



Toward an investable sustainable aviation fuel sector: the UK as a globally replicable model

Foreword

Since 2022, the GFI, supported by Breakthrough Energy, has been working with the UK Government, investors, lenders and insurers to identify solutions to create an investable advanced Sustainable Aviation Fuel (SAF) industry in the UK. This engagement has been underpinned by in house research and financial analysis as well as a state of the market report produced by KPMG for GFI, which is published alongside this report.

The reality faced by SAF project developers in the UK (and elsewhere) is that they are competing for capital with other less risky options – both in the clean and conventional technology space. In the case of debt capital in particular, a decision to invest ultimately comes down to whether a SAF project can provide sufficient risk-adjusted returns to clear a bank's credit approval processes. Where there exists an alternative investment with the same return, but lower risk, that will be preferred. Currently, there are many other options that beat SAF on this metric. Given that a cap on returns (a function of the buyout price for the SAF certificate trading system) has been fixed in the UK, for SAF plant to have a realistic chance of securing investment, efforts need to be made to further address risks if the governmental goal of having five plant in construction in the UK in 2025 is to remain in reach.

This report sets out what has already been done to address investor concerns – and what more could be done by the UK Government and the market to create an investable UK SAF sector.



Executive Summary

We share here our key findings on the state of the Sustainable Aviation Fuel (SAF) market, challenges to creating an advanced SAF industry in the UK and options for addressing them, some of which are already in the process of being implemented.

The aviation sector is a priority to decarbonise. With demand for air travel expected to double by 2040, emissions need to fall by an average of 3.4% per annum to keep the sector's GHG footprint stable over the next 15 years¹. While more efficient aircraft have the potential to reduce in-flight emissions by 20%², fleet replacement is expensive and occurs, on average, every 20 years. Transformative solutions such as hydrogen and electric planes will require significant hardware changes which are still in the early stages of development. Therefore, to reduce emissions in line with ambitious net-zero targets, SAF will play a pivotal role.

SAF is already available in global markets, however it only accounts for 0.53% of aviation fuel consumption. To meet future mandated demand, the SAF market needs to scale exponentially. However, established and lower cost methods of production, such as Hydroprocessed Esters and Fatty Acids (HEFA), are capacity constrained by feedstock availability. Advanced SAF will be crucial to scaling production, however, these technologies have yet to be proven at scale. With plant development costs that can exceed £1bn, a substantial amount of capital is needed. Currently, a number of barriers are preventing this, including:

- 1. Price risk** – SAF is a nascent market. The lack of an existing market price and uncertainty over future advanced SAF pricing is too significant of a risk for potential debt lenders.
- 2. Feedstock risk** – To get SAF projects past final investment decision (FID), feedstocks need to be contracted for a term that matches the tenor of the debt, typically 10-15 years. This is challenging given the immaturity of the advanced SAF industry, particularly given the high competition for these feedstocks with other cleantech industries.

- 3. Technology risk** – Novel technology pathways and an end-to-end technology process that is unproven at scale creates first-of-a-kind (FOAK) technology risk.

The UK Government is in the process of developing an enabling policy environment, the foundation of which is introducing an ambitious SAF mandate from 1st Jan 2025 to guarantee domestic demand. This is necessary but not sufficient to ensure plant bankability, therefore, in addition the Government has committed to introduce a Revenue Certainty Mechanism (RCM) to address price risk. Construction time for SAF plant is 4+ years, therefore to meet the 2030 SAF mandate of 10%, plant need to pass final investment decision within the next 12 -24 months. Given the RCM won't be operational until year end 2026 at the earliest, GFI's market engagement indicates interim revenue certainty mechanisms are needed. This could take the form of an offtake agreement with both price and volume commitments to bridge this gap and get 2-3 SAF plant through FID and into construction in 2025.

Finally, given the novel nature of the technology for the first few UK advanced SAF plant to get past FID, public-private risk sharing across the debt capital structure is also needed. This could come from public finance instruments, including some combination of loan guarantees, export credit guarantees and concessionary or mezzanine debt. The capital structure risk can be further distributed to private sector insurance, through performance guarantees or warranties. The GFI will continue exploring the model of risk sharing across the capital structure, engaging key stakeholders on the role they can play and how these various instruments can be most effectively blended to allow SAF plant to get past FID and get spades in the ground.

¹ Source: [iata.org/en/iata-repository/publications/economic-reports/global-outlook-for-air-transport---june-2023/](https://www.iata.org/en/iata-repository/publications/economic-reports/global-outlook-for-air-transport---june-2023/)

² Source: [Net zero 2050: new aircraft \(iata.org\)](https://www.iata.org/en/iata-repository/publications/economic-reports/net-zero-2050-new-aircraft/)

Introduction

Responsible for 2.5% of global GHG emissions³, decarbonisation of the aviation sector is now firmly on policy-makers agendas. To reach net zero by 2050, SAF has been identified as a key transition solution, with the International Air Transport Association (IATA) estimating that 65% of the emission reductions required will be achieved through the use of SAF⁴.

Operationally equivalent to Jet A1, SAF offers a “drop-in” solution to power aviation with up to 80% fewer CO₂ emissions. It can be directly blended with Jet A1 and is broadly compatible with modern aircraft. This allows airlines to continue flying their existing fleet while original equipment manufacturers (OEMs) continue improving aircraft efficiency and in parallel bring to market transformative net zero hardware solutions such as hydrogen powered and electric aircraft.

Global SAF production in 2024 is expected to reach 1.5 million tonnes, representing only 0.53% of aviation’s fuel requirements for the year⁵. However, a surge in SAF mandates and non-binding targets has marked a turning point for global SAF demand. By 2025, the majority of SAF consumption is expected to be under mandate⁶. Should all the proposed legislation come into force, 6.9Mt of global SAF demand will be mandated by 2030. Including non-legally binding targets, 2030 global demand could reach 9.2Mt. This demand has the potential to significantly outstrip expected supply, theoretically ensuring robust pricing.

³ Source: [What share of global CO₂ emissions come from aviation? - Our World in Data](#)

⁴ Source: [IATA - Sustainable Aviation Fuel \(SAF\)](#)

⁵ Source: [IATA - SAF Production to Triple in 2024 but More Opportunities for Diversification Needed](#)

⁶ Source: [SAF-Market-Outlook-2024-Summary.pdf \(skynrg.com\)](#)





There are multiple different pathways to produce SAF. HEFA production is the most mature pathway and dominates current global production. However, given their reliance on waste fats and oils as the primary renewable feedstock, global production is considered capacity-constrained. To meet net-zero targets in the UK and elsewhere, there is a need to scale advanced (second/third generation – or 2g/3g) SAF technologies such as advanced biofuels and Power-to-Liquid. These technologies are comparatively immature and projected to be 2-4x more expensive than HEFA. Substantial capital investment will be required to demonstrate and deploy them. However, given the immaturity of both the technology and the SAF market, risks around plant construction and commissioning, revenue certainty and supply of feedstock are currently too significant to make the sector investable in most markets without further market interventions.

The UK is one of a number of countries working to develop a supportive environment for SAF investment in country. Alongside the £165mn in grants from the Advanced Fuel Fund, the UK Government has committed to implement a SAF mandate from the 1st January 2025 (subject to parliamentary approval). This will require a 2% blend of SAF by 2025, 10% by 2030 and 22% by 2040. While the mandate generates a robust demand signal, further measures are needed to ensure SAF plant are seen as 'bankable' in the UK by lenders. In September 2023, an amendment was published to the Energy Bill along with a consultation published in April 2024 on an RCM to address investor concerns about price risk. The RCM is not likely to be implemented before Q4 2026. Given construction and commissioning times of 4+ years for SAF plants, there remains a challenge in reaching final investment decisions in the near term to achieve 2030 targets. This report sets out the some of the analysis developed by the GFI to support UK policy making, including the decision to consult on an RCM, as well as options for addressing remaining risks with the goal of enabling plant to get through FID in 2025.

The UK Market opportunity

The UK SAF market is small and fragmented, sized most recently in 2022 at \$3.7mn⁷. Currently, there are no dedicated facilities producing SAF. The SAF supplied in 2023 came primarily from the Humber Refinery, a co-processing facility operated by Phillips66. The UK government has the goal of having five SAF plant under construction in 2025 – and there are a number of facilities due to come online between now and 2030. However, combined current and announced capacity is only sufficient to meet half of the 2030 mandated volumes⁸.

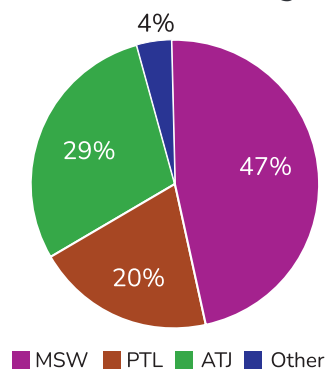
To meet its ambitious SAF mandate, the UK will need to attract sufficient investment to develop its domestic SAF production capacity. If this is not achieved, the UK will have to import SAF from what is likely to be a highly competitive global market. This also misses the opportunity to create good quality jobs in the UK, which is a key goal of the UK’s new Government, elected in July 2024⁹. Thus, as a priority the barriers to investment need to be worked through and solved. Key Risks to investment include price, technology and feedstock. Securing the investment required to meet the goal of having five plant in construction in 2025 will require developers to secure billions from private markets, supported by policy and incentives that are conducive to securing this investment. That policy environment is already partly developed – but given the construction time for a SAF plant is 4+ years, the next 12-24 months will be crucial to ensure to get UK SAF plants past FID and into construction in 2025 and operational in 2030.

There are currently nine certified pathways to produce SAF, each with widely varying costs, scalability, and GHG profiles, depending on their feedstock and the maturity of the technology. The most mature standalone SAF production pathway is HEFA: a proven technology that has been demonstrated at commercial scale for many years.

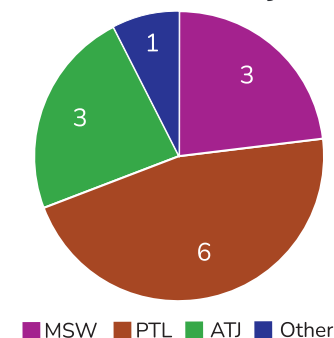
It is currently leading from both a present and future production volume perspective and is estimated to account for 85% of SAF volume over the next five years¹⁰. However, the primary renewable feedstock for HEFA, waste fats and oils, is in limited supply. This constrains its production capacity to a level that will be insufficient to meet global net zero targets, highlighting the need to diversify SAF supply.

In support of supply diversification, plant supported under the UK Government’s Advanced Fuel Fund, include a mixture of technologies. Of the allocated £135mn, 47% has been awarded to Municipal Solid Waste to SAF (MSW) with a total of four projects receiving funding, 29% has been awarded to three Alcohol-to-Jet (ATJ) projects and 20% to six Power-to-Liquid (PtL) projects. One pyrolysis plant, operated by Abundia, has also received ca.£5mn of funding.

Advanced Fuels Fund, Funding Allocated (£)



Advanced Fuels Fund, Projects Funded



⁷ Source: Apollo

⁸ Source: Urgent Government action needed to meet 10% Sustainable Aviation Fuel by 2030 target | Sustainable Aviation

⁹ The current government has retained its commitment to the SAF sector, issuing a ministerial statement on 22 July 2024 that reiterated its intention to introduce both a SAF mandate from 1 January 2025 and a revenue certainty mechanism. It stated that SAF production is expected to add over £1.8billion to the economy and create more than 10,000 jobs across the country, while also supporting decarbonisation.

¹⁰ Source: IATA - SAF Volumes Growing but Still Missing Opportunities

Barriers to scaling the SAF industry

Many of the technology pathways for producing advanced SAF are novel, leading to FOAK technology risk. Finding suitable investors is a challenge given developers are small start-ups or scaling businesses. Equity would seem to be an obvious option – but for private equity and infrastructure fund managers the ticket size is attractive but the risks too high to secure investment. For venture capital the risk profile is more attractive but ticket sizes too big for a single investor. A mixture of equity and debt provision will therefore be key to securing finance for FOAK plant.

Reaching FID, the point at which a project sponsor commits to construct a project, will rely on transferring and sharing risks between different counterparties through contractual agreements, so the underlying project is sufficiently de-risked to allow a bank to lend against those cash flows. The term of the debt at this scale is typically 10-15 years. To get to this point, a number of risks need to be addressed.

The table sets out the key milestones in getting a SAF project financed and built, key hurdles that need to be cleared at each stage and the associated risks. These risks relate to both global market conditions and the deployment of new technologies within the UK.

Milestones	Key Hurdles	Key Risks
Final investment decision	Permits and licensing	Regulatory
	EPC agreement	Construction / Technology
	Technology performance insurance	Technology
	Feedstock supply contracts	Feedstock
	Offtake agreements	Price / Volume / Credit
	Renewable power purchase agreement	Energy
	Other agreements (e.g. land lease, technology, utilities)	Other
Project completion	Plant construction	Construction
	Mechanical completion	Construction / Technology
	Commissioning	Technology / Feedstock / Operational
Plant operation	Supply chain management	Feedstock / Operational
	Operational efficiency	Technology / Operational
	Revenue stability	Price / Volume

The risks can be viewed as a series of ‘adjustable levers’, with investors able to manage certain levels of some risks providing there is sufficient transparency on others. Below we provide further context on these risks and in a [later section](#) we provide further context on some of the available options to address them.



Feedstock risk

To get advanced SAF projects past FID, feedstocks need to be contracted for a term that matches the tenor of debt. Advanced SAF production is competing with other cleantech industries for feedstocks. For example, the Municipal Solid Waste used in Gasification Fischer-Tropsch SAF production is also a key input for Energy-from-Waste (EfW) plants. In the case of MSW supplies, the relative immaturity of the SAF industry makes suppliers wary of long-term commitments, out of concern about the risk of the SAF plant failing and not being able to take its contracted volume.

In Power-to-Liquid SAF production, a significant amount of electricity is required to produce hydrogen. For the SAF to meet GHG emission reduction requirements, this electricity needs to come from renewable sources. Given high competition, accessing cheap green energy for long-term contracts is difficult, and further complicated by additionality requirements stipulated in the UK (and also EU) mandates. Additionally, green hydrogen, is a core component for decarbonisation in other industries such as steel and chemicals.

Price risk

SAF is a nascent market: small and fragmented. It is also concentrated in 1st generation HEFA-type SAF, which has a lower cost of production. The price of advanced SAF is impossible to forecast accurately. Even with global demand for SAF forecast to outstrip available supply, the lack of an existing market price and uncertainty over future advanced SAF pricing (with a cost of production +4x times fossil kerosene) it is too significant a risk for potential debt lenders to take without risk mitigants in place.

Offtake agreements are an effective way to mitigate price risk, but the tenor needs to match debt terms, circa 10-15 years. Both who the offtaker is and their creditworthiness are important factors. Many airlines, which might seem an obvious offtaker, are not deemed credit worthy beyond ~5 years. The fuel suppliers (the intermediaries that move fuel from producer to airline and who are the obligated party under the SAF mandate) are considered credit worthy counterparties, but are not yet materially active in the advanced SAF market.

Technology risk

Options exist to start to mitigate FOAK / technology risk, to increase the bankability of projects.

- **Leveraging corporate balance sheet:** Strategic corporate investors – for example the UK power companies that invested in the early days of the onshore wind market – can carry risks by virtue of having a significant balance sheet to leverage. In the case of SAF, strategic corporate investments into advanced SAF by the oil and gas suppliers mandated to blend it are not currently forthcoming. Instead, leading developers are smaller companies that do not have this option available to them.
- **Technology performance guarantees & insurance** are provided by technology suppliers and/or external insurers to mitigate technology risk for investors. Technology suppliers provide full or partial guarantees, but for SAF plant, these typically don't match the level of risk associated with the capital being provided. Private sector insurance is increasingly showing interest in the sector, with New Energy Risk having underwritten a significant tranche of debt for a US based MSW-SAF project that was a key enabler to that project getting the necessary debt finance. Premiums for such insurance are understandably high, which can be prohibitive for some project developers.
- **Engineering, procurement & construction (EPC) agreements** transfer key risks in the construction phase to construction companies. In more mature sectors, these companies may commit to EPC wraps, that effectively transfer the major risks associated with construction and commissioning. However, given the FOAK technology risk of SAF, EPC wraps are not available in the short term.





Creating investment-enabling conditions in the UK: state of play

The UK Government is developing a broader policy enabling environment to mitigate some of the risks mentioned above. It intends to introduce a SAF Mandate from 1st Jan 2025. It has also committed to implementing an RCM: a consultation on this closed on 20th June 2024. Given there are a number of steps required for the RCM implementation (as detailed in the Annex), including potential primary legislation, this is unlikely to be introduced before the end of 2026. Detail on both these policies is provided below, including their potential to address key investment risks, particularly surrounding demand and price.

SAF Mandate

In July 2022, as part of its Jet Zero Strategy, the UK's previous Government announced it would introduce a SAF Mandate from 2025. The finalised mandate was recently published and will come into effect from 1st January 2025, subject to parliamentary approval. As per this regulation, 2% of UK aviation fuel will need to be from sustainable sources in 2025, approximately equal to 230,000 tonnes of SAF. This obligation rises to 10% in 2030 and 22% in 2040 with the path beyond 2040 to be established as the industry develops to ensure further targets are achievable. The policy is forecast to reduce projected 'business-as-usual' aviation emissions by 2.7 MtCO_{2e}¹¹ in 2030 and 6.3 MtCO_{2e} in 2040¹².

Details of the mandate are provided in the [Annex](#).

¹¹ Million Metric Tons of Carbon Dioxide Equivalent

¹² Source: Aviation fuel plan – GOV.UK (www.gov.uk)

While the mandate works to address volume risk, it has been acknowledged that its measures are insufficient to ensure the bankability of SAF plants. This has led to industry calls for a RCM. The GFI has been actively involved in the development of this mechanism, conducting proprietary analysis and market engagement with others to determine and advise on the optimal approach. Consequently, in an amendment to the energy bill (September 2023), the UK Government has committed to implement an RCM by end year 2026. The following section lays out details of the analytical and investor engagement work GFI did to support these decisions.

GFI's Analysis of an RCM

At the request of the Jet Zero Council Commercialisation Delivery Group, GFI alongside the Renewable Transport Fuel Association (RTFA) assessed options for an RCM to address price risk. Four options being considered by the DfT were reviewed to identify the optimal price mechanism structure that balances the needs of SAF producers, investors and government. These comprised of:

- **Guaranteed strike price (GSP)** – guarantees an agreed price per litre of fuel produced to SAF producers who choose to apply to the scheme (similar to low carbon electricity contracts for difference (CfD)).
- **Buyer of last resort (BOLR)** – a counterparty steps in to purchase SAF certificates when the market price falls below an agreed level. This guarantees an agreed minimum price for the producer's SAF certificates redeemed through the SAF Mandate.
- **Mandate auto-ratchet (MAR)** – the Mandate (and its HEFA cap) adjusts when there is an oversupply in the market, to bring the price of SAF back closer to the buy-out price.
- **Mandate floor price (MFP)** – includes a minimum price for certificates which is universally applied through the Mandate itself (in addition to the buyout price).



GFI also considered possible industry-led interventions (based on any of the above) and a 'do nothing' option (i.e. no long-term revenue certainty mechanism is implemented either by government nor industry) which analysis and engagement showed was not a suitable option.

GFI's research comprised of:

- Analysis and modelling of the various mechanism's outcomes, based on MSW-SAF technology, against various supply/demand scenarios.
- Developing the logic to determine a minimum viable floor price.
- Developing a risk allocation framework.
- Consideration of the funding perspective i.e., how financial resources to underpin the scheme could be secured.

In addition, GFI considered the viability of other measures that could assist project developers in the task of raising both debt and equity investment for the first projects, in line with an 'Icebreaker approach' proposed by an independent consultant: Philip New.

Analysis was underpinned by several assumptions. These included:

- To keep the analysis manageable the GFI modelled indicative costs for an MSW-SAF plant, based on publicly available data. The model was based on a 15-year revenue certainty contract term and the key inputs were:
 - SAF price forecast developed by ICF, which was commissioned by Sustainable Aviation for use in their 2050 Roadmap. We used the MSW-SAF price forecast.
 - Cost of production as set out in the Sustainable Aviation Fuels Mandate Consultation Cost Benefit Analysis published in May 2023¹³. This was developed by the Whittle Lab at Cambridge University. We used the mid-range 2022 cost estimate for MSW-SAF production. The plant modelled produces 100m litres of SAF per annum with a capital cost of ~£800m.
- It is important to emphasise that industry feedback at the time of modelling indicated expected costs would be higher than the assumptions used here. However, noting the price forecast used was also based on similar production cost estimates at that time, at the request of DfT, and in lieu of more accurate data, we determined the findings sufficient for the purpose intended – which was to provide a comparison of the options and relative cost-benefit analysis, to support DfT’s decision making on the need to implement a revenue certainty mechanism. In the final SAF Mandate Cost Benefit Analysis published in April 2024, the Whittle Lab updated their cost estimates to be significantly higher than those used in this modelling.
- From a mathematical perspective the BOLR and MFP amount to the same thing and so received the same treatment in the modelling.
- Feedback from the GFI’s Investor Working Group was that the ratchet mechanism would not work in isolation as it does not provide sufficient certainty of revenue levels. However, it could complement the BOLR/GSP and provide a level of dynamic price support if the market is oversupplied. Thus, the ratchet mechanism has not been modelled separately but has been integrated into the downside scenario for both the GSP and BOLR mechanisms.

- The overall outcomes of this analysis, as a comparison between the revenue certainty options, can be considered transferable to other SAF technology pathways (e.g. AtJ & PtL), albeit they will have different costs of production and associated SAF prices. Broadly, the pros and cons will be similar.

In terms of the model itself, the following assumptions were used to build the model, informed by engagement with investors both bilaterally and through feedback during the three Investor Working Groups GFI held during June and July 2023. The model and assumptions have been reviewed by a number of investor and industry stakeholders.

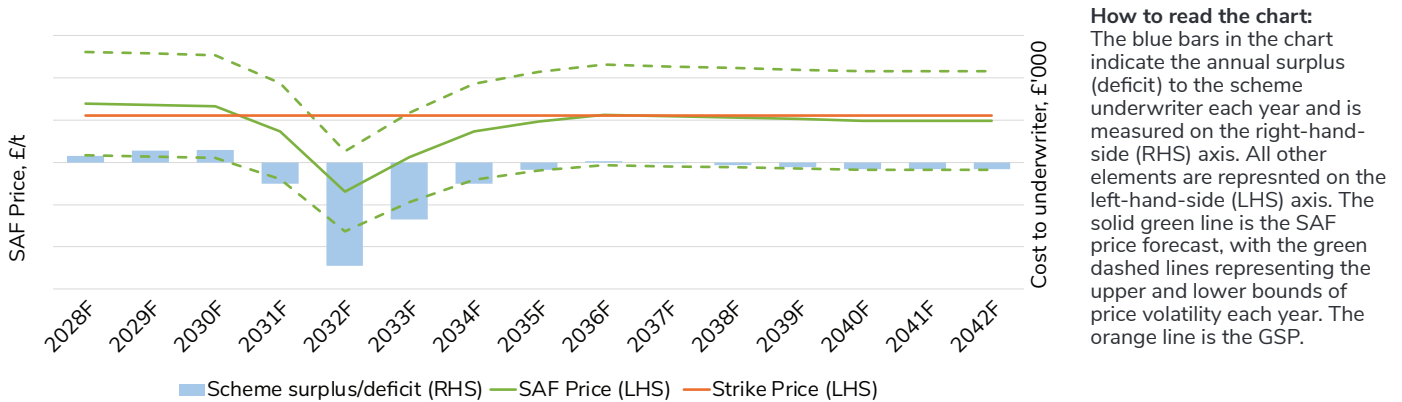
- The carbon intensity of the SAF produced is assumed at 70%. 1L of SAF is awarded 1 SAF certificate.
- Strike and minimum prices have not been inflated.
- Price volatility is based on a normal distribution with reference to the jet A1 fuel price.
- Tenor of debt at 12 years post completion.
- Equity return at 15% (noting that without revenue certainty, the expected rate of return would be higher).
- Debt interest rate of 7.5%.

The below provides further detail on each of the price support mechanisms assessed. The charts present an indicative view of how the mechanisms might operate under the proposed scenario. Multiple scenarios were modelled, however, we only present one in this document for simplicity.

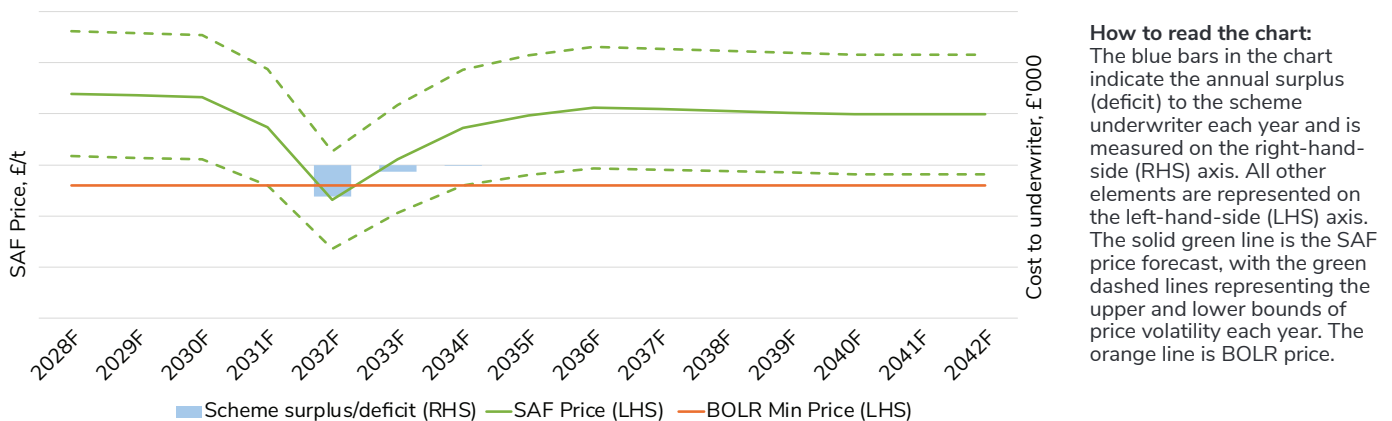
Scenario: *In the early years of plant production, regulated demand meets supply and provides sufficient price support for production. However, global government price and demand signals have triggered a significant investment in production. This production comes online in the early 2030s, and the market becomes oversupplied in 2031 and 2032. The UK Government recognises this oversupply, and triggers the ratchet mechanism, increasing mandated demand in the UK. This provides price support in 2033 and the UK SAF market price reverts to the mean forecast, reducing scheme deficit in future years.*

¹³ UK sustainable aviation fuel mandate: consultation-stage cost benefit analysis (publishing.service.gov.uk)

Guaranteed Strike Price (GSP): Similar to a CfD model¹⁴, the GSP is a private law contract between a scheme underwriter, such as the Low Carbon Contracts Company (LCCC) and the SAF developers, that provides developers with a fixed price (strike price) for every tonne of SAF they produce. The strike price is theoretically set at a price that covers the cost of production and debt financing costs, and provides a return for equity investors. The price is the same for every tonne produced; if the market price is lower than the strike price, then the scheme underwriter pays the difference. If the market price is higher than the strike price, the developer pays back the difference to the underwriter.



Buyer of last resort (BOLR): The BOLR would also be based on a private law contract and provides developers with a minimum price for every tonne of SAF they produce. The minimum price is theoretically set at a price that covers the cost of production and debt financing costs. If the market price is lower than the minimum price, the scheme underwriter pays the difference. However, when the market price is above the minimum price, the difference is profit to the developer that provides equity returns.



Mandate auto-ratchet (MAR): A ratchet mechanism within the mandate would introduce a function whereby the Government could dynamically adjust the mandate rate (e.g. from 10% to 12%) earlier than planned. It could be introduced in response to a scenario in which SAF is oversupplied, causing a price crash, pushing up demand and driving prices back up.

Mandate floor price (MFP): A price floor within the mandate. This would write into the SAF mandate legislation a minimum price for every litre of SAF supplied in the UK.

¹⁴ A Contract for Difference (CfD) is a financial mechanism where the government (or alternative counterparty) pays the difference between the market price and a pre-agreed strike price, ensuring price stability and revenue certainty for producers.

GFI's Key Findings

What's the best RCM option?

The analysis and engagement found:

- At the right price, either a GSP or a BOLR mechanism would provide enough revenue certainty for investors to manage price risk.
- The mandate auto-ratchet would not be enough to mitigate price risk on its own. However, it could be a complimentary measure for the GSP or BOLR, that could be used to increase mandated demand in periods of price depression (as modelled above), reducing downside risk to the scheme underwriter. However, further engagement with investors indicates that such a mechanism by virtue of it being adjustable at the Government's choice may create more uncertainty and would not be favoured by financiers.
- The mandate floor price was not considered a viable option, as the incentive could not be targeted at UK SAF producers. Rather, it would flow to any SAF suppliers, locally or globally.

In its RCM consultation, the UK Government published independent analysis undertaken to score these four options against 1) investability, 2) deliverability and 3) affordability. Aligning with our findings, the GSP came out with the highest overall score, offering the highest level of certainty for investors, is familiar to the market (parallels can be drawn with renewable CfDs), and would be administratively simpler to manage for the counterparty for example, the Low Carbon Contracts Company. For full analysis see [here](#).

A comparison of the GSP vs. the BOLR

Guaranteed Strike Price	
Pros	Cons
<ul style="list-style-type: none"> • Provides price stability to both equity and debt, effectively eliminating price risk. • Provides upside opportunity to the underwriter of the scheme when the market price floats above the strike price (whether HMG or industry). • Private law contract increases investor confidence. • Will achieve more efficient (not lower) pricing through competitive tender than the minimum price model. • CfD-type instruments have a long history in the UK through the renewables sector, so investors are familiar with how they work and have confidence in their function e.g. they will be simpler for bank credit committees to understand and therefore sign off. • If the underwriter is industry (e.g. airlines) the GSP will be the preferred option as it provides cost certainty to industry. 	<ul style="list-style-type: none"> • In periods of price depression, the cost to the scheme underwriter will be greater than under the BOLR. • In the early years of a GSP there may be complexities around understanding the true market value of SAF, so the real reference price may be depressed. These complexities include: <ul style="list-style-type: none"> • If all UK production was contracted under a strike price, the market value may become distorted as producers are not incentivised to sell fuel for a high price (their profit is contained to the strike price) so market prices may be lower than what it would be under open market dynamics. • If fuel producers are producing according to the UK SAF mandate sustainability/feedstock criteria, then the relevant reference price needs to reflect this. An international reference price may not be as relevant if the fuel does not meet UK SAF mandate sustainability/feedstock criteria.

Buyer of Last Resort	
Pros	Cons
<ul style="list-style-type: none"> • Provides debt investors with price stability, effectively eliminating price risk. • Provides equity investors with a minimum return, with the benefit that they also get the upside above the minimum price up to the buy-out price. • Private law contract increases investor confidence. • Market engagement indicates this instrument is the preferred option for equity investors. • Price discovery will be simpler, as producers will be motivated to sell SAF at a higher price than the minimum price because it increases their return on investment. • Downside risk could be further mitigated with the inclusion of an option for the administrator to sell back certificates when prices rise, albeit this will add an additional layer of administrative complexity. • If the underwriter is HMG, the BOLR will be the more attractive option as it minimises downside risk. 	<ul style="list-style-type: none"> • There is no upside for the scheme underwriter, only downside risk. • The minimum price will likely be higher than theoretical modelling. Through the price-setting process (between administrator and developer), the providers of equity would likely set a minimum rate of return closer to their expected rate of return. This would mean the BOLR would be triggered more often.

Further scheme design features for the for the Government to consider

The detailed design of the scheme will be critical to ensuring it supports capital investment into UK SAF producers over the long-term. GFI's engagement with the market indicates the following issues remain outstanding:

- **Contract allocation:** ensuring that only companies that can produce and deliver SAF in the UK are awarded contracts. Requires detailed due diligence to avoid contracts being awarded to projects that are unable to get to project completion.
- **Price setting process:** ensuring the strike price or minimum price is optimally set at a level that meets the competing needs of SAF producers, government and the broader industry. It should utilise a balance of competitive tension through an auction process, combined with a well-informed bilateral negotiation that recognises the nuances of SAF technology pathways.
- **Price discovery:** ensuring a market price for 2g and 3g SAF is allowed to develop, thereby reducing the short/medium term cost of any RCM, and facilitating a longer term move toward more free market dynamics where an RCM is not required. As an example, if all UK SAF production is contracted under a GSP, then there will be no motivation for SAF producers to achieve a high market price, as their returns are fully underwritten by the GSP. Options to address this could include:
 - SAF producers are only awarded a GSP contract on X% of their volume (e.g. 80%), with the remaining to be sold on the market, thereby developing a natural market price. This would have the advantage of also giving equity investors access to upside market prices, and the opportunity to increase their returns.
 - Taking learnings from the Hydrogen and CCUS business model, apply some form of gain share where producers are allowed to keep a share of the price for any market price received above the strike price.
- **Scheme funding:** the Government have always stated the RCM is to be industry funded however the mechanism for funding is not yet clear. Options to consider include:
 - Increasing the passenger duty to directly cover scheme costs.
 - Redistributing aviation UK Emissions Trading Scheme (UK ETS) costs back into funding this scheme. Using the GHG-associated costs of fossil kerosene to fund the green transition of the industry seems a logical step.
 - The SAF mandate obligation applies to the fuel suppliers, so a levy could be applied to the fuel supplier to cover scheme costs.

As noted earlier, it is anticipated that the RCM will not be introduced before Q4 2026 and in the recent Government consultation, pre-RCM interim measures were not proposed. During GFI's engagement with investors, it was highlighted that even if an RCM is introduced, it may not be sufficient to stimulate SAF plant debt financing for the first few SAF plant across different technology pathways. Other risks will also need to be addressed in tandem to reduce uncertainty, particularly over the short term, to get the first few UK SAF plants to a final investment decision. We highlight some potential solutions in the following section.



Addressing wider risks

GFI worked with investors to identify and take forward solutions to address the risks identified. Solutions focusing on managing price risk were developed in detail and were a key input into the Government’s decision to consult on an RCM. The table summarises some of the solutions available to mitigate key risks across the most challenging aspects of a SAF production plant development and operation.

Project Stage	Construction & Commissioning	Operational Management	Revenue Generation
Government Intervention	Debt guarantee (high)	Strategic planning (medium)	Guaranteed strike price (high)
	Export credit guarantee (high)	Regional government prioritisation (low)	Buyer of last resort (high)
	Mezzanine loans (high)	Behind the meter connections (medium)	Public procurement (medium)
Industry Intervention	Insurance mechanism (high)	Pass through key input costs to offtaker (low)	Collective offtake (high)
Risk Addressed	Construction / Technology	Feedstock / Energy	Price / Volume

Note: ratings in brackets denote the relative impact of interventions on investment attraction.

We expand on some of these proposed solutions below.

Construction and technology risk

- **Public finance co-instruments** are an effective method of crowding in private capital by reducing financial risk and increasing confidence for investors. Such approaches can bring down the cost of capital of a project, reducing financing costs. This has the added benefit of reducing the strike price or minimum price that would be required through the UK RCM. The UK Infrastructure Bank and UK Export Finance are the two key institutions in the UK that can provide such facilities.

UK Infrastructure Bank products include¹⁵:

- Debt facilities across the capital structure, with the ability to tailor solutions to each transaction. Debt can be provided on a fixed or floating rate basis and includes senior debt, mezzanine debt and bridge financing. Mezzanine debt, in particular, can be used to help crowd-in debt capacity by reducing the risk of a project from the perspective of senior funders, potentially also raising the project's overall debt capacity. This can be achieved by, for example, providing funded or contingent mezzanine debt to cover construction cost overruns, respond to temporary revenue shortfalls, or to wrap and thus mitigate specific technical or commercial risks.
- Guarantees to qualifying infrastructure projects backed by the Sovereign Infrastructure Guarantee, including:
 - Financial guarantees: providing credit substitution for an underlying debt instrument.
 - Credit enhancement guarantees: unfunded guarantees designed to enhance the credit quality or credit rating of other project debt.
 - First loss guarantees: guarantees for a capped amount of potential losses on a portfolio of smaller debt obligations.

UK Export Finance products include:

- Export Development Guarantees¹⁶ that help UK exporters to access high-value loan facilities for general working capital to execute projects that will boost international trade. There is the possibility that such an instrument could be used based on UK SAF producers selling SAF to foreign airlines at UK airports. This has not yet been tested in practice or approved by UK Export Finance, but remains a concept worth exploring.
- Direct Lending Facility¹⁷ provides a direct loan from UK Export Finance to an overseas buyer to support the purchase of goods, services or intangibles from the UK. Such an instrument could be used to guarantee the debt required to pay for services from a UK technology provider or construction company working on a foreign SAF project. Such products are also offered by foreign country export credit agencies and could be used to guarantee the debt required to pay for the goods and /or services provided by companies domiciled in those countries, to UK SAF plant construction.

National Wealth Fund:

- The new UK Government has committed to launch a new catalytic investment vehicle, the National Wealth Fund with the aim to mobilise billions in private capital towards the UK's transition to net zero. It will be allocated £7.3billion of additional public capital.
- The fund is slated to reshape the approach to public, private risk-sharing, providing private investors with the confidence needed to fund the technologies and infrastructure needed to drive growth in green industries within the UK.
- Although SAF is not included within the initial scope of the fund, we believe the catalytic approach intended is needed to create an investable SAF sector in the UK and so if UKIB or UKEF cannot support investment, the NWF should be considered.

¹⁵ Source: [Our products | UK Infrastructure Bank \(ukib.org.uk\)](#)

¹⁶ Source: [Export Development Guarantee - UK Export Finance](#)

¹⁷ Source: [Direct Lending Facility - UK Export Finance](#)

- **Technology performance insurance** is increasingly being used to address FOAK technology risk in green technologies. Several insurers are considering product development in this space, approaching the technology with significant due diligence, and believing that, often, the broader market is overpricing the risk associated with these investments. New Energy Risk is an example of this, with the company specialising in providing performance insurance solutions to support the commercialisation of novel technologies. While the premiums for technology performance insurance may be high, if it brings down the cost of capital sufficiently then it could make sense. And without a balance sheet to leverage or access to government guarantees, it may be the only option.

Feedstock / energy risk

- **Strategic planning:** Cross-government department engagement is needed to ensure feedstock availability. The Department for Environment, Food & Rural Affairs (DEFRA, who are responsible for waste policy), the Department for Transport (DfT) and the Department for Energy Security and Net Zero (DESNZ) need to coordinate on waste policy to establish a hierarchy for feedstock use based on emissions reductions achieved and whether feedstock needs to be prioritised for hard to abate sectors such as aviation.
- **Regional government interventions** are needed to create accommodative planning and permitting. Speeding up permitting and grid connections are key priorities for the new UK Government.

Price risk

Price risk remains the greatest barrier to a UK SAF production facility accessing the necessary debt capital to fund construction. Both public and private capital require revenue certainty before debt capital can be provided. The SAF mandate provides a strong demand signal, but neither public or private capital can accept the uncertainty surrounding advanced SAF forecast prices. To develop the long-term viability of the industry, Government intervention is required:

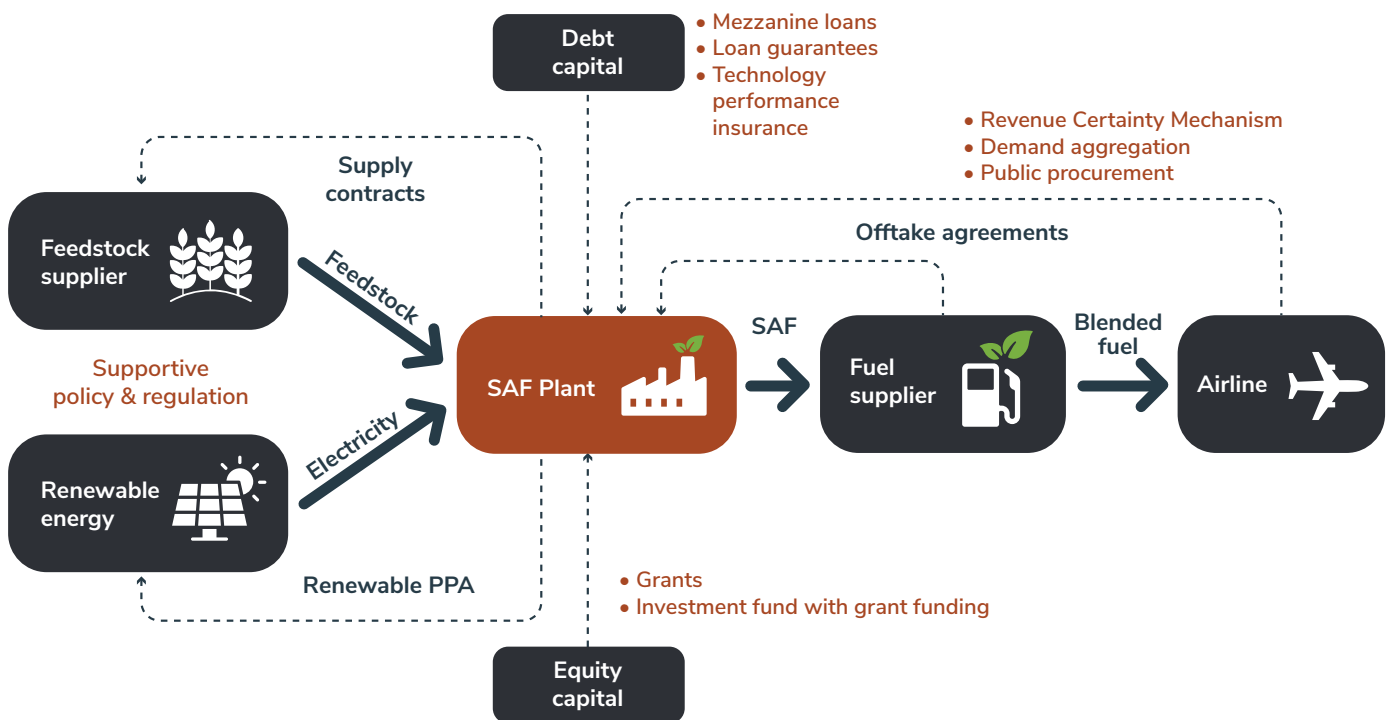
- A **Revenue Certainty Mechanism**, will be introduced by the end of 2026, as confirmed by the UK Government. This will be a key tool to address price risk, creating a world-leading environment for supporting SAF production within the UK. Both the Guaranteed Strike Price and Buyer of Last Resort will sufficiently mitigate price risk for financiers.
- A **collective offtake model**, which pools demand from a range of offtakers to diversify counterparty risk and distribute price and volume risk across a range of parties. GFI has explored the potential to implement this as an **interim solution** until the RCM is introduced. Our [key findings are detailed below](#).
- **Government procurement** schemes provide both price and volume certainty to developers. The Ministry of Defence (MoD) in the UK is already purchasing 1st generation SAF. The MoD could commit to a long-term price and volume-based offtake, providing a level of price support for a number of producers.

Taking the final steps to commercialisation

For the first few advanced SAF plant to get past FID in the UK, an RCM needs to be in place and the mandate enshrined in legislation. But several other policy areas need to be addressed in tandem. The figure setting out ‘A path to commercialisation’ provides a high-level illustration of how the wider set of solutions that GFI has identified and set out in this report can be combined to create the conditions for a commercially viable SAF sector in the UK. The diagram underscores that there is not just one solution to the SAF conundrum, but that interventions are needed at each point in the value chain if commercialisation is to be achieved and sufficient SAF production is to come online to meet the mandate.

In terms of sequencing these wider policy actions, given the RCM will likely come in 2026 it will need to be complemented by some form of interim revenue certainty solution to hasten the path to FID. This could take the form of a bridging RCM.

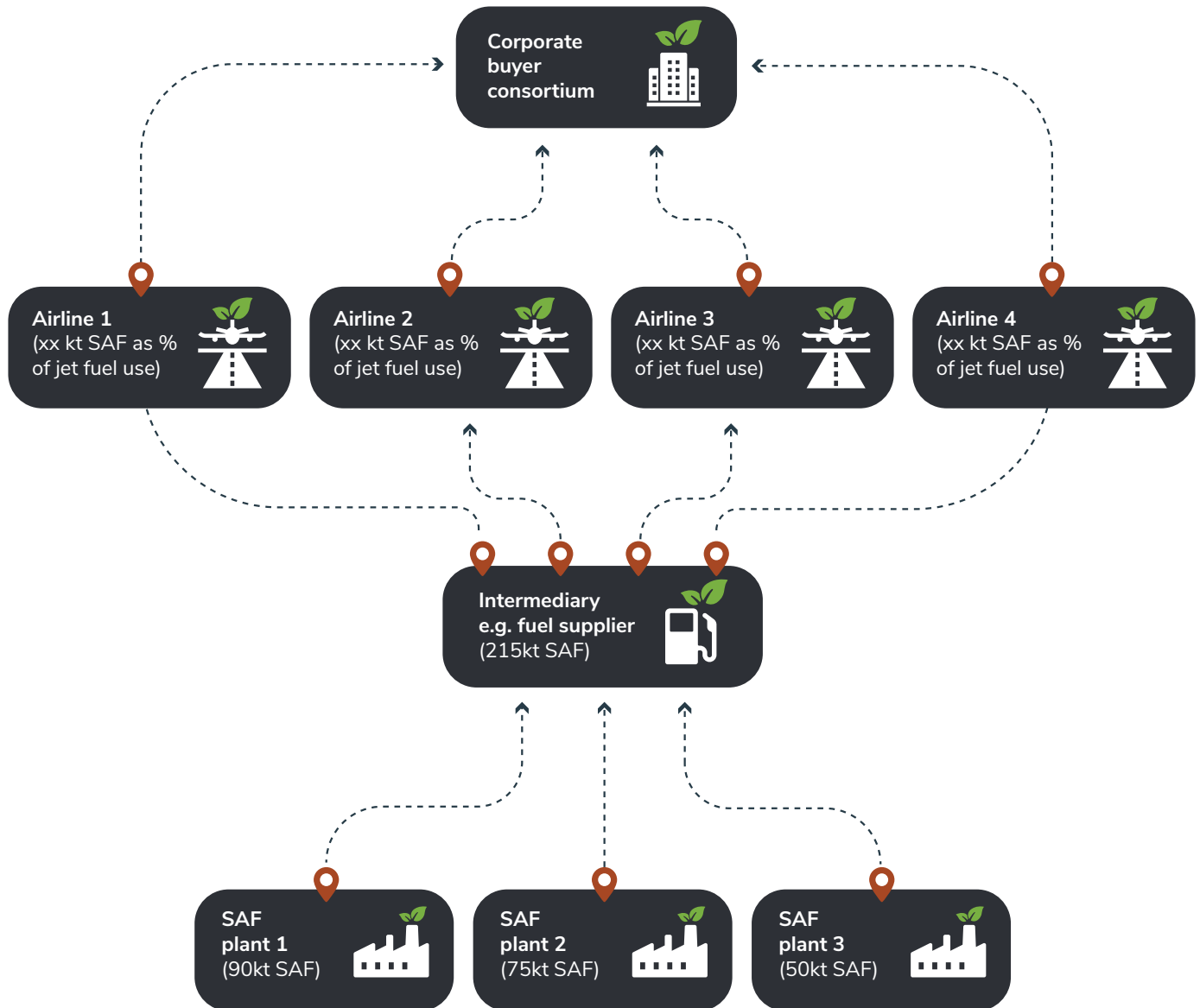
A path to commercialisation



Bridging RCMs

An offtake agreement with both price and volume commitments is the simplest form of revenue certainty in the absence of an RCM. The GFI has been testing with the market appetite for **interim offtake agreement** to bridge this gap and get 2-3 SAF plant through FID and into construction in 2025.

Illustration of collective offtake agreement



Feedback from investors was that the bankability of an offtake depends on the credibility of the counterparty. While fuel suppliers, such as Air-BP, Total Energies and Q8 Aviation, are considered strong counterparts, they have not demonstrated appetite to engage in long-term offtake agreements. Airlines, although active in the offtake space, often have low credit ratings, making them less likely to be deemed bankable by debt financiers. A collective offtake agreement from a group of airlines could partially mitigate this risk. Further diversifying the pooled demand to include corporates looking to offset their Scope 3 emissions would improve the credit rating of the collective agreement and provide a direct pass through of some of the price premium to corporate buyers who are more able to carry the additional cost. Bringing fuel suppliers into the collective would further diversify risk and improve the bankability of the model. This level of volume commitment would support the development of the 2-3 SAF plants necessary to seed the UK SAF industry. Importantly, any such model is only intended as an **interim measure**, with all obligations transferring over to the RCM when it comes into effect.



The GFI spoke with banks, SAF developers, airlines and fuel suppliers to test the viability of the model, and engaged lawyers on the issue of competition law. There was broadly positive sentiment on the concept of the model, and legal advice indicated there should be a path through the Competition and Markets Authority through their Green Agreements Guidance. However, turning the model from concept to commercial reality is currently hindered by a number of factors:

- The enabling SAF mandate legislation is yet to be implemented: feedback from the market is that the commercial reality of the mandate will only be recognised once this legislation is enacted.
- Scope 3 emissions accounting does not allow recognition of SAF certificates, and mandated volumes are generally not accepted as emissions reductions.
- Legal action taken against airlines for greenwashing claims, including on the use of SAF, may have had a chilling effect on airline appetite for SAF offtake agreements in the short term¹⁸.

¹⁸ See, for example, [KLM's greenwashing has been found illegal | ClientEarth](#)



Next steps for GFI's work in the UK

Structured (blended) finance solutions

Under the new impetus created by announcements of a NWF, which will play a central role in delivering the Government's Industrial Strategy and make transformative investments across the UK, the government is examining the case for bringing together bodies from across the UK's public finance institutions. Currently the SAF opportunity appears to be 'falling through the cracks' – the sector should be a prime target for project-based public co-investment given the demonstrable need to share risk across the capital stack to attract private debt to projects. Various options will need to be considered – for example some combination of loan guarantees, export credit guarantees and concessionary or mezzanine debt. The most obvious providers based on their mandates would be UKIB and UKEF. The capital structure risk can be further distributed to private sector insurance, through performance guarantees or warranties.

The GFI will continue further exploring the model of risk sharing across the capital structure, engaging key stakeholders on the role they can play and how these various instruments can be most effectively blended to allow SAF plant to get past FID and get spades in the ground.

Wider policy changes

All of this work will likely need to be further complemented by coordinated efforts by other interested stakeholders to ensure wider policy issues relating to feedback availability and access to clean energy as well as the proposal for the MOD to act as interim offtaker are also addressed in a timely fashion. We urge such stakeholders to get in touch if they would like collaborate with us to create this wider enabling environment.

Taking the GFI's work into the EU

The GFI is of the view that well-evidenced capital mobilisation solutions developed in the UK will be of relevance to other markets. As such we are partnering with Systemiq and the Mission Possible Partnership (MPP) on Project Skypower, a project that aims to seed the SAF PtL industry in the EU and UK, by helping 2-3 plant through FID. It aims to achieve this by aligning stakeholders, identifying critical levers to de-risk investment, developing detailed financial models that quantify the resulting value accretion, and then supporting the execution of those levers, up and down the value chain. The project draws extensively on the GFI's UK work.

If you are interested in getting involved, please get in touch.





Annex

Key elements of the UK SAF mandate

- Higher GHG-saving technologies are prioritised given tradable certificates are awarded a value linked to GHG emissions saved. A 70% reduction will serve as the central point that attracts one certificate and a minimum reduction of 40% must be achieved. This minimum threshold is intended to increase in future years.
- The obligated party under the mandate is the fuel supplier, those entities that source fuel from producers and distribute to airports and into aircraft.
- Acknowledging the limitations in HEFA feedstock and the need for diversification within SAF supply, the Mandate will introduce a HEFA cap at 92% from 2027. This will fall to 71% of total SAF in 2030 and 33% in 2040.
- In recognition of the finite supply of some feedstocks, food, feed and energy crops are currently not eligible. The policy will be reviewed every five years, with the potential to include additional feedstocks as road transport becomes electrified and its demand for biofuels decreases.
- To promote the development of PtL SAF, it includes a sub-mandate on PtL, set at 0.5% in 2030 and ratcheting up to 3.5% in 2040. In 2030, this will be equivalent to c. 60kt of fuel. Additionality rules apply to the supply of renewable energy into PtL production, ensuring its use doesn't detract from national grid decarbonisation plans.
- With the HEFA cap and the PtL sub-mandate, this leaves c. 290kt of SAF to be met by advanced biofuel based SAF in 2030, the equivalent of 3-4 SAF plant
- The mandate will include a buy-out mechanism for both the main and Power-to-Liquid obligations. These will be set at £5,875 and £6,250 per tonne of fuel, respectively.

UK RCM implementation timeline

The RCM consultation concluded on 20th June 2024. As laid out in the indicative timeline below, next steps include:

- **Government response:** Responses to the consultation need to be analysed. It could take 6-12 months for the government to publish a response.
- **Report to Parliament on progress:** The Government amendment to the Energy Bill includes a statutory duty to lay before Parliament a report on progress made towards the development of a SAF RCM.
- **Legislative process:** Post the policy development process, the Government will need to secure the appropriate legislation to implement a mechanism and draft regulations. Legislating could take a further 12 to 24 months.
- **Delivery:** Depending on the delivery model, this could take place in parallel – or may need to take place following any legislation – and would involve establishing a body to deliver the RCM. This could take 12 to 24 months.
- **Assumptions:** This timeline assumes only one consultation is required. It is possible that more than one consultation will be required to develop the full scope of the RCM. This may add an additional 8 months to the timeline.

Milestone	2023		2024				2025				2026			
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Develop and launch consultation	■													
Consultation period on SAF policy			■											
Analysis of consultation responses, waiting and publication of Government response			■											
Report to Parliament on policy progress							◆							
Legislative process (if needed)							■							
Delivery preparation with industry through the Jet Zero Council			■											

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