategies to Mitigate Risks and Address Challenges

The various challenges to SAF deployment can be met through levers that increase availability of feedstock and production capacity. On the supply side, prioritizing feedstocks toward SAF while stimulating production incentives can ensure that enough feedstocks are available to meet future refining demands.

Prioritizing SAF development requires a balance of removing mandates that incentivize non-SAF fuel pathways using the same feedstocks, while providing another avenue for those pathways. Road transport is a common example where feedstocks are used to refine biodiesel as a drop-in fuel but would be more effective to allocate toward industries with fewer alternatives for decarbonization, such as aviation.

Stimulating the production of feedstocks will ensure that SAF is produced at quantity but also able to scale with increasing demand (see Exhibit 8). Financial mechanisms can be drafted to target regional feedstock development and incentivize growing crops that support a more sustainable SAF blend. When shifting crops into a SAF feedstock, it’s vital to prioritize feedstocks that aren’t in competition for food production. Agricultural land conversion will need up-front training and assurances for farmers that there will be a market for their crops. Assurances go beyond mandating market demand because the chain of custody for SAF feedstocks must be traceable back to the farm. Creating a digestible yet robust method for tracking feedstock attributes, such as carbon intensity, has been a challenge that the private sector is starting to address.

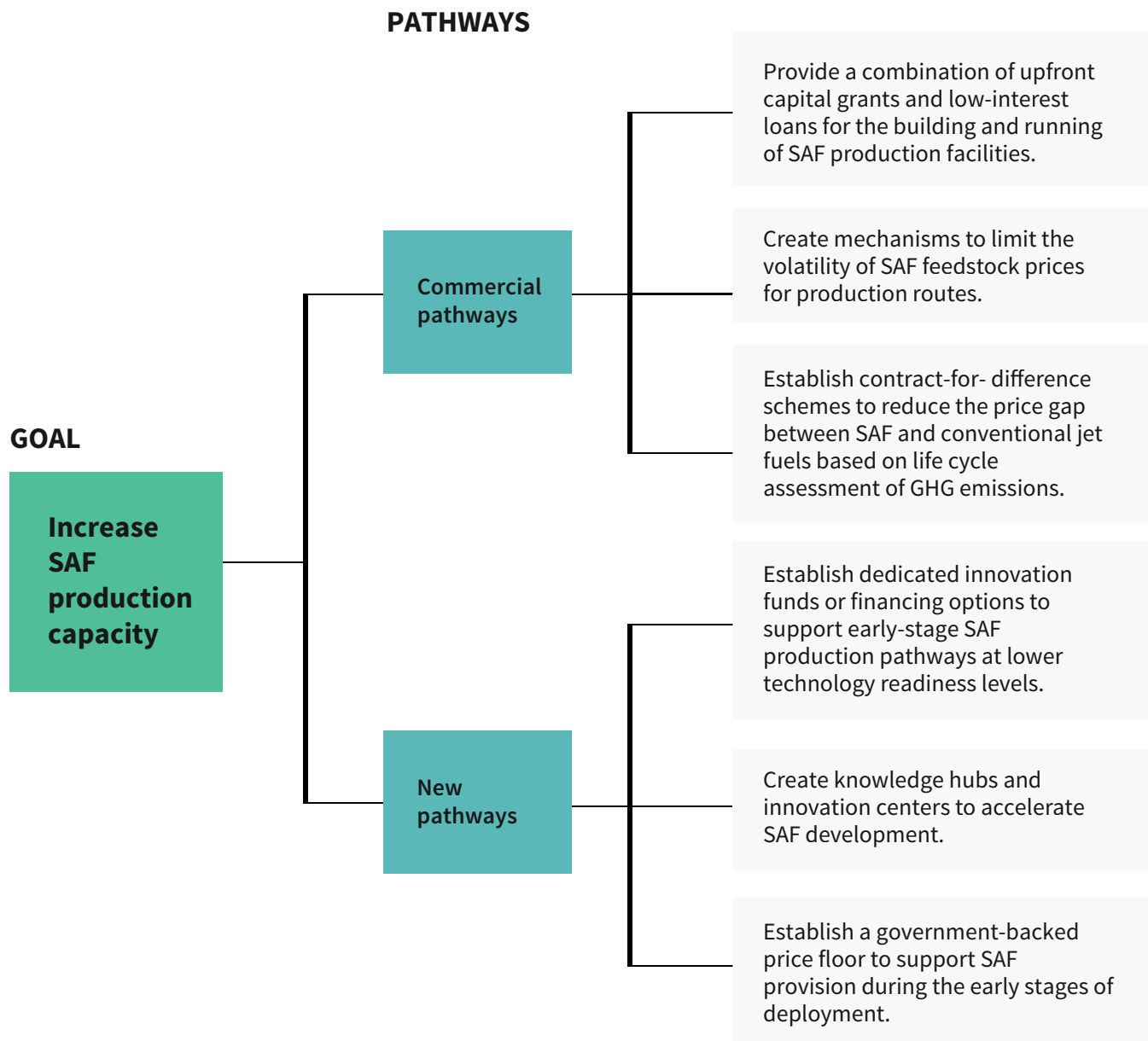
Exhibit 8   Levers to Increase SAF Feedstock Availability



RMI Graphic. Source: World Economic Forum, [https://www3.weforum.org/docs/WEF\\_Clean\\_Skies\\_for\\_Tomorrow\\_Sustainable\\_Aviation\\_Fuel\\_Policy\\_Toolkit\\_2021.pdf](https://www3.weforum.org/docs/WEF_Clean_Skies_for_Tomorrow_Sustainable_Aviation_Fuel_Policy_Toolkit_2021.pdf)

Production capacity gains can be made through concretizing the near-term commercial pathways and supporting development of new pathways for scaling beyond 2030 (see Exhibit 9). Triggering the growth of commercial pathways requires up-front assurances on the financial prospects. Low-interest loans or grants coupled with fuel tax credits can help improve the chances of commercial SAF plants reaching fruition. New pathways for SAF are being carefully explored as the market reveals increased future demand. Nascent technologies can be matured through innovation funding and the establishment of knowledge hubs (such as the Integrated Pennycress Research Enabling Farm and Energy Resilience project or IPREFER). Financial support mechanisms for novel refineries are crucial to ensuring scalability while competing not only with conventional and renewable fuels, but also possibly with other more reputable SAF technologies.

## Exhibit 9 Levers to Increase SAF Production Capacity



RMI Graphic. Source: World Economic Forum,  
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# Conclusion



The identification of potential growth areas and emerging opportunities for SAF within the Rocky Mountain region has highlighted pivotal factors that will shape the trajectory of the industry.

The significance of hubs boasting accessible infrastructure capable of integrating transportation and industrial facilities cannot be overstated because they underpin the marketability and distribution efficiency of SAF.

The regional availability of feedstock is equally crucial in terms of both quantity and strategic placement, rendering the region's SAF competitive on a broader scale. Moreover, the alignment of regional biofuel legislation with the necessary feedstock incentives and demand-side mechanisms provides a robust foundation for SAF scalability in the region.

Looking ahead, the recommendations for future actions, investments, and policy support underscore the potential to harness existing systems to propel a cost-effective and sustainable bioeconomy. By leveraging the RD&D capabilities of knowledge hubs, a bridge can be built between innovative research and successful project development.

In the face of these prospects, stakeholders must collaborate synergistically to steer the course of SAF development in the Rocky Mountain region. The convergence of favorable conditions, supportive legislation, and proven technologies offers a unique opportunity to not only transform the aviation sector but also catalyze positive environmental and economic impacts on a regional and global scale.



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**RMI Innovation Center**

22830 Two Rivers Road  
Basalt, CO 81621

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