Clean Skies for Tomorrow

WORLD ECONOMIC FORUM

In collaboration with RMI and PwC Netherlands

Powering Sustainable Aviation Through Consumer Demand: The *Clean Skies for Tomorrow* Sustainable Aviation Fuel Certificate (SAFc) Framework

INSIGHT REPORT

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Preface

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Businesses need new approaches to achieve climate stability, and there is no time to hesitate. According to the Intergovernmental Panel on Climate Change (IPCC) Special Report 17, we have until 2030 to make significant emissions reductions, and by 2050 we must eliminate all carbon emissions. In the electricity sector, carbon-free energy is within sight. Wind and solar are already cost-competitive with conventional fossil fuel power. Harder-to-abate industries, such as aviation, face economic and commercial barriers to reducing emissions. To address the challenge, *Clean Skies for Tomorrow*'s Demand Signal working group members have forged a promising solution.

This is the time for innovation. In the 1990s, power from wind and solar cost more than 10 times what it does today. Massive investments in renewable energy technology, supported by new revenue streams (including the Energy Attribute Certificate), helped the industry to grow exponentially. Corporate leadership and financial ingenuity were a major factor in making renewable electricity competitive.

Corporate buyers can also stimulate the use of renewable fuels for aviation. Flying is critical to our economy. We have new options to communicate virtually, but to forge meaningful connections we need to get people in the same room. Delivering time-sensitive essential goods, such as vaccines, requires aviation's speed. As we recover from COVID-19, it is critical that we can return to the skies and do it sustainably.

A challenge this big cannot be managed by any one group alone; it will take participation from all concerned. Future government policy is critical but considered insufficient without long-term durable demand. Corporate passenger and air cargo customers can step up to this challenge. We agree with the World Resources Institute (WRI)'s *A Time for Transformative Partnerships*, published in 2020, which calls for fresh climate approaches and related products. The Sustainable Aviation Fuel certificate (SAFc) proposed in this white paper provides an example of that new approach and makes it easier for businesses to participate.

The private sector can mobilize and help to lead the way. Other critical industries such as trucking, shipping, steel, aluminium and cement face similar challenges to air transport. SAFc provides a blueprint across sectors, equipping all players along the supply chain to contribute actively to the solution. With the new SAFc, and future tools like it, we can solve the issue of harder-to-abate emissions at an unprecedented speed.

Foreword

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Aviation already has the technology to address carbon emissions in the form of sustainable aviation fuel (SAF). But even without the economic disruption of the current COVID-19 pandemic, commercial airline market dynamics leave limited ability for airlines to fully cover SAF's price premium. When aircraft operators are unable to carry the full cost of SAF, air transport customers and corporate travellers in particular have a key role and leadership opportunity in reducing the environmental impact of their travel.

Instead of buying offsets, the SAFc framework provides customers with the option to invest directly into SAF and receive recognition for this purchase to prove Scope 3 carbon abatement. The framework, outlined in this report, is the first of its kind in the sector.

The World Economic Forum's *Clean Skies for Tomorrow* (CST) "Demand Signal" working group collaboratively developed the SAF certificate (SAFc) concept as a workable solution for customers, enabling them to take ownership of their emissions reduction goals. Corporations, other firms and individuals are able to purchase the SAFc to address aviation emissions from passengers and air cargo.

The Science Based Targets Initiative (SBTi) recognizes SAF as an in-sector mitigation option for both aircraft operators and their customers. Voluntary purchases can unlock new revenue for SAF production, which will accelerate new production capacity. This is especially needed during aviation's recovery from the pandemic. CST stakeholder input, including a strong representation from leading professional services and technology companies, suggests that corporate demand alone could cover over a third of the price premium associated with reaching the International Air Transport Association (IATA)'s 2025 global SAF volume target – as detailed in this report.

The SAFc framework, and this report, is the product of generative ideation and refinement facilitated by the World Economic Forum, PwC Netherlands and RMI, with indispensable input from CST's working group partners. It is also a testament to air transport's benefits, demonstrating a clear commitment from across aviation's value chain to continue enabling the social and economic benefits of the aviation sector while opening up new opportunities to accelerate its decarbonization.

Future pilots will test the approach, and lessons learned will be integrated into a finalized framework with accompanying implementation guidance for release later this year. Already we see examples of successful SAF purchases piloting the SAFc system across CST's broad coalition, including Alaska Airlines, American Airlines, Deloitte, DHL Global Forwarding, Microsoft, PwC, SkyNRG and United Airlines, among others. Ultimately, SAFc also requires robust and transparent tracking, verification and governance – including through an issuing body and registry – to provide assurance that the emissions claims are legitimate and claimed only by a single party.

As we continue to finalize this innovative framework, we look forward to receiving feedback and input from the CST community and beyond. Through collaborative innovation, consumer demand will be leveraged to power a more sustainable aviation industry.

Executive summary

As aviation – one of the world's most carbon-intensive industries – rebounds following COVID-19, initiatives such as SAFc can support a net-zero pathway.

~3%
percentage of global CO_2 emissions from aviation

Rapid decarbonization and energy-source transitions are required in every industry to meet the challenge of climate change. Aviation is a carbon-intensive and "hard to abate" sector and accounts for ~3% of global CO_2 emissions annually. Although air travel and its emissions declined precipitously during the COVID-19 pandemic, aviation traffic is expected to rebound over the coming years and continue to grow in both traffic and emissions as per industry estimates.[1]

As significant air transport users in terms of both people and cargo, corporations and other organizations have a mutually beneficial role to play in supporting aviation's net-zero pathway, while also achieving their own direct and business-travel emissions reduction targets. A mechanism to achieve both of these ambitions at the same time is needed. The World Economic Forum's *Clean Skies for Tomorrow* (CST) initiative has developed the sustainable aviation fuel certificate (SAFc) framework to meet this need.

CST is a mechanism for leaders along the aviation value chain to facilitate the industry's transition to net-zero emissions by mid-century, with a particular focus on scaling global production and the use of sustainable aviation fuel (SAF). SAF is recognized as the fastest, most viable in-sector decarbonization approach, but SAF is two to five times the price of conventional jet fuel. Therefore, its widespread adoption suffers from a "chicken-and-egg" challenge, whereby SAF producers and consumers are unable or unwilling to shoulder the initial costs of scaling production.

The SAFc framework is one potential solution to this challenge. SAFc is a novel accounting instrument that decouples SAF fuel from its emissions reduction benefits so that the actual fuel can be delivered to the nearest airport and the climate benefits can be claimed by the SAFc buyer. Firms purchase SAFc, which provides a market-based mechanism for managing their aviation-related emissions and enables them to be recognized for their mitigation efforts. By covering SAF's price premium, the purchase of SAFc also addresses the aviation industry's supply-and-demand impasse over scaling SAF. The concept was developed in collaboration with a wide variety of CST's partners and is building on their input.[2]

This concept is now being tested by CST's partners, including Alaska Airlines, American Airlines, Deloitte, Deutsche Post DHL Group (DPDHL), Microsoft and SkyNRG; the outcomes of the pilots will inform additional refinement and finalization of the framework.

The SAFc framework is modelled on Energy Attribute Certificates (EACs), a well-established virtual accounting instrument. This was key to accelerating renewable electricity investment, when wind and solar energy costs significantly outweighed those of fossil energy. EACs are instruments that allow firms to make reliable renewable energy usage claims without the need to produce their own electricity.

SAFc functions as follows: fuel producers generate eligible SAF from sustainable feedstocks, following standards such as those developed by the Carbon Offset and Reduction Scheme for International Aviation (CORSIA). They issue a defined amount of SAFc based on either fuel volume or overall life-cycle emissions reductions. Producers can then sell the actual SAF volume as well as the virtual SAF certificates (SAFc) separately. In a

FIGURE 1 | **The SAFc framework provides a verifiable emissions reduction value to SAF**

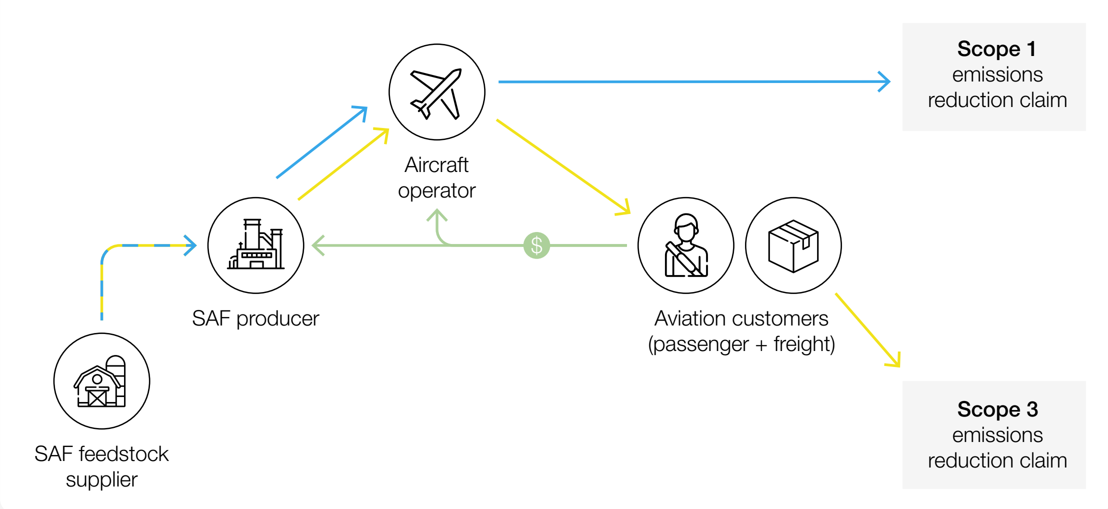
SAFc transaction pathway

SAFc facilitates customer payment in exchange for verified reductions of emissions through SAF

Each volume of SAF would produce a Scope 1 claim for an airline and a Scope 3 claim for the travel customer, both being systemically linked

SAFc applies to both passengers and freight

- Scope 1 virtual value
- Scope 3 SAFc virtual value



volumetric model, SAFc prices could factor in the overall premium of the associated SAF over fossil-based jet fuel after government incentives are incorporated, and in a life-cycle assessment (LCA)-based model, SAFc prices would be based on overall LCA emissions reductions over a standardized baseline of fossil-based jet fuel. SAF buyers/users such as aircraft operators can claim the direct (Scope 1) emissions reduction value of SAF itself and the buyer of the SAFc, such as a corporation with business travel needs, can retire the certificate and claim the related indirect (Scope 3) emissions reductions. Customer payments help cover SAF price premiums and unlock new SAF supply. To earn eligibility, SAFc volumes will need to meet defined stringent sustainability requirements. Once the SAF is certified as sustainable, it can be transacted and ownership transfer is tracked both physically and virtually until claims are retired within a registry.

The SAFc conceptual standard was designed to comply with existing and expected updated standards and guidance from the Greenhouse Gas Protocol, the Science Based Targets initiative (SBTi) and the CORSIA; further development of the framework will ensure compatibility with other regional SAF regulations and policies, such as a European Union SAF blending mandate and US-based Low Carbon Fuel Standards (LCFS).

Introduction

Decarbonizing hard-to-abate sectors such as aviation is a difficult task and requires both a systemic approach and leadership from across the value chain.

Decarbonizing hard-to-abate industries such as aviation is especially challenging and requires a holistic and systemic approach. The International Air Transport Association (IATA)'s industry decarbonization pathway has been building mainly on the significant operational fuel efficiencies achieved from one generation of aircraft to the next. Both electric propulsion and hydrogen-based fuels will also play a role in the future post-2030, but each of these technologies has its limitations in terms of scope and range and will not be available at scale until well into the 2030s. Given the available technologies, sustainable aviation fuels are the only viable alternative in the near-medium term – and for long-haul flights, even in the longer term.[3] Scaling SAF production necessitates overcoming a deadlock between supply and demand: SAF costs will decline as production increases, but because SAF producers lack guaranteed market signals, they remain unwilling or unable to invest in increased production.

Two primary levers exist for breaking this "chicken-and-egg" challenge: government policy/regulatory action and the willingness of firms to voluntarily decarbonize their operations. Both levers are necessary and address different components; public investment and supportive policies alone are not long-term solutions, and a market-based solution is necessary to accelerate aviation's decarbonization journey.

A large part of the post-pandemic growth in demand for air transport will come from business travel and freight transportation. At the same time as their air travel needs are poised to increase, many organizations are setting ambitious targets and strategies to reduce their greenhouse gas (GHG) emissions and achieve net-zero energy goals. For many companies, aviation-related emissions represent the single largest source or even the majority of their indirect (Scope 3) GHG emissions.

BOX 1 **Understanding GHG emissions under the Greenhouse Gas Protocol (GHGP)**

The GHGP defines direct and indirect emissions as follows:

– Direct emissions stem from sources owned or controlled by the reporting entity

– Indirect emissions are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another entity

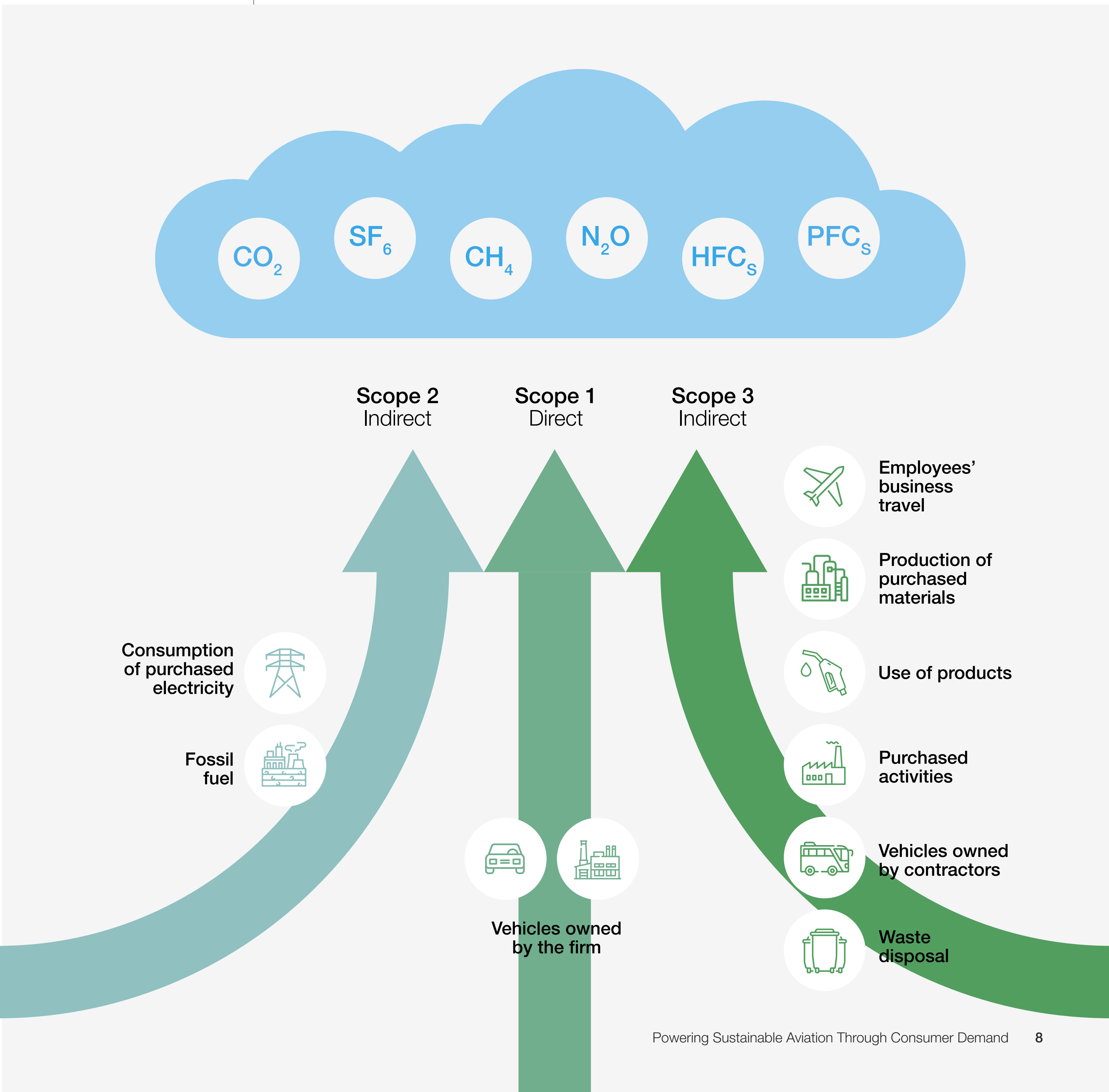
The GHGP further categorizes these direct and indirect emissions into three broad scopes:

– **Scope 1**: all direct GHG emissions

– **Scope 2**: indirect GHG emissions from consumption of purchased electricity, heat or steam

– **Scope 3**: other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities (e.g. transmission and distribution [T&D] losses) not covered in Scope 2, outsourced activities, waste disposal, etc.

FIGURE 2 **GHG emission classifications under the GHGP**



This situation presents sustainability leaders with a challenge. Whereas companies have proven ways to reduce their Scope 1 direct emissions and their Scope 2 emissions from purchased energy, guidance on how to address indirect aviation-related Scope 3 emissions should be improved. Established climate accounting frameworks such as those from GHGP and CDP do not currently recognize ways to mitigate aviation emissions besides simply not flying. Although reduced travel is expected in the medium term due to the pandemic, air travel will continue so it requires a sustainable option. Moreover, existing corporate accounting protocols consider only direct emissions from aviation fuel burn without incorporating more accurate life-cycle emissions, which for SAF include upstream reductions from biogenic feedstocks.

In November 2020, the SBTi recognized SAF in draft guidance as an in-sector mitigation option for both aircraft operators and their customers. This presents an opportunity for a new SAF-focused solution that would help address both the aviation sector's need to scale SAF and firms' desire to be credited for managing their aviation-related Scope 3 emissions. CST has developed SAFc to fill that role.

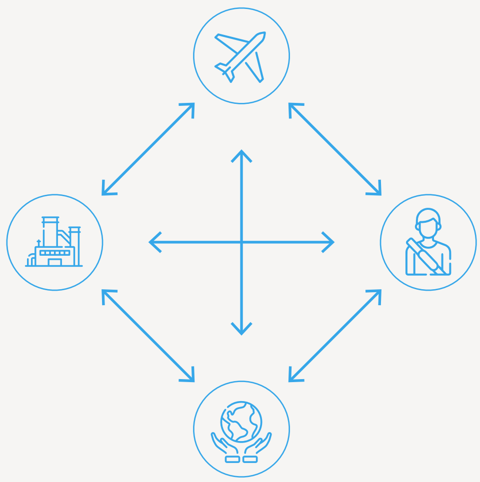
FIGURE 3 **SAFc provides numerous climate benefits for stakeholders along the aviation value chain**

Aircraft operators

- A solution for climate-conscious customers to cost-share SAF premiums
- SAF prices decrease through efficiencies and economies of scale

SAF producers

- A standardized and uniform framework for virtual SAF transactions
- A new revenue stream from aviation customers to cover SAF's price premium
- Strong demand signals to increase market confidence, enabling new production capacity investments



Air transport customers

- Transparent disclosures verifying social and environmental criteria
- An emissions solution reportable as a recognized mitigation action
- Ability to compare and source lowest-emissions SAF

Environmental NGOs

- Verifiable and quantifiable decarbonization actions
- Emissions accounting based on comprehensive life-cycle emissions
- Uniform reporting, feedstock transparency and emissions savings, based on GHGP guidance

1 The case for SAFc

The SAFc framework is designed to speed the scaling of SAF by unlocking additional funding while ensuring the highest sustainability standards.

CST developed the SAFc framework based on several factors: SAF's essential role in decarbonizing aviation; corporate interest in addressing their Scope 3 emissions; and an evaluation of potential emissions reduction accounting approaches.

Working within the dedicated "demand signal" workstream of the overarching CST initiative, the cross-sectoral community (detailed in Figure 4) developed the framework as a market-based mechanism to not only drive faster SAF innovation and development but also ensure the highest levels of sustainability standards required to successfully meet the challenge of climate change.

FIGURE 4 *Clean Skies for Tomorrow* **"demand signal" community**

Alaska Airlines, American Airlines, BCG, BlackRock, Boeing, CDP, Deloitte, Delta, Deutsche Post DHL Group, EDF Environmental Defense Fund, Fulcrum BioEnergy, Google, Gulfstream (A General Dynamics Company), ISCC (International Sustainability & Carbon Certification), jetBlue, KLM Royal Dutch Airlines, McKinsey & Company, Microsoft, Port of Seattle, pwc, Red Rock Biofuels, RSB, salesforce, SFO San Francisco International Airport, Schiphol Group, Shell, SkyNRG, Southwest, United, World Resources Institute, WWF

1.1 SAF's essential role in decarbonizing aviation

SAF is produced from sustainable, renewable low-carbon feedstocks such as used cooking oils, forestry residues and municipal solid waste. When used to power aircraft, SAF can reduce the carbon intensity of flying by up to 100% on a life-cycle basis, depending on the feedstock selection and technological pathway. Several characteristics make SAF the most viable near-term technology for decarbonizing aviation, including:

1. **Immediate action** – according to findings from the Intergovernmental Panel on Climate Change (IPCC), the most critical time to reduce emissions is between now and 2030 if we are to keep warming well below 2°C.[4] Because SAF is compatible with existing aircraft and fuelling infrastructure, major changes to aircraft and airports that would delay broad sector use are not needed.

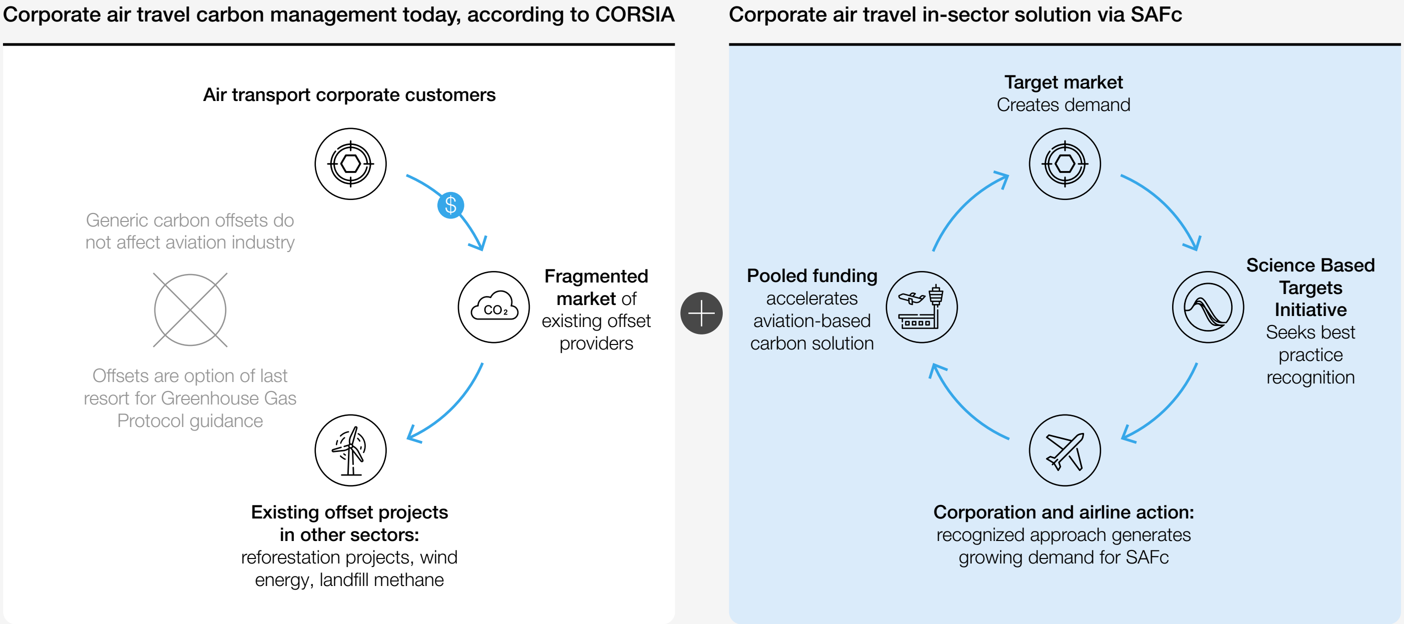
2. **Scalability** – SAF production can grow to cover 10% of total jet fuel sales by 2030,[5] based on sustainable feedstock availability, if the investment capital can be secured.

3. **Aviation value chain** – at this time, SAF is the only "in-sector" near-term climate solution, as hydrogen and electric flying will develop at scale over the next decade and may not cover long haul.

4. **Co-benefits** – the production of SAF introduces significantly less sulphur and particulate matter into the environment than the production of fossil-based jet fuel. In addition, SAF production creates new high-quality jobs.

A critical barrier to faster scaling of SAF is its price, which is currently at least double that of fossil-based jet fuel, but will come down, once economies of scale kick in. The cost of feedstocks currently exceeds the price for finished fossil-based jet fuel. Unlike fossil fuels, input feedstocks may require additional pre-processing before the material can be refined. Also contributing to SAF's cost premium are higher transportation costs, requirements to blend SAF with conventional jet fuel and fees to cover additional safety testing.

FIGURE 5 | SAFc enables a SAF-based in-sector emissions reduction market for Scope 3 emissions as a complement to the current CORSIA offsetting scheme



The aviation industry and fuel producers have been investing in SAF technologies and infrastructure for nearly 15 years, yet only two commercial SAF plants are operational worldwide, producing less than 0.01% of jet fuel supply. Because the industry is nascent, SAF producers are not yet able to benefit from efficiencies of scale or best practices from existing production facilities, further limiting the ways to reduce production costs. Air transport is a highly competitive industry with extremely low margins; aircraft operators are generally not able to afford SAF and remain economically competitive.

CST analysis has confirmed findings from prior academic research that future SAF production efficiencies plus a carbon fee are necessary to enable SAF to reach price parity with fossil-based jet fuel. Depending on the conversion technology and region, these two factors are not likely to make SAF competitive until at least 2040.[6] Until price parity is achieved, another mechanism for covering the price difference and catalysing the SAF market is needed.

1.2 Corporate interest in addressing Scope 3 emissions

The private sector has an important role to play in supporting SAF growth. As firms increasingly look for solutions to address Scope 3 emissions in their supply chains, they have expressed willingness to pay for the emissions reductions provided through SAF. As an anecdotal example, many of CST's aviation-customer partners indicated that a 5–10% increase in airfare costs would be acceptable, provided they reflected a significant decrease in emissions. Conventional fuel currently accounts for an estimated 20–30% of commercial airline operational costs, depending on the year. Although the amount of corporate voluntary contributions may not be sufficient to cover the substitution of SAF for all conventional jet fuel, it does indicate a potential source of significant funding for SAFc, thereby breaking through the "chicken-and-egg" challenge and kickstarting a virtuous cycle of creating supply and economies of scale.

FIGURE 6 **Corporate willingness to pay around 5–10% of airfare costs towards mitigating emissions can support significant growth of SAF production**[7,8]

Demand

- $243 billion spent on business airfares annually across all companies[a]
- SBTi companies represent 17.5% of business airfare[b]
- $2.5 billion (willingness to pay) of SBTi companies' airfare spend

Supply

- 1.9 million metric tonnes SAF produced annually (assumes $1/litre SAF premium)
- 19 SAF plants needed to meet that annual production volume[c]
- 1/3 of IATA's 2025 SAF production goal met (5.6 million tonnes)[d]

Notes:

[a] Assumes 17% of global airfare is attributed to business travel and total business travel spending in 2019 was $1.43 trillion

[b] Assumes travel spending is proportional to equity valuation of ($15.4 trillion)

[c] Assumes 100,000 MT/facility

[d] Does not include SAF demand to cover air cargo. The International Air Transport Association (IATA) 2025 goal is for 2% of demand, or 7 billion litres, to be met through SAF

1.3 Potential emissions reduction accounting approaches

To operate effectively in support of the SAF market, the SAFc mechanism must be based on a sound accounting methodology.

To operate effectively in support of the SAF market, the SAFc mechanism must be based on a sound accounting methodology. Four emissions reduction accounting approaches were considered as foundations for the framework:

1. **Standalone disclosure:** voluntary actions are currently not recognized under GHGP including SAF usage, but they can be reported separately through annual emissions disclosures such as CDP.

2. **Carbon offsets:** project-based emissions reductions measured in metric tonnes CO_2e (tCO_2e) outside a company's value chain. This accounting approach follows a published methodology and generates credits that are tracked and retired through validated registries. Carbon offsets must demonstrate their "additionality", or evidence that the emissions reductions would not have occurred in the absence of revenue from the sale of the carbon offset.

3. **Carbon insets:** carbon emissions reductions that occur within an organization's value chain and can originate from carbon reduction measures within a supply chain, such as use of renewable fuels or the purchase of renewable electricity used by an upstream supplier.

4. **Energy Attribute Certificates (EACs):** a market-based mechanism for conveying the environmental attributes of a unit of renewable energy to the buyer. In the case of SAF, the related attribute is the carbon reduction associated with the use of sustainable feedstocks compared to conventional jet fuel.

These four approaches were evaluated against six main necessary attributes. First, an approach should generate funding to cover SAF's price premium. Second, it should eventually be incorporated into established international GHG emissions accounting standards such as GHGP, so that corporate participants can secure auditable recognition of their efforts to reduce emissions. Third, it should facilitate production of increased volumes of SAF. Fourth, it should not require proof of "emissions additionality" with the same level of detail as carbon offset projects because of the difficulties associated with determining intent for each and every flight. Fifth, the approach should allow the tracking of SAF as a physical good to offer additional measurement-based assurances for traceability of associated emissions reductions. Finally, it needs to be an in-sector solution supporting net-zero benefits. Using this filter approach and given current accounting methodology practices, the EAC-based model proved most promising, as detailed in the next section.

BOX 2

Additionality and SAFc

The term *additionality* within emissions accounting refers to a causal assessment of whether the financing of a particular carbon reduction project generates a beneficial effect beyond what would have ensued in other scenarios without the financial resources from that project in relationship to a determined baseline.[9]

While SAFc enables increased demand for SAF and therefore facilitates reduced GHG emissions via air travel, it is outside the scope of the concept to integrate either a standardized or project-specific determination of emissions additionality.[10]

2

The SAFc framework

The SAFc concept is expected to be based on an Energy Attribute Certificate (EAC)-type model for successful emissions reduction accounting.

> SAFc will reach EAC-like status once it is fully developed and has been incorporated into emissions accounting standards such as GHGP.

EACs are a well-established virtual accounting instrument in the United States and Canada, representing the clean energy attributes of renewable electricity from sources such as wind and solar. Internationally, EACs are comparable to Guarantees of Origin (GOs) in the European Union and international renewable energy certificates (I-RECs) in countries across Asia, Africa and South America. They are also established mechanisms through GHGP and CDP for emissions accounting.

EACs have proven to be effective at accelerating the transition to renewable energy by creating an additional revenue stream for renewable energy suppliers and signalling demand for additional renewable electricity generating capacity.

Following evaluation, it is expected that an EAC-based model will form a successful emissions reduction accounting approach for SAF as represented in the SAFc concept. EACs meet each of the six criteria and offer an entirely scalable and auditable approach, including potential follow-on certificate trading markets to encourage SAF demand above and beyond immediate use.

Standalone disclosures are not a long-term solution for SAF, due to unanswered questions about both impact measurement and their ability to generate impact funding. Importantly, although SAFc will require reporting as a standalone disclosure while in development and pilot modes, it will reach EAC-like status once it is fully developed and has been incorporated into emissions accounting standards such as GHGP.

Carbon offsetting is used extensively by the aviation industry and underpins CORSIA, but while the framework is useful for out-of-sector emissions offsetting, it is not effective for in-sector mitigation efforts – failing all but one of the attribute requirements within this analysis.

Intriguingly, alongside an EAC-based approach, insetting also offers significant potential for scaling SAF demand and associated Scope 3 reporting frameworks. An EAC-based framework could be a mechanism for documenting and transacting insets. The EAC and inset have similar underlying emissions calculations and accounting practices. They are not necessarily contradictory or mutually exclusive systems. Insetting with a tradable certificate-based approach may support the scaled use and development of SAF.

The Smart Freight Centre and MIT's Center for Transportation & Logistics (SFC-MIT) are currently developing guidelines for an insetting approach for SAF. CST and SFC-MIT are in active communication to better determine how these frameworks can complement each other.

2.1 The Energy Attribute Certificate model

Ultimately, organizations need a market-based instrument to address their air transport-based emissions. Following extensive stakeholder consultations and analytical modelling, SAFc functioning as an EAC is the current proposed model, borrowing an approach from the electricity utility sector that is already accepted within the GHGP standard. GHGP's Scope 2 standard includes EAC guidance that can be used to further develop SAFc implementation methodology. It also provides a methodology for virtual product GHG accounting and reporting. Following incorporation of SAFc into internationally recognized standards, SAFc reporting processes would shift from stand-alone disclosures to EACs.

Outlined below are the high-level approach and calculation method; the benefits and risks for double counting; and potential solutions. The longer-term goal of CST is to convince the GHGP authors to incorporate the SAFc, similar to an EAC. To ensure that SAFc is a credible mechanism, without vulnerability to false claims, a central registry needs to be established to host retired Scope 3 certificates and their linkage to Scope 1 claims.

Emissions reduction and inclusion within GHG inventory

SAFc as an EAC creates a product that a company can count in its GHG inventory. This will reduce the gross emissions reported.

High-level approach and calculation method

Using one of the three calculation methods to calculate air transport GHG emissions (the fuel-based, distance-based and spend-based methods), SAF volume is then multiplied by a life-cycle emissions factor to calculate emissions.

In an analogy to the GHGP standards for accounting and reporting on emissions, two EAC calculation methods could be used: one based on the actual carbon intensity of the SAF batch, and one based on an external emissions factor (e.g. CORSIA's average feedstock conversion carbon reduction). Both of these calculation methods enable corporations to report SAFc usage to mitigate their emissions. Additionally, aligning with the GHGP would require separately

FIGURE 7 **How SAFc is modelled on an EAC**

SAFc as an EAC

Application of SAFc in GHG preparation:
Scope 3 Category 6 Business travel emissions

Conventional Scope 3 Category 6 preparation	*Fuel consumption allocated to company through SAFc (kg fuel)*	×	*Emission factor (industry, conventional jet fuel) (kg CO_2e/kg fuel)*	=	**Scope 3 Category 6 Business travel emissions (kg CO_2e) – industry**
SAF Scope 3 Category 6 preparation	*Fuel consumption allocated to company through SAFc (kg fuel)*	×	*Emission factor (**SAF, supplier specific**) (kg CO_2e/kg fuel)*	=	**Scope 3 Category 6 Business travel emissions (kg CO_2e) – SAF, supplier-specific**

accounting for and reporting on carbon removals/sequestration, biogenic emissions and non-biogenic emissions. A GHGP working group is establishing a new reporting approach for carbon removals, bioenergy and land use, with published findings expected in 2022.

The main drawback of developing SAFc as an EAC is that international emissions accounting standards rely on detailed guidance that excludes market-based mechanisms as an emissions solution, but this is arguably more a shortcoming of the existing accounting standards than of market-based mechanisms' effectiveness. In the GHGP's Scope 3 guidance, reducing consumption of goods or services or shifting to a lower-emitting supplier are the only recognized options for managing Scope 3 climate impacts. SAFc will require more time to earn acceptance and incorporation from emissions accounting frameworks, but will also support improved definitions within existing accounting practices. Phase II of the SAFc development will ensure close collaboration with these entities to ensure verifiable sustainability credentials and auditable accounting principles.

2.2 Catalysing SAF demand

An overview of how EACs work with renewable electricity illustrates the basic concept of the SAFc and how it covers SAF's price premiums and catalyses SAF demand.

Electricity producers are issued with EACs for the renewable electricity they produce that complies with the defined standards and legislation. Producers then sell their EACs to businesses and consumers, often separately from the electricity itself. Businesses and consumers, for their part, purchase EACs as a way to reduce their carbon footprint from electricity use without having to install their own renewable energy systems. EACs are traded with a book-and-claim system in which only the entity that "cancels" the certificate can claim the usage of the renewable energy unit it represents.

SAFc could work in a similar way. The fuel producer generates eligible SAF from sustainable feedstocks and is issued with a corresponding number of SAFc based on either a volumetric calculation or an emissions-based calculation. As with EACs, the producer can then sell the actual SAF produced and the virtual SAFc that was issued separately.

SAFc helps address the supply-and-demand deadlock that is limiting the growth of SAF.

The SAF buyer can claim the emissions reduction value of the sustainable fuel itself once consumed (Scope 1), depending on local regulations. The eventual buyer of the SAFc – an air transport customer such as a corporation for the purposes of this simplified description – can retire the certificate and claim the related Scope 3 emissions reductions.

Importantly, SAFc helps address the supply-and-demand deadlock that is limiting the growth of SAF. Low demand for SAF results in low investment in increasing SAF production.

As a market-based GHG mitigation standard for the aviation sector, SAFc catalyses additional demand for SAF by generating new funding that can be used to cover its price premium.

This funding in turn creates market demand signals to drive investment in increasing SAF production capacity. This is similar to how EACs in the electricity market improved the economics for renewable electricity developers when wind and solar were more costly than fossil sources. In 2020, renewables were the largest source of newly installed electricity generation capacity.[11]

2.3 Addressing shared responsibility for Scope 3 emissions

Within existing GHGP guidance, multiple parties along the supply chain can have overlapping individual responsibility for the same GHG emissions. In aviation, these parties include fuel producers, fuel suppliers, aircraft and engine manufacturers, airports and air transport buyers. As an illustrative example, an aircraft operator may burn 1 tonne of fossil-based jet fuel, generating more than 3 tonnes of CO_2. The aircraft operator is responsible for the emissions within its Scope 1, and the aircraft operator along with all of the other participants in the supply chain share responsibility for the Scope 3 emissions for their customers for the same fuel burn.

A key innovation incorporated into the SAFc framework is a mechanism to assign coinciding and linked value to Scope 3 and Scope 1 emissions, providing reductions in both emissions categories. This SAFc characteristic is important because it provides a way for air transport customers and aircraft operators (and eventually other parties in the supply chain) to address their shared responsibility for Scope 3 emissions. It also enables downstream parties to influence emissions reductions by working with their suppliers to address the source of emissions, in alignment with SBTi guidance for supply chains.

3 SAFc functionality

To operate effectively and reliably, SAFc requires robust and transparent sustainability certifications and a robust governance system to facilitate ownership and trade.

Intergovernmental bodies such as the International Civil Aviation Organization (ICAO) have established minimum sustainability criteria for SAF,[12] but there is currently no governing body or governance system in place for the creation, trade and retirement of SAFc. To operate effectively and reliably, a SAFc mechanism must have three core elements:

- Standards to govern the entire life cycle of a SAFc
- Systems to facilitate ownership and trade of SAFc (e.g. a registry and governance standards)
- Markets through which SAFc create value

This report establishes the SAFc mechanism principles and outlines further phases of research, analysis and pilot projects already underway within CST on the SAFc mechanism itself as well as related accounting frameworks, traceability components and governance operations.

3.1 The SAFc product

Essential elements of the SAFc product to be standardized include its sustainability criteria, its unit of trade and its value streams. Importantly, all elements of the SAFc product must ultimately comply with and function within existing and proposed SAF regulations and policies, including those related to blending mandates.

Unit of trade

> Although simpler, the volumetric model does not address some of the nuances inherent in SAF, such as different SAF feedstocks and production pathways themselves having significantly different emissions footprints.

SAFc requires a common measurement, or unit of trade, to enable the parties involved in a SAFc transaction to communicate with each other and to account for both the size of individual company actions and overall aviation sector progress in meeting GHG goals.

Using an EAC model, in which renewable electricity is calculated in megawatt hours (MWhs), SAFc could use either a volumetric-based calculation (mass/volume) or an overall LCA emissions-based calculation (CO_2 carbon equivalency, or CO_2e).

Using a volumetric model, as conventional fossil-based jet fuel that SAF replaces is measured in mass/volume, SAFc could be purchased and recorded in mass units. Establishing mass as the primary metric allows stakeholders to understand progress towards replacing conventional jet fuel with SAF. Using a mass-based approach enables SAF producers to easily report liquid fuel mass measurement, as mass is a consistent metric that does not change according to differing regulatory jurisdictions or life-cycle analysis methods. Additionally, one metric tonne of fuel represents a specific energy unit that can be tied to the SAFc, similar to the way in which the EAC product is based on MWhs of electricity. It is also easier to transact assets that are tied to physical goods (e.g. fuel volume).

However, although simpler, the volumetric model does not address some of the nuances inherent in SAF, such as different SAF feedstocks and

production pathways themselves having significantly different emissions footprints. Establishing a SAFc valuation based on an LCA emissions-based calculation may add initial complexity but can more effectively support the long-term scaling of the lowest-emissions SAF technologies.

Using an overall emission calculation model, SAFc could be purchased and recorded in CO_2e based on a predetermined LCA emissions factor. This factor would vary depending on both the SAF feedstock and technological pathway. It would allow market forces to properly reflect the emissions-reduction values of SAF and drive investments towards more efficient next-generation SAF such as power-to-liquid (PtL), over time encouraging a "race to zero" within the industry. Challenges remain in determining an appropriate comparable emissions baseline for conventional fossil jet fuel, as baselines vary based on regulatory jurisdiction. But these can be overcome.

CST has not yet determined the most effective and applicable approach to the SAFc unit of trade. While a volumetric approach may be simpler to transact, it is a blunt approach and does not enable the assigning of higher SAFc values to lower emissions fuels. For example, in using a volumetric approach, 1 tonne of SAF with 60% emissions reductions over fossil jet fuel could have an associated SAFc equal in value to the SAFc associated with 1 tonne of SAF with 100% emissions reductions over fossil jet fuel. While an LCA emissions-based approach may be the most accurate, a market-based solution is effective only if it is implementable. Importantly, as both the SAF volume and emissions factors are necessary components for comprehensive reporting and emissions assessments, it is likely that both quantifications will be required. Final determination will be made within Phase II of SAFc framework development, as informed by pilot transactions and continued collaboration across the CST community of partners.

Sustainability criteria

To accelerate aviation's decarbonization pathway and achieve maximum LCA emissions reductions, SAF must be produced using the most efficient technological pathways, most sustainable feedstocks and most socioeconomically responsible guidelines.

CORSIA has established robust SAF sustainability requirements, with further guidance pending.

Two independent sustainability certification schemes, the International Sustainability and Carbon Certification (ISCC) and the Roundtable on Sustainable Biomaterials (RSB), are both recognized by ICAO. Both certifying bodies require producers to minimize emissions impacts in a variety of performance categories, referred to within CORSIA as the 12 themes. These are:

Minimum GHG reduction target	Conservation	Local and social development
Air	Water use rights	Soil
Land use rights and land use	Water	Human and labour rights
Carbon stock (intensity)	Waste and chemicals	Food security

CST recognizes that corporate air transport customers have an additional desire to reduce their carbon impact. In response, CST and working group stakeholders added the following three requirements for the SAFc product:

1. **Carbon intensity:** While CORSIA requires eligible SAF to have emissions at least 10% lower than those of fossil-based jet fuel,[13] CST coalition members have indicated a preference for at least a 60% LCA emissions reduction in SAF. The SAF life cycle goes from "well-to-wake" (though in the case of SAF, "well" means sustainable feedstock) and includes transport from refinery to airport. A SAFc value would not be applied without meeting a minimum threshold, to be finalized in Phase II of the framework development.

2. **Feedstock integrity:** CST supports complete transparency in the feedstock process and full supply-chain certification. Due to concerns about sustainability verifications and the impacts from both direct and indirect land use change, no palm-based materials, for example, would currently be eligible for SAFc fuels, including palm fatty acid distillate (PFAD). Palm offers some of the lowest emissions reduction benefits among the feedstock candidates,[14] and using PFAD for SAF may result in more palm oil demand and cultivation to replace its current uses.[15] Should the situation change and LCA calculations demonstrate that palm-sourced feedstocks can generate emissions savings above the 60% threshold, this determination may be reconsidered.

3. **Certification consistency:** Currently, ISCC and RSB certification processes differ. Their sustainability certification scheme (SCS) processes could benefit from harmonizing to cover the 12 themes as well as calculations of carbon intensity related to indirect land use change and the potential impact from secondary effects such as feedstock substitution.

FIGURE 8

RSB and ISCC differ in their sustainability certification schemes and could benefit from harmonization

Elements	RSB	ISCC	Potential actions for CST
CORSIA 12 themes	ICAO considered RSB 12 principles for its "themes". RSB has methodologies for all; some are qualitative	Needs functionality for all 12 themes	Equivalent requirements between SCS; quantitative metrics where possible
Indirect land use change (ILUC) estimate	Low ILUC risk biomass calculator	Not yet available	ILUC consideration requirements
Feedstock displacement evaluation	Methodology for displacement emissions	Not yet available	Potential for displacement within CST
Feedstock transparency	Internal to producer	Internal to producer	Disclosed to buyer
GHG – transport from refinery to airport	Estimate based on transport mode and distance	Estimate based on transport mode and distance	Process to automate into CST accounting system(s)

3.2 Accounting framework

SAFc needs to function within existing voluntary GHG accounting and reporting standards. GHGP is recognized as the authoritative climate accounting and reporting industry guidance. SAFc accounting approaches need to be developed so that voluntary SAF purchases can be recognized within GHG accounting and reporting frameworks, such as GHGP, and associated emissions reduction targets, such as SBTi. Both of these initiatives are stakeholders within the CST Coalition, and full alignment between these systems and the SAFc framework is key to long-term success. Consultations are ongoing to ensure long-term mutual compatibility between the SAFc framework and GHGP and SBTi guidance.

GHGP application

GHGP outlines five principles applicable to GHG measurement, accounting and reporting. A SAFc accounting framework that adheres to these principles would enable reliable, comparable and consistent disclosures by participating companies. The following five principles for SAFc are adapted from GHGP:[16]

1. **Relevance:** Ensure the GHG inventory appropriately reflects a company's emissions generated through the purchase and use of SAF (via the SAFc) and serves the decision-making needs of both internal and external users.

2. **Completeness:** Account for and report on all GHG emissions sources and activities within the inventory boundary related to the purchase and use of SAF (via the SAFc). Where a company has excluded emitting activities, omitted impacts should be sufficiently disclosed and justified.

3. **Consistency:** Apply consistent measuring, accounting and reporting methods for emissions related to the purchase and use of SAF (via the SAFc). If methodology changes occur, new methods must be appropriately disclosed, and a re-baselining exercise may be needed for prior year disclosures.

4. **Transparency:** Address all relevant emissions disclosures in a factual and coherent manner, supported by a clear underlying audit trail. Significant assumptions, estimations or judgements must be appropriately disclosed and include information on relevant methodologies and data sources.

5. **Accuracy:** GHG emissions resulting from the purchase and use of SAF (via the SAFc) should be sufficiently accurate to enable users to make decisions with reasonable confidence as to the integrity of the reported information. Uncertainties related to assumptions, estimations or judgements should be minimal.

These principles require the reporting of GHG emissions regardless of scope or industry and are intended to ensure the information reported appropriately quantifies the company's overall emissions. GHGP guidance is voluntary and not subject to legal restrictions.

Current GHGP Scope 2 guidance covering the use of EACs for electricity emissions mitigation can potentially be used to inform a Scope 3 SAFc accounting framework. Although covering different emissions parameters, both EACs and SAFc provide a solution to address the limited options end customers have to purchase emissions-mitigating energy.

Setting boundaries for Scope 3 GHG categories

GHGP provides guidance on boundaries for emissions reporting, indicating a preference for a "consistent consolidation approach" across Scope 1-3 inventories.[17] It also identifies three approaches to determine organizational boundaries and to allocate GHG emissions to the reporting entity:

- Equity share (based on economic benefits from proportion of ownership)
- Financial control
- Operational control

In addition, the guidance includes minimum boundaries for reporting on different categories of Scope 3 emissions. Emissions within the minimum boundaries for Scope 3 include air transport passengers and cargo.

Companies typically estimate direct aviation emissions based on an allocation of Scope 3 emissions relative to their share of aircraft use; only direct emissions are incorporated in Scope 3 air transport emissions calculations within GHGP. Although GHGP does not explicitly include the fuel's life-cycle emissions, it does include limited guidance to account for biogenic fuels from emissions savings.[18] In inputting to the development of the SAFc concept, the World Resources Institute's GHGP authors indicated that it is acceptable to report life-cycle fuel emissions for SAF and compare that to the life-cycle conventional fossil-based jet fuel. In the past, many reporting entities have limited aviation reporting to only direct emissions from aircraft, but such a change to consider holistic comparisons with true and comparable baselines would enable a more thorough accounting approach.

In practice, only aircraft emissions directly from aircraft engines are technically assigned to the aviation sector; they are not assigned to fuel-related upstream life-cycle emissions. National GHG inventories will need to be reconciled for SAF's upstream life-cycle reductions to be assigned to air transport. Currently, GHGP guidance states that any removals should to be reported separately from Scope 1, 2 and 3. (A GHGP working group is currently establishing a new reporting approach for carbon removals, bioenergy and land use, with published findings expected by 2023.)

Leveraging GHGP principles for development of SAFc's accounting framework

There is no "ideal fit" for a virtual product such as SAFc within existing GHGP standards. For example, existing GHGP guidance on reporting of combined life-cycle factors or biogenic emissions separately, outside of the Scope 1, 2 and 3 inventories, would prevent clear indication of the lower-carbon benefits of SAF when compared to conventional jet fuel. This is because the reductions do not occur at the point of combustion but upstream in the value chain. A consolidated emissions factor, comprising a single life-cycle factor including both fossil and biogenic emissions, is necessary to demonstrate life-cycle emissions reductions from SAF.

Despite this existing lack of clarity, GHGP standards are useful to broadly inform a SAFc accounting approach. For example, the five GHG accounting and reporting principles detailed above apply to any emerging GHG measurement or method, whereas the guidance on implementing quality criteria for either the Scope 2 location- and market-based emissions or the offset baseline scenarios can be used as reference to ensure quality criteria underpin the SAFc itself.

Emissions estimation approach

GHGP's *Technical Guidance for Calculating Scope 3 Emissions* provides guidance on how to calculate indirect emissions from air travel by category, as well as guidance regarding acceptable source data. The calculation methods are:[19]

1. **The fuel-based method**, which involves determining the amount of fuel consumed (i.e. Scope 1 and Scope 2 emissions of transport providers) and applying the appropriate emissions factor for that fuel
2. **The distance-based method**, which involves determining the mass, distance and mode of each shipment, then applying the appropriate mass-distance emissions factor for the vehicle used
3. **The spend-based method**, which involves determining the amount of money spent on each mode of business travel transport and applying secondary emissions factors.

FIGURE 9 **GHGP's formula for calculating Scope 3 emissions from business air travel**

Most accurate

Method	Activity data		Emissions factor		Result	Current considerations
Fuel-based method	Mass of fuel consumption allocated to organization by its aviation supplier(s) (l)	×	**Emissions factor per fuel type** *Depending on the type of fuel:* *1. Jet kerosene kgCO_2/kg fuel* *2. LCA SAF kgCO_2/kg fuel*	=	Absolute Scope 3 emissions in kg/tonne of CO_2	– Data availability from supplier(s) – Careful accounting required to avoid double claiming across Scopes 1 and 3
Distance-based method	SUM per travel type (typically short, medium and long haul + economy, premium economy, business and first) of distance travelled (per employee)	×	**Emissions factor per travel type** *Either:* *1. Primary carrier specified vehicle specific emissions factor (kgCO_2e/vehicle-km or passenger-km)* *2. Secondary emissions factor (e.g. ICAO) (kgCO_2e/vehicle-km or passenger-km)*	=	Absolute Scope 3 emissions in kg/tonne of CO_2	– Inaccurate Scope 3 emissions data as a result of actual fuel consumption not being considered – Careful accounting required to avoid double claiming across Scopes 1 and 3
Spend-based method	Fuel consumed (litres)	×	**Emissions factor (kgCO_2e/litre)** *Depending on the type of fuel:* *1. Jet kerosene kgCO_2/kg fuel* *2. LCA SAF kgCO_2/kg fuel*	=	Absolute Scope 3 emissions in kg/tonne of CO_2	

In addition to the calculation formula, the GHGP distinguishes between two types of data:

- **Primary data** from specific activities within a company's value chain
- **Secondary data** not from specific activities within a company's value chain

Primary data could include utility bills and fuel invoices paid by a company. Secondary data could include information provided by an aircraft operator regarding trip distances and fuel burn data. The GHGP states that "in general companies should collect high-quality primary data". Aircraft operators' ability to provide fuel consumption data to their customers will vary. Secondary data using distance or travel spend does not include aircraft operator efficiency information or SAF usage. Therefore, CST proposes that aircraft operators employ the fuel-based method to provide primary emissions data, which includes SAF usage, so that firms and individuals can use the emissions data to address the balance of the impact and avoid over or underpaying for SAF.

Reporting emissions reductions in the context of baseline emissions

GHG reductions must be quantified relative to a baseline. In corporate GHG inventories, the reduction is typically quantified relative to the base year. However, it is also possible to quantify GHG reductions relative to a baseline scenario for the same period, known as project accounting. The GHG Protocol defines emissions reduction as either a reduction in GHG emissions or an increase in the removal or storage of GHGs from the atmosphere, relative to baseline emissions. In this case, the baseline scenario emissions are the emissions

associated with a hypothetical description of what would most likely have occurred in the absence of any mitigation. These scenarios follow three options:

1. Implementation of the same technologies or practices used in the project activity
2. Implementation of a "baseline" emissions estimation
3. The continuation of current activities, technologies or practices that provide (where relevant) the same type, quality and quantity of product or service as the project activity

In this approach, companies are required to provide the rationale for selecting a specific baseline scenario, such as considerations related to secondary effects accounting (e.g. life-cycle analysis) and timespan. The current baseline scenario assumes that air transportation relies exclusively on fossil-based jet fuel. If SAF usage by aircraft operators eventually becomes the norm, it will influence baseline estimates.

Science Based Targets initiative (SBTi) guidance

“For SAFc, CST proposes using actual SAF disclosures, which are more accurate for each fuel producer and individual production batch.

Within the private sector, working with SBTi to set science-based targets is increasingly viewed as the industry standard for climate responsibility. SBTi is currently developing science-based target-setting methods, tools and guidance for aviation companies. As part of that process, in November 2020, it released draft guidance for public consultation, which in Section 5 formally recognizes SAF as one of the viable "methods to realize Scope 3 Category 6 targets" for aviation emissions that cannot be reduced through efficiency.[20] The draft guidance is designed primarily for aircraft operators using science-based targets, and the main GHG reduction method is based on an aircraft operator revenue metric (revenue-tonne-kilometre) that is not applicable to corporate customers for their air transport usage. Instead, SBTi uses metrics based on full-time employee headcount for aviation business travel targets.

The SBTi's draft aviation sector decarbonization approach aligns with CORSIA in that it recognizes the same SAF sustainability certification schemes (ISCC and RSB), SAF minimum emissions reduction threshold (≥10%) and carbon intensity of fossil fuel (89 gCO_2e). SBTi offers either default or actual carbon intensities for SAF feedstocks, which is also in line with CORSIA. For SAFc, CST proposes using actual SAF disclosures, which are more accurate for each fuel producer and individual production batch.

Section 5.3 of SBTi's draft guidance includes the following four requirements, which have implications for SAFc accounting:

1. **Proof of fuel consumption** – the working assumption for SAFc is that it is acceptable to use a proof of delivery to airport that includes measurement for what is likely an already blended fuel volume.

2. **Environmental benefits evidence** – the SAFc preconditions, which include ISCC and RSB certification and life-cycle assessment (LCA) carbon reduction values, will meet this requirement.

3. **Descending chain of custody** – based on this requirement, SAFc will at least initially require transactions that follow the supply chain. SBTi guidance allows fuel suppliers to sell SAF to businesses. Ideally, SAFc could eventually be traded in a marketplace that would enable transactions in any direction.

4. **Well-to-wake emissions analysis** – this requirement aligns with SAFc but introduces a mismatch with CORSIA Scope 1 compliance, which is currently limited to tank-to-wake for fossil-based jet fuel.

According to SBTi guidance, firms can realize the SAF emissions reductions through direct procurement of SAF following a book-and-claim approach, provided it is consistent with the GHG Protocol either via direct purchase from a fuel supplier or indirect purchase from an airline.

3.3 SAFc traceability

SAFc enables firms to secure GHG emissions reductions for their travel and air cargo without owning the physical product or any associated safety considerations or connected liabilities. Decoupling the carbon reduction and other benefits from the physical SAF allows the fuel to be delivered to the most suitable airport, enabling more efficient, lower-cost SAF solutions.

Decoupling avoids the administrative costs, transportation costs and GHG emissions associated with delivering SAF to an exact flight. Decoupling also enables multiple parties to participate in claiming the SAFc emissions reductions. For SAFc to function, traceability mechanisms related to tracking and verification, and to registry and government, must be addressed.

Tracking and verification

Physical delivery of SAF being sold via SAFc-based transactions to a specific aircraft is not required if digital tracking and other safeguards are in place. Technology can serve as a substitute for actual measurements. To identify the appropriate traceability option, the following three methods for monitoring the transfer of SAF along the supply chain are considered:

1. A **physical segregation** approach in which SAF is kept separate from conventional fuel

2. A **mass-balance** approach in which the SAF volume is physically measured before it is added to the conventional fuel supply chain. Every subsequent transfer along the supply chain includes documentation accounting for the original SAF volume as part of the larger blended volume of fuel

3. A **book-and-claim** approach in which the SAF producer accounts for virtual movement of the fuel. Sustainability attributes can transact independently from the sale and transport of the physical fuel molecules

SAF is a drop-in fuel considered equivalent to fossil-based jet fuel, and as such does not require any additional implementation infrastructure. This 1:1 compatibility is a key cost-limiting feature, so physical segregation of SAF for SAFc use is therefore not a workable solution.

A hybrid system deploying both mass balance and book-and-claim to track and verify SAF and SAFc is the proposed initial approach. Initially, a hybrid system that uses both mass balance and book-and-claim[21] to track and verify SAF and SAFc is proposed.

In this combined approach, mass balance accounts for physical attributes along the supply chain, and book-and-claim covers virtual tracking. For example, the SAF producer uses mass balance to document the physical volume of a specific quantity of SAF. When that SAF volume is blended with conventional fuel, the percentage of SAF volume within the blended batch continues to be physically recorded at each transfer point in the supply chain. Producers must provide accounting documentation showing that the volume of SAF sold equals the volume of SAF produced for each issuance of SAFc. Mass-balance tracking provides assurance that SAF delivery occurred. It is also used to document that fuel certification and safety requirements were executed.

The book-and-claim system is used to virtually track the ownership of the SAF molecules as well as their Scope 1 and 3 attributes from the SAFc. Fuel-based book-and-claim tracking begins when a measured SAF volume is issued with a SAFc and introduced into the delivery supply chain. From that point, the flow of the SAF molecules is accounted for virtually as part of the total fuel volume headed for an airport fuel farm. Chain-of-custody documentation records the agent responsible for transfer and the owner of the Scope 1 and 3 attributes at each segment of the supply chain until the emissions reductions are booked and retired.

Registry and governance

For SAFc to be credible, it must itself be logged and tallied within a registry (similar to an offset registry) and be overseen by a robust governance structure for recording emissions reductions and preventing double counting and double claiming. Registries are systems that track transfer of ownership for one type of product and ensure credible counting and claiming. For energy or environmental attributes, a registry records a “product” that meets one specific standard. Carbon offset projects have several different standards, such as Verra, Gold Standard and Climate Action Reserve, and each standard operates its own independent registry. The variety of “standards” and “registries” has led to significant questions over their validity, quality and effectiveness, creating public distrust of the concept and encouraging claims of greenwashing.

With the opportunity to create a SAFc system from scratch, all efforts should be made to learn from and avoid the pitfalls of other frameworks. The proposed CST SAFc concept would be an internationally consistent evaluative framework standard, governed by one singular independent entity, with all transactions logged and tallied within one global registry. Such a system would allow for and incorporate independent SAFc transactions such as through SAF partnerships, provided these transactions meet the global evaluative framework requirements and the SAFc transactions are appropriately logged and reported.

3.4 Avoiding Scope 1 and Scope 3 double counting

❝ SAFc supports emissions reduction above regulatory compliance, facilitating a faster "race to zero" within the aviation sector.

Any credible climate solution must avoid the double counting of emissions reduction claims, which occurs when multiple parties claim the same emissions within the same scope. Under current accounting practices, when an aircraft operator purchases SAF, the Scope 3 benefits are shared proportionally among all of its customers.

In the SAFc model, there is a perceived risk of double counting were there to be multiple claims to reductions of Scope 3 emissions. For instance, double counting could potentially happen under the following conditions: when an air transport customer reduces its Scope 3 emissions via SAFc, the aircraft operator it is partnered with realizes the Scope 1 emissions benefit made possible by SAFc. The aircraft operator's other customers – those not in the SAFc partnership – may then believe they can also claim a portion of the Scope 3 emissions associated with the SAF made possible through the SAFc.

To prevent this sort of Scope 3 double counting from occurring, during the SAFc pilot phase the Scope 3 value associated with SAFc will be transferred to a single buyer only. That buyer alone will own the indirect emissions reduction claim.

In other words, an aircraft operator will be able to share SAF emissions reductions only with the partner that directly paid for the SAFc. This transfer of claims to a single buyer only safeguards against double counting. Future guidance will cover circumstances where multiple Scope 3 parties are involved in the same SAFc transaction, such as when a freight forwarding company is purchasing air cargo services on behalf of its customers.

SAFc supports emissions reduction above regulatory compliance, facilitating a faster "race to zero" within the aviation sector. To be clear, aircraft operators will be able to make public statements that the SAFc supported their net-zero goals, but they will not be able to "double claim" the reductions as part of their emissions compliance reductions. Instead, the SAFc Scope 1 reductions could be applied to the international transport bunker fuel inventory, used to track emissions associated with international travel and therefore outside national-level emissions profiles.

Phase II SAFc development will address the specific questions related to functioning within key-market regulatory requirements.

3.5 Functioning within key regulatory frameworks

SAFc-based Scope 3 emissions reductions are not subject to regulatory oversight. SAF and its associated direct emissions benefits are regulated under several frameworks, as detailed below along with outstanding questions to be addressed in future SAFc development.

CORSIA

Recognizing aviation's responsibility to address its significant contribution to global carbon emissions, ICAO adopted CORSIA in 2016 to address the industry's climate impacts. CORSIA focuses mainly on using carbon offsets and eligible alternative fuels to address emissions from international air transport. CORSIA consists of three implementation phases, with the voluntary pilot phase beginning in 2021 and lasting until the end of 2023.[22] Phase 1 will run from 2024 until the end of 2026. All participation is considered voluntary until 2026, though the least-developed countries, small-island developing states and landlocked developing countries will not be mandated to comply. Nations are able to join or withdraw from the voluntary implementation phases at the beginning of each year, provided they notify ICAO by the previous June. Even without participating in CORSIA, all ICAO member states are required to monitor, report and verify CO_2 emissions of international flights beginning in 2019.

- **Open question:** To prevent double claiming, only Scope 1 emissions related to SAFc use not claimed elsewhere as Scope 3 reductions will count towards airline decarbonization obligations; how will SAFc accounting procedures ensure proper functioning within CORSIA?

European Union region

EU Emissions Trading Scheme

The EU Emissions Trading Scheme (EU ETS), implemented in 2005, applies the cap-and-trade principle of emissions allowance to all European Union nations, plus Iceland, Liechtenstein and Norway. By establishing a carbon price and developing an international marketplace, EU ETS is designed to lower GHG emissions and incentivize clean energy investments. Aircraft operators emitting 10,000 tonnes of CO_2 annually are subject to these regulations. In 2012, the aviation industry was incorporated into the EU ETS, joining other hard-to-abate industries such as power provision and oil refining, under Phase 3 of the regional trading scheme.[23] In order to comply with the annual maximum cap on CO_2 emissions, aircraft operators must surrender a number of permits ("allowances") equivalent to their CO_2 emissions reported in the previous year. Allowances represent 1 tonne of CO_2 equivalent. Every year, the EU places a cap on the allowable CO_2 emissions and restricts the number of permits within the marketplace. As the cap and number of allowances progressively decreases, the market price of permits increases, driving an incentive for polluters to reduce their emissions.

- **Open question:** If both EU aircraft operators and air transport customers are involved in a SAFc transaction, is there an acceptable method to split the premium between parties?

Renewable Energy Directive

In 2018, a revised renewable energy directive (RED), RED II, was enacted within the European Union. The revisions made in RED II extend the EU's 2030 renewable energy consumption target to 32% and require member states to mandate that fuel suppliers produce a minimum of 14% of the energy used in the road and rail transport sector as renewable energy by 2030. While the aviation sector is not included in the RED II targets, the policy recognizes voluntary aviation requirements within national legislation and enables SAF use towards meeting RED II targets. Eligible SAF volumes must comply with RED II-directed sustainability criteria, including indirect land use change considerations, feedstock and process requirements. Non-bio-based SAF is given a multiplier of 1.2 in calculations of its contributions towards national renewable energy obligations.

- **Open question:** How would the RED II multiplier factor into Scope 3 certificates, given the stated objective that direct emissions inventories should match indirect emissions totals?

Blending mandates

A number of EU nations have existing or planned minimum SAF percentage blending requirements. CST, as part of its policy worksteam, has published analysis on this policy option.[24] A SAF blending mandate creates an obligation for fuel suppliers/airlines to provide a certain percentage of fuel from renewable sources or gradually reduce the GHG emissions intensity of their fuel production. The obligation under consideration could likely apply to flights departing from the EU, the European Economic Area and the United Kingdom. In the EU, it could be implemented by including fuel producers as an obliged party to the next iteration of RED II, or the Fuel Quality Directive (FQD), or via a new separate mandate. Adoption would accelerate SAF production and drive new SAF investment.

– **Open question:** How might SAFc operate within a policy environment with mandated SAF usage and apply only to SAF volumes above and beyond already mandated volumes?

Additional individual European country programmes

The UK and the Netherlands also offer their own independent programmes to advance biofuels. The UK's Department for Transport oversees the Renewable Transport Fuel Obligation (RTFO). RTFO certificates are issued for each litre of eligible renewable fuel. Fuel producers producing more than 450,000 litres annually are subject to the RTFO and must either make a renewable fuel to cover a percentage of their product or buy certificates from another party.[25] In the Netherlands, the Energy for Transport compliance system issues bio-tickets for renewable fuel units (HBEs: *Hernieuwbare Brandstofeenheden*). HBE values have ranged from €0.21–€0.33/litre and double this amount for fuels using feedstocks listed in "ANNEX IX" of the EU Renewable Energy Directive.[26] HBEs are used to comply with the annual obligations of Dutch companies to reduce GHG emissions.

– **Open question:** What is required for the SAFc to work in the UK and Netherlands given their individual country policies?

North America

Renewable identification numbers

Under the 2005 Renewable Fuel Standard (RFS) programme, there are mandates for renewable fuel to be used to replace or reduce conventional transportation fuel, heating oil and jet fuel. Petrol and diesel fuel refiners and importers are obligated to comply with the RFS by participating in the renewable identification number (RIN) market. Directed parties are able to generate and purchase RINs in order to meet their renewable volume obligation. RINs are generated and assigned to verified batches of renewable fuel. The number of RINs assigned to each batch varies according to the energy intensity of the renewable fuel compared with that of 1 gallon of ethanol. The four eligible fuels under the RFS are biomass-based diesel, cellulosic biofuel, advanced biofuel and total renewable fuel. RIN verification of fuels depends on the fuel type, feedstock and process requirements, meaning that SAF can be eligible for RIN production under each of the current feedstock conversion pathways. When a batch of renewable fuel is sold and blended with non-renewable fuel, the RINs are separated from the batch of blended fuel and can be traded.

- **Open question:** How does the RFS address the carbon value for the obligated parties (fuel producers) vs. the fuel buyers (aircraft operators), and how will that affect Scope 3 valuation?

Blending tax credits

Stacked with the RINs, the US Congress is considering renewing a "blender's credit" that will support SAF production. Under the Kildee/Schneider proposal, the proposed minimum payment ($1.50) would add a carbon intensity performance bonus for each percentage of carbon reduction above 50% compared with fossil-based jet fuel.

- **Open question:** If the life-cycle assessment (LCA) carbon calculations used in the blending tax credit differ from CORSIA's calculations, which determination takes precedence in determining the Scope 3 value available to corporate air transport customers?

The Low Carbon Fuel Standard

Implemented by the California Resources Board (CARB) in 2011, the Low Carbon Fuel Standard (LCFS) aims to reduce the carbon intensity of the state's transportation fuel through improved technology, advanced fuel efficiency and increased transportation mobility options. The LCFS programme is designed to achieve at least a 20% reduction in the carbon intensity of transportation fuels by 2030.[27] CARB uses the term "alternative jet fuel" for SAF. To generate credits, SAF must have a lower carbon intensity than the fossil fuel benchmarks. The life-cycle analysis of fuels covered under LCFS regulation is calculated with the CA-GREET (Greenhouse gases, Regulated Emissions, and Energy use in Technologies) Model. Beginning in 2019, the California LCFS was expanded to include alternative aviation fuel as an eligible credit generator.[28] However, it is important to note that conventional jet fuel is not subject to any compliance measures, meaning that fossil-based jet fuel does not generate credit deficits. SAF producers can voluntarily opt into the programme to generate LCFS credits to compensate for fossil fuel generation obligations or sell the LCFS credits to other deficit generators.

- **Open question:** How does the addition of a regional cap-and-trade system ensure that emissions are reduced in total and not simply shifted between transport modes (e.g. surface and air)?

Next steps

Development of the SAFc framework will proceed through four phases.

Phase I, which focused on the required research, analysis and extensive stakeholder consultations to construct the SAFc concept framework, was completed in early 2021.

Phase II, which focuses on resolving the outstanding questions addressed in this report and establishing clear and explicit implementation guidance, informed by pilot SAFc use and reporting in collaboration with CST coalition partners, has already begun. SAFc will be reported as a stand-alone disclosure and initial alpha tests will inform the creation of appropriate governance structures.

Phase III begins with the release of finalized SAFc usage guidelines and the establishment of an operational SAFc registry, through which use of the concept will scale.

The fourth and final phases will be reached upon incorporation of SAFc into international GHG accounting standards such as SBTi and GHGP. Ultimately, the expectation is that SAFc becomes the go-to option for institutional air transport customers to address their air transport emissions, driving up the use of sustainable aviation fuels and driving down air transport emissions.

FIGURE 10 **SAFc framework development process**

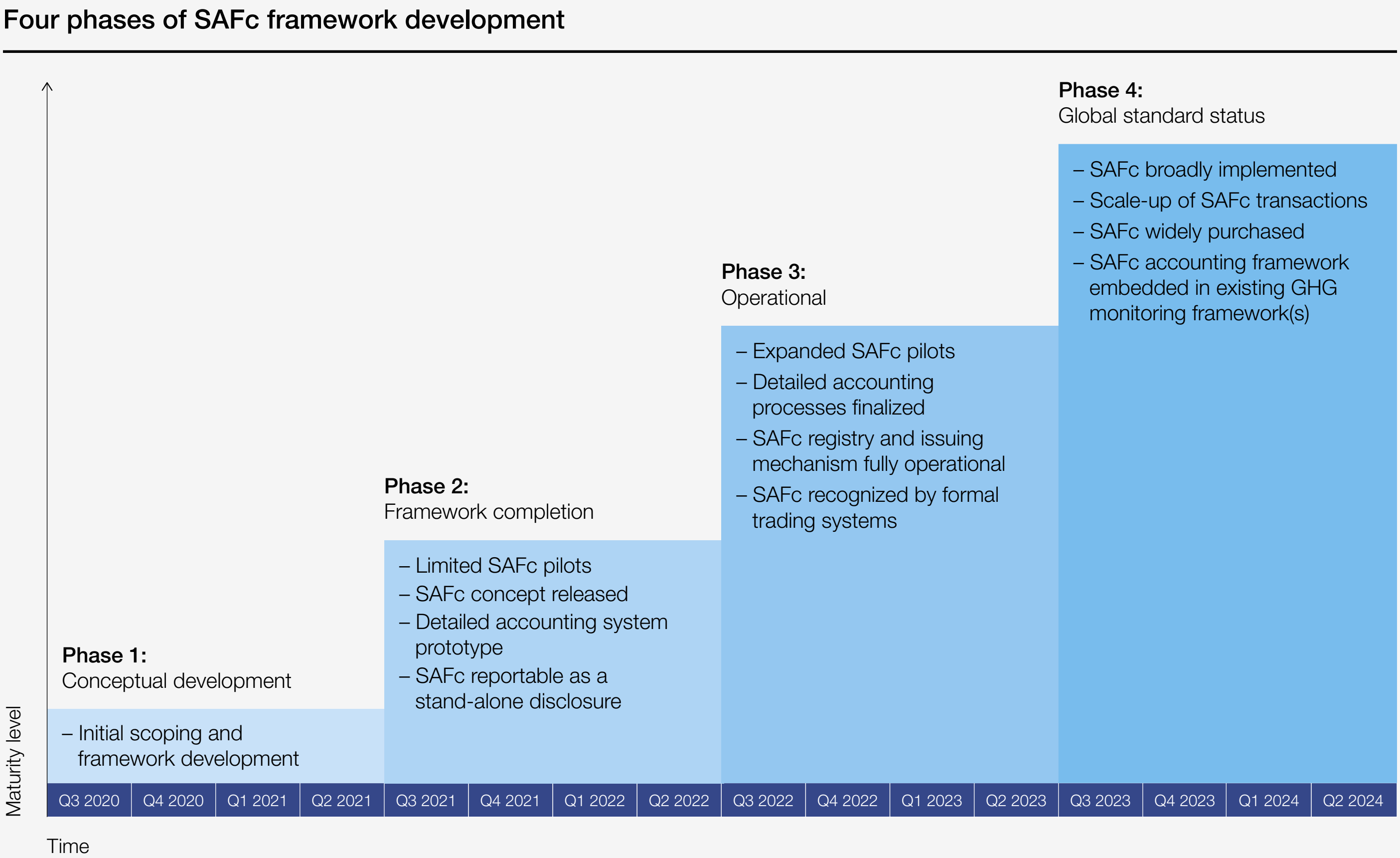


Figure 11 details the four sub-workstreams within the CST project focused on SAFc development, as well as those leading organizations collaborating through the CST coalition to design, test and implement the SAFc framework.

Each sub-workstream will focus on the specific elements necessary for SAFc implementation as components of the broader *Clean Skies for Tomorrow* initiative, led by the World Economic Forum and implemented in collaboration with a variety of project partners.

FIGURE 11 | The SAFc framework system and related external components

	A Accounting system	B Issuing mechanism/ registry specification	C Full implementation guide	D Transaction facilitation
2021 ambition	Detail SAFc accounting framework, including: – SAFc carbon intensity requirements – Corporate reporting guidelines – Implications regarding regional regulatory GHG baselines – SAF policy frameworks, i.e. CORSIA /potential mandates – RSB/ISCC requirements – SAFc compatibility with other models, e.g. insetting – Auditing/assurance requirements	Specify and design: – SAFc issuing mechanism that has standard-setting authority including governance and tariffs – SAFc registry based on accounting system, including external feed-ins from official SAFc ledgers	Produce holistic framework implementation guide incorporating (A) and (B), including specifications for: – RSB/ISCC verification roles and LCA determination – Tracking and book-and-claim features	– Alpha-test SAF/SAFc agreements according to operational framework, with lessons learned informing framework finalization and implementation – Coordinate with other SAF purchase agreement entities seeking SAFc usage
2022+ ambition	Establish SAFc as an accepted mechanism within GHGP and SBTi	Operationalize issuing mechanism and registry at scale	Operationalize a verifiable LCA emissions reduction assessment tool for SAF/SAFc	Using live registry and issuing mechanism, conduct beta-testing of SAF/SAFc agreements, with insights further informing SAFc framework maturation

Source: World Economic Forum and RMI in collaboration with SkyNRG, Smart Freight Centre, SABA, RSB, PwC, KLM, ISCC, EDF, DPDHL, Deloitte and others

Sub-workstream A: Accounting system

Building on the conceptual analysis outlined in this initial report, the essential next step is to construct a detailed and implementable SAFc accounting framework and sustainability standards, including requirements for incorporation into accounting standards as guided by GHGP and SBTi and associated corporate reporting guidelines. This detailed execution guide will also address SAFc compatibility with other models such as insetting, and explicitly include international, national and regional regulatory compliance considerations, including management of Scope 1 claim ownership across regional regulatory regimes.

Sub-workstream B: Issuing mechanism and registry specification

Work within this sub-workstream will focus on the specification and design of both a SAFc-issuing mechanism and a registrar mechanism. To successfully reduce aviation emissions through the scaling of SAF, SAFc must be issued by an independent and non-profit entity. Credibility and trust in the SAFc concept depends on effective claim management, so SAFc use must itself also be tracked, reported and measured. This could occur using an independent digital technology and function as part of a specifically designed SAFc registry system. The issuing mechanism could also function as the "standard holder" that assesses and updates associated sustainability or other requirements as necessary in accordance with the accounting system. Routine review is necessary to ensure that the certification providers (or sustainability certification schemes) act on the best available data and practices. In addition, the issuing body can recognize auditing service providers that can assess transactions and provide assurance to SAFc buyers.

Sub-workstream C: Full implementation guide

As a sequel to this report, a written SAFc implementation guide will provide a detailed overview of the finalized SAFc framework, providing a singular point of reference for users across the value chain. This includes directions on life-cycle emissions assessments used as a basis for SAFc valuation. An effective LCA emissions calculation tool with auditable results is vital to a properly functioning SAFc system, both for defining the SAFc unit of trade and for ensuring that the appropriate sustainability requirements for the SAF volume (and supporting SAFc) are consistently met. This verification, likely conducted by existing evaluators such as ISCC and RSB, will require full compatibility with book-and-claim systems as well as fully auditable internal operations to ensure validity and build trust in the system. The guide will detail these attributes, requirements and implementation procedures.

Sub-workstream D: Transaction facilitation

Actual SAF usage is core to the proper functioning of the SAFc framework. SAF and supporting SAFc agreements will be tested in initial one-off transactions to inform continued framework development – quickly followed by increasingly scaled transactions to routinely update and strengthen the underlying SAFc framework.

Conclusion

> First movers will benefit not only from recognition of innovative action but also from immediate emissions reductions through SAF use.

Through collaboration across its diverse Partner community, the World Economic Forum's *Clean Skies for Tomorrow* initiative is working to ensure a safe, clean and inclusive future for air transportation.

SAF is essential to aviation's decarbonization pathway, and while a rapid scale-up is required to provide the volumes needed, global progress needs speed. CST developed the SAFc concept to accelerate this SAF use and production ramp-up while ensuring it meets stringent social and environmental requirements. It provides a potential solution not only to the aviation industry's fuel supply challenges but also to the sustainable flight needs of air transport customers the world over. SAFc represents a new mechanism for downstream customers to cover price premiums that fuel suppliers may not be able to pay for themselves. This type of Scope 3 accounting could also be used in other harder-to-abate sectors such as shipping and road transport, and the SAFc framework could be scaled accordingly.

With SAFc, corporate climate leaders will be able to address their aviation GHG footprint for operations that they cannot directly eliminate. Today, air transport customers can pilot the SAFc concept and report the LCA emissions reductions as a standalone disclosure within their environmental footprint assessments. Pending future acceptance from GHG accounting and target-setting bodies, SAFc will function as an internationally recognized mitigation action.

As examples of successful SAF partnerships, a variety of agreements are already piloting the SAFc system, including those between Microsoft, SkyNRG and Alaska Airlines, Deloitte and American Airlines, and DHL Global Forwarding and United Airlines. Additionally, the Sustainable Aviation Buyers' Alliance (SABA) was launched in 2021 on the basis of the SAFc framework. These partnerships demonstrate not only the existing strong demand for SAF but also the need for and power of the SAFc system to facilitate increased use and investment in SAF production technologies.[29]

The conceptual framework outlined in this report is a significant step, but only the first one necessary to fully operationalize a SAFc system. Support will be required from along the aviation value chain, including testing the approach through pilots to identify implementation challenges and generate learnings to improve the framework. These first movers will benefit not only from recognition of innovative action but also from immediate emissions reductions through SAF use.

Through the collaborative work within *Clean Skies for Tomorrow* and the SAFc framework, aviation's more sustainable future is achievable.

Appendixes

Appendix A: Use cases

The following examples of SAF procurement highlight the current SAF market for a range of actors, highlighting current and future transactions. The illustrative use cases also provide an overview of how SAFc can be applied to such agreements once operational. Each example was produced with detailed input and the permission of all involved parties.

Aircraft operator: Gulfstream Aerospace Corporation

Gulfstream Aerospace Corporation, an American jet aircraft manufacturer, has been a trailblazer in the business aviation industry since 1958. In addition to developing several flagship aircraft, Gulfstream has been an industry leader in sustainability. Gulfstream began purchasing sustainable aviation fuel (SAF) in 2016 and has subsequently functioned as both a consumer and supplier; it purchases a significant percentage of market-available SAF (more than 1.2 million gallons to date) from World Fuel Services, its fuel provider, for both its own operations and resale to clients at a subsidized conventional Jet A market price. Since March 2016, Gulfstream has flown more than 1.3 million nautical miles with SAF delivered to both its Savannah, Georgia, and Long Beach, California, locations.

Because fuel costs are a smaller proportion of operating costs for business aviation companies and private operators vs. commercial passenger airlines, they may have more resources available to cover SAF premiums. Gulfstream pays a premium that covers its own Scope 1 emissions until the aircraft is transferred to customer ownership. Gulfstream's customers may receive environmental attributes, such as Scope 3 benefits, at no additional cost.

Gulfstream's SAF services could be scaled rapidly with a proposed SAFc mechanism. Currently, Gulfstream pays the full price premium for the blended fuel it provides to customers. By implementing SAFc, Gulfstream could carry on scaling its SAF services without continuing to bear the full cost and also add an additional product offering to Gulfstream's existing carbon offset options.

Airport: Swedavia Fly Green Fund

SkyNRG, Karlstad Airport and the Nordic Initiative for Sustainable Aviation (NISA) launched the Fly Green Fund in 2014. Funded by Swedavia, a Swedish state-owned airport operator, and the Swedish Regional Airport Association, the Fly Green Fund covers the price premium of SAF for airlines via voluntary customer contributions. Like airlines and corporations, airports have their own emissions inventories to mitigate, including carbon emitted by aircraft operations at altitudes of less than 1,000 metres. In addition to supporting SAF adoption, the Fly Green Fund also promotes local supply chain and local feedstock development.

Swedavia currently receives 450 tonnes of SAF annually at several of its airports. SAF volumes purchased through the Fly Green Fund are composed of HEFA-based SAF from used cooking oil. SAF purchases enable Swedavia to significantly mitigate its Scope 3 emissions without using offsets, abating an estimated 891 tonnes of CO_2e emissions in total.

By using a SAFc system, the scope and scale of the Fly Green Fund could expand significantly in terms of both resource support and partner expansion. Swedavia is already awarded emissions reductions through a book-and-claim method; the adoption of SAFc will eventually support lower fuel premiums, mitigate common barriers to SAF production and consumption and establish Swedavia as a model for corporations looking to offset their Scope 3 emissions by funding SAF price premiums.

Futures contract: SkyNRG

SkyNRG's Board Now programme, launched in 2019, provides firms with an option of reducing air transport emissions through direct SAF purchase. Programme members select and commit to pay for an annual SAF volume of their choice (minimum 50 metric tonnes) based on their emissions reduction targets, with SkyNRG fronting the SAF premium to secure the product. All delivery and emissions claims are verified by an independent third-party auditor, with each member receiving an annual impact report. By facilitating bulk purchases and fronting the costs, SkyNRG enables increased confidence in the nascent SAF market and expands the SAF market beyond air transport operators direct to customers.

Freight forwarder: Deutsche Post DHL Group

Deutsche Post DHL Group (DPDHL) is a major global logistics company. In 2017, DPDHL set a goal of reducing logistics-related emissions to net zero by 2050. The group believes that the impact of mitigating emissions will be even greater if it enables customers to obtain access to climate-friendly solutions and offers sustainable logistics, including the use of SAF. In 2020, 66% of DPDHL's CO_2 emissions were associated with air transport. In addition to other emissions reduction efforts, DPDHL signed two SAF purchase agreements in 2020 with Neste and Shell. DPDHL receives deliveries of SAF at Amsterdam Schipol Airport (AMS) and San Francisco International Airport (SFO) thanks to their proximity to the fuel suppliers' existing supply chains, which reduces logistics costs and the environmental impacts of the delivery. DPDHL's largest hubs – in Cincinnati, Ohio, and the German city of Leipzig – currently lack existing SAF supply chains. SAF delivery to these locations would require establishing a costly transportation supply chain. Therefore, AMS and SFO were determined to be the optimal locations because they offered transportation and cost efficiency, allowing DPDHL to source more SAF. As part of the contracts, DPDHL requires the fuel producer to provide monthly updated documentation regarding delivered volumes, feedstock information and estimated emissions savings.

SAFc complements DPDHL's current SAF efforts and can help the company and its fuel producers to significantly scale contracted volumes. With financial support of customers looking to lower their Scope 3 emissions, DPDHL can cover the full price premium of SAF and reduce its Scope 1 emissions while distributing Scope 3 certificates to respective customers.

Corporate customer: Microsoft-KLM Transaction

KLM Royal Dutch Airlines, with the support of SkyNRG, created the KLM Corporate Biofuel Programme in 2012. The programme was implemented to offer its corporate clients a lower-carbon travel option. By contributing the price premium of SAF, corporate participants can fly on sustainable fuel and reduce their business travel emissions, with KLM then able to purchase higher SAF volumes without the price burden. Microsoft is a corporate client of KLM with an overall target of "carbon negative" operations. Central to that is its internal business travel strategy to "reduce" (travel reduction), "replace" (use SAF over conventional jet fuel) and "remove" (use carbon offsetting and invest in carbon removal technologies).

Microsoft signed a 2019 agreement with KLM to secure its own SAF, in which KLM served as intermediate SAF owner. In accordance with the contract, Microsoft agreed to fund the development and purchase of SAF. While the contract made no specific mention of the fuel producer or batch number for the volumes that Microsoft would be supporting, the language indicated that all purchases would come from World Energy SAF supply. As the owner of SAF volumes, and as the party that used the physical fuel, KLM retained all Scope 1 value and was therefore able to pass on the Scope 3 benefits to Microsoft.

Under the SAFc approach, KLM would continue to provide Microsoft with an annual report containing the total SAF volume purchased, total fuel burn and emissions savings information, which would be used to award Scope 3 certificates to Microsoft for annual emissions reporting. Formal disclosure of feedstock origin/source would also be necessary. With an established book-and-claim system and central registry, Microsoft and KLM would be able to access and claim their emissions reduction certificates independently.

Appendix B: Example SAFc implementation

Standalone disclosure

A viable, immediate option for SAFc accounting and reporting is standalone disclosure (SD) reporting. A standalone disclosure can exist outside of the Scope 3 GHG inventory a company reports and allows the SAFc framework to be tailored for a virtual product. Firms should use a standalone disclosure for their SAFc reporting until it is formalized into globally standardized metrics such as the Greenhouse Gas Protocols.

Standalone disclosures provide flexibility on SAFc reporting, allowing for one combined life-cycle assessment (LCA) figure with aggregated quantifications of carbon removal/sequestration, biogenic emissions and fossil emissions. Use can begin immediately without triggering GHGP non-compliance, and standalone disclosure can be incorporated into CDP reporting to record the action, although they do not yet enable emissions mitigation claims.

High-level approach and calculation method

A standalone disclosure methodology allows companies to purchase SAFc and reduce their reported GHG emissions, disclosing the emissions reductions separately from the GHG inventory. Emissions calculations are based on the existing GHGP's Corporate Value Chain (Scope 3) Accounting and Reporting Standard. The disclosure should include elements such as:

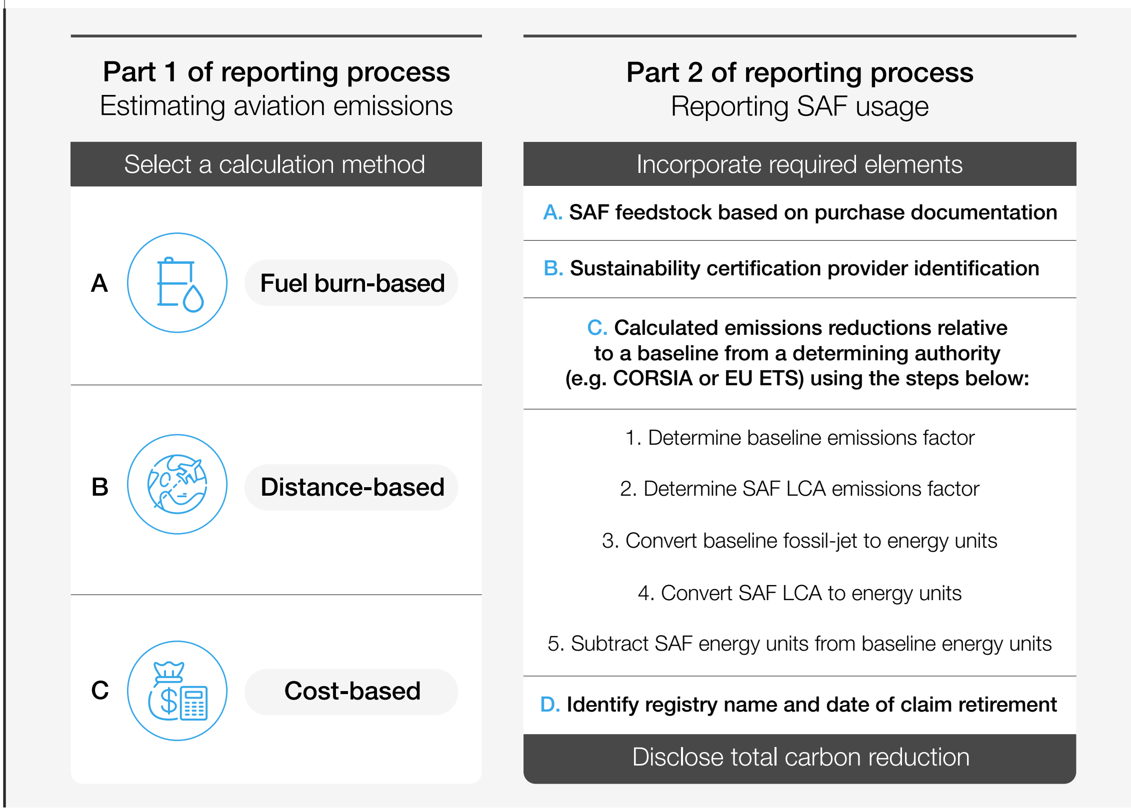
1. The SAF volume secured through the SAFc purchase
2. The SAFc net GHG emissions calculated on a life-cycle basis
3. The net GHG emissions reduction from using SAF in place of an equivalent volume of conventional jet fuel, provided as part of the SAF chain-of-custody documentation

Process for standalone disclosure CDP reporting

Standalone disclosure is a temporary approach for SAFc and has limitations, many of which can be addressed with clear international guidance and standards for calculating and reporting GHG emissions reductions. Without clear guidance and standards, such risks include inconsistencies among parties, resulting in non-science-based GHG accounting and reporting.

Figure 12 details an initial standalone claim-reporting methodology process usable for reporting to CDP in an independent standalone section. The approach aligns with pending SBTi aviation consultation guidance, but air transport customers may choose different carbon intensity factors based on aircraft operator guidance. The following are possible steps to report SAF usage. A future full implementation guide accompanying the finalized framework in later project phases will address each regulatory regime and the related SAFc emissions calculations requirements.

FIGURE 12 **Standalone claim-reporting methodology process**



Contributors

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