Deloitte.

Reaching cruising altitude

A plan for scaling sustainable aviation fuel

Our sustainable aviation fuel initiative

Deloitte's World*Climate* strategy articulates a strong ambition and commitment to tackling climate change-related issues through our own actions and collaboration with our partners and stakeholders.

Our sustainable aviation fuel (SAF; rhymes with laugh) initiative is an example of this commitment. Through this, we have brought together Canadian stakeholders from across the aviation ecosystem to assess the need as well as the challenges facing SAF adoption in Canada and to begin to identify opportunities for joint action. Although SAF is not the only possible solution to decarbonizing the aviation industry, we consider it a critical stage of flight in the overall energy transition for this industry.

Through efforts like this one, we aim to send a strong demand signal that will drive us toward a lower-carbon future in the short to medium term, as innovation continues to create even greater long-term solutions. We believe strongly in the power of the collective, and we hope to see more collaborative efforts of this kind.

This report lays out a suggested flight path to accelerate Canadian capabilities and advance SAF adoption in Canada. It represents the perspectives of the stakeholders we approached, including fuel supply and distribution companies, airports and airlines, governments, corporate and leisure travellers, and beyond. We brought this group together to not only help solve the issues facing Canada's SAF industry today, but also to build a cohort of influential and committed stakeholders that can continue to take this work forward.

If you're reading this, you also have a part to play in accelerating SAF adoption and decarbonizing the aviation industry. We hope you'll join us as we work together to remove barriers to low-carbon aviation, reshape the future of sustainable travel, and ultimately demonstrate the type of bold action that our planet needs now.

Sheri Penner
Executive Lead for World*Climate*,
Deloitte Canada

Anthony Viel
Chief Executive Officer
Deloitte Canada

We acknowledge that Deloitte offices reside on the traditional, treaty, and unceded territories of Turtle Island (North America) that are still home to many First Nations, Métis, and Inuit peoples. ***We are all Treaty people.***

The decarbonization imperative

Canada's commitment to achieving net-zero carbon emissions by 2050 requires us to take immediate action to decarbonize our economy. This includes our aviation sector, which has largely remained unaddressed by public climate policies and actions that have been introduced since the Paris Climate Agreement. Canada has an opportunity to be a leader in the production of clean fuels that help decarbonize transport, including aviation. To lead, the country will have to introduce measures to accelerate low-carbon fuel production. These include policy interventions, investments, and other enabling initiatives that work together to remove barriers along the biofuel value chain.

Our focus is on aviation because the industry will continue to be incredibly important to a vast country like Canada, even in a net-zero carbon future. Canadians rely heavily on aviation to connect communities and supply essential goods to remote regions. The industry employs over half a million people in airlines, airports, and air traffic control[1]. It also contributes significantly to our regional and national economy, and has an important role to play in Equity across its diverse regions.

While there are a host of operational efficiencies and emerging technologies (such as battery or hydrogen-powered aircraft), the global industry recognizes sustainable aviation fuel (SAF) and carbon-removal technologies as two readily deployable and necessary parts of decarbonizing aviation.[2] Low-carbon aviation fuels and SAF are compatible with current aircraft and infrastructure, and, depending on the feedstock source, can substantially lower the life cycle carbon emissions of aviation fuel. In this report, we focus on how to foster the production and use of SAF in Canada.

Since aviation has fewer and less affordable emissions-reduction options than most sectors of the economy,[3] its share of global emissions will increase over time.[4] Adding to the challenge is the fact that air transport is predicted to grow in Canada.[5] If Canadians don't start finding ways to scale the supply and uptake of SAF, aviation's contribution to national greenhouse gas emissions will continue to grow. Canada needs to act now to enable the nation to attain its pledged target by 2050.

In developing this report, Deloitte invited a cross-section of aviation and clean fuel stakeholders to come together to identify opportunities for coordinated action toward the goal of decarbonizing aviation with Canadian-based solutions that bring economic opportunity to Canada and serve to improve our environment. It sets out a path to support the future workforce transition from employment in fossil fuels to renewable energy. We envision a future in which Canada operates in a net-zero emissions environment and contributes to a resilient, sustainable world economy and, most of all, a healthier planet.

This work has demonstrated that stakeholders have both the knowledge and the tremendous capacity to collaborate, to come together and ideate around how to achieve the lower-carbon future our country wants and needs. There will be challenges and resistance to overcome. But by working together, Canadians *can* achieve their collective goals and bring about a brighter, cleaner future.

Hard to decarbonize

Aviation is part of the group of transport modes that are responsible (along with shipping, trucking, and heavy industry) for nearly one-third of global CO_2 emissions, a number that is expected to double if no action is taken.[6] Canada is committed to reaching net-zero greenhouse gas (GHG) emissions by 2050 and pursuing efforts to limit the global temperature increase to 1.5°C.

To get there, we have to look beyond "hard to decarbonize." Every industry has a part to play in limiting emissions, and this report outlines the immediate action required by the aviation sector to decarbonize. For Canadians to continue to travel quickly and move goods across large distances while being mindful of their carbon footprint, Canada needs to take action today.

Even in the time that we took to prepare this report, the SAF landscape in Canada changed, with announcements of new partnerships, investments, and production facilities. While this progress is positive, the size and scale of the issue and the input received from aviation and clean-fuel stakeholders demonstrate that Canada will need to continually evolve its thinking and solutions. This report outlines a path that can move Canada forward.

The aviation industry makes a critical contribution to Canada's GDP.[7] It supports approximately 633,000 jobs across the country, directly and indirectly, including 241,000 positions with airlines, airports, onsite enterprises (retailers, restaurants, financial services), and air traffic controllers as well as 146,000 in the airline supply chain.[8] Pre-pandemic, members of the National Airlines Council of Canada carried over 80 million passengers annually and directly employed over 60,000 people.[9]

In some regions of this expansive country, the option of a land connection doesn't exist or is not practical. In particular, many Indigenous communities are remote and only accessible by air for most of the year.[10] For those communities, aviation connectivity is essential, and critical for social mobility, prosperity, and logistics. This is an important imperative to climate mitigation of lands and resources, as we acknowledge, respect, and embrace Indigenous peoples' inherent rights and responsibilities through their spiritual and cultural connections to land, water, and air.

The difference between aviation fuels

Petroleum jet fuel
Fuel that results from the extraction, refining, and burning of fossil deposits from under the ground. The source is carbon-based and the process to render them usable creates carbon dioxide, so both result in an increase in the overall level of CO_2 in the atmosphere.

Lower-carbon aviation fuel (LCAF)
LCAF also originates in fossil deposits but it's produced using less emissions-intensive processes than legacy methods[11]: more energy-efficient extraction methods may be employed, the carbon emitted at refineries may be captured and stored, and electric trucks may be used for any road travel required to transport it. Over its life cycle, petroleum LCAF has a lower indirect emissions impact than most petroleum jet fuel used in aviation today.

Sustainable aviation fuel (SAF)
A lower-carbon alternative, SAF is produced using bio-based feedstocks—food waste or forestry residue, for example—or atmospheric carbon. The carbon dioxide emitted during combustion is reused in feedstock production, which balances CO_2 emissions.[12]

Top recommendations for the flight path

This report is the culmination of a series of interviews, surveys, and workshops with stakeholders from across the SAF value chain to understand barriers to the production of SAF in Canada, and the actions Canada can take to accelerate the country's production and uptake of SAF. While there is no direct path to get there, these discussions clarified the need for a made-in-Canada solution that reflects our landscape, governance, and policy structures, and have led to a way forward—a focused path with a series of proposed actions required to accelerate SAF production and adoption in Canada.

The most pressing of these actions to consider in the short term are:

Action	Objective
Leadership and accountability	
Establish a clear mandate for SAF leadership and governance, including, for example, a lead government entity responsible for a multi-agency task force that mirrors the complexity of this emerging market, representing aviation, clean fuel, innovation, and investment expertise.	Develop an aviation-specific solution to decarbonization that includes SAF. Work directly with industry to develop and implement SAF policy in a coordinated manner.
Policy mechanisms and funding	
Develop and evaluate SAF-specific policies in Canada.	Minimize uncertainty, including variation in regulation across Canada. Feed into a comprehensive regulatory framework to decarbonize Canada's aviation sector.
Accounting, transparency, and reporting	
Early voluntary SAF procurement and agreement from public and private sectors.	Voluntarily commit to sending a clear demand signal and enable producers to plan capital investments in plant and distribution.
Partnerships and collaboration	
Accelerate action through industry partnerships that provide coordinated and consistent input and work directly with a government led task force.	Accelerate partnerships across clean fuel, corporate, investment, and aviation sectors and through knowledge-building and data-sharing.

The rest of the report provides further analysis and detail on these and other recommendations for action. We're hopeful that new innovations and technologies will emerge to contribute further to the decarbonization of air travel. In the short to medium term, we believe that SAF is a core solution, one in which participants throughout the aviation ecosystem have important roles to play.

SAF: A vital tool for decarbonization

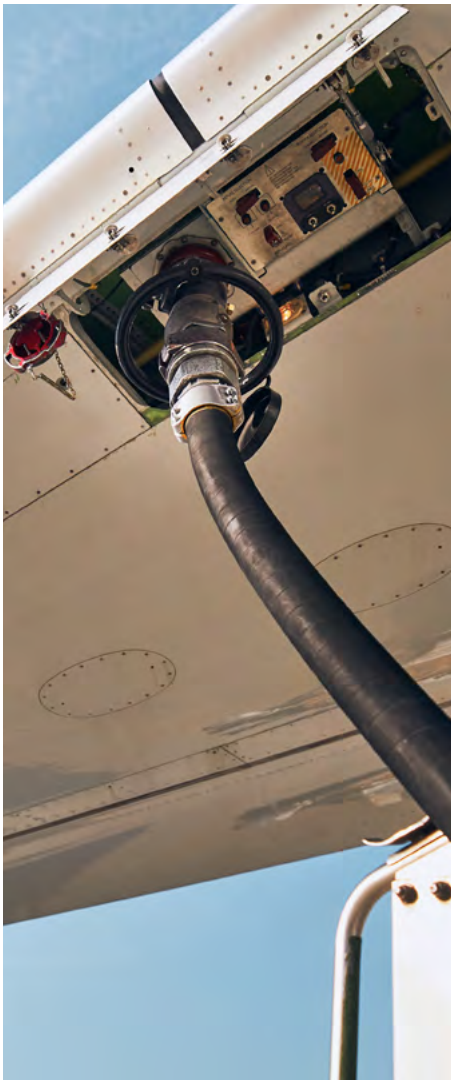
Meeting Canada's net-zero emissions commitment to the global community by 2050 requires every sector of the economy to undergo decarbonization. However, despite efforts made across the sectors so far, the country as a whole has been unable to make any meaningful reduction in its absolute greenhouse gas (GHG) emissions over the past decade and, while there have been reductions in its emissions intensity, absolute emissions levels have largely remained flat over the past decade.[13]

Aviation emissions will be some of the most difficult to abate. A combination of strategies are necessary to decarbonize this sector, such as:

- **Behavioural and operational efficiencies:** Some emissions reduction will be achieved with behavioural changes, such as reducing travel, switching to lower-emissions-intensity modes of transport, creating efficiencies in flight paths, or enacting policies to minimize fuel consumption.
- **New aircraft technology:** Other emissions will be avoided by replacing existing aircraft with battery and fuel cell electric turboprop planes or hydrogen-powered jets for short- to medium-haul flights.[14]
- **Sustainable aviation fuel:** Replacing petroleum jet fuel with SAF is thought to have the greatest direct impact* on aviation decarbonization in the medium term. SAF represents only a drop in the type of fuel that can be used safely today in aircraft fuel systems without upgrades or retrofits. It is currently permitted as an up to 50% blend with petroleum jet fuel. It's expected that, as legacy equipment is phased out of fleets, blending limits will rise and eventually be eliminated.
- **Permanent carbon removal, carbon offsets, and nature-based solutions:** An alternative to traditional abatement, these technologies and solutions are expected to play an important role in fully decarbonizing aviation.

SAF stands out among these solutions because it can be produced today and has already proven its value by reducing carbon emissions around the globe.

It can replace petroleum fuel in existing jet propulsion technology. It emits 60% to 90% less life cycle carbon emissions today, and is expected to achieve up to 100% less in the future.[15]



Deloitte's gauge of existing announcements and interviews conducted as part of this work shows that with strong policy signals, an estimated half-billion litres of SAF could be produced in Canada by 2030. In 2019, the domestic aviation sector consumed more than eight billion litres of jet fuel; the Canada Energy Regulator (CER) forecasts that this consumption will increase to 10.6 billion litres by 2030.

*https://www2.deloitte.com/global/en/pages/energy-and-resources/articles/decarbonizing-aviation.html

SAF is a lower-carbon fuel derived from non-petroleum sources. It can be made from either biogenic sources (e.g., used cooking oil, oil crops, forestry waste, and even municipal solid waste) or synthetic sources that combine clean hydrogen with carbon captured from the atmosphere or from smokestacks. There are standards developed for each version of SAF (based on its molecular composition and how alike it is to the composition of actual petroleum jet fuel). This is regulated by the American Society for Testing and Materials (ASTM), an international standards organization. Although recent demonstration flights have flown with 100% SAF, regulatory bodies currently limit its use to a 50% blend with petroleum jet fuel.[16] Once blended fuel is recertified as petroleum jet fuel, it can be handled, transported, and used in the same way as petroleum fuel.

The International Energy Agency (IEA) forecasts that net-zero won't be achieved without SAF accounting for 75% of aviation fuels used worldwide by 2050.[17] The International Air Transport Association (IATA) forecasts that SAF will need to account for 65% of aviation fuel to meet the same objective.[18]. Deloitte's gauge of existing announcements and interviews conducted as part of this work shows that with strong policy signals, an estimated half-billion litres of SAF could be produced in Canada by 2030. In 2019, the domestic aviation sector consumed more than eight billion litres of jet fuel; the Canada Energy Regulator (CER) forecasts that this consumption will increase to 10.6 billion litres by 2030.[19] There's a lot of work ahead. To succeed, Canada needs a coordinated, end-to-end response to produce SAF at scale.

SAF is a lower-carbon fuel derived from non-petroleum sources. It can be made from either biogenic sources (e.g., used cooking oil, oil crops, forestry waste, and even municipal solid waste) or synthetic sources that combine clean hydrogen with carbon captured from the atmosphere or from smokestacks.

Momentum in the Canadian SAF industry

For nearly 15 years, producers in various parts of the world have been working on developing this more climate-friendly kind of fuel. Despite this, few dedicated SAF production plants are currently operating (there are no commercially scaled plants in Canada), and they account for less than 0.01% of the global jet fuel supply.[20] There are pilot programs underway across Canada to accelerate early-stage SAF production capacity by using existing refineries for co-processing.[21]

There is a starting point.

In Canada, SAF development has been supported by Natural Resources Canada's Sky's the Limit Challenge, launched in 2018 and completed in the spring of 2022. The initiative challenged innovators to develop the cleanest, most affordable, and most sustainable aviation fuel and encouraged industry to power the first cross-Canada commercial flight with a minimum 10% blend of made-in-Canada SAF.[22]

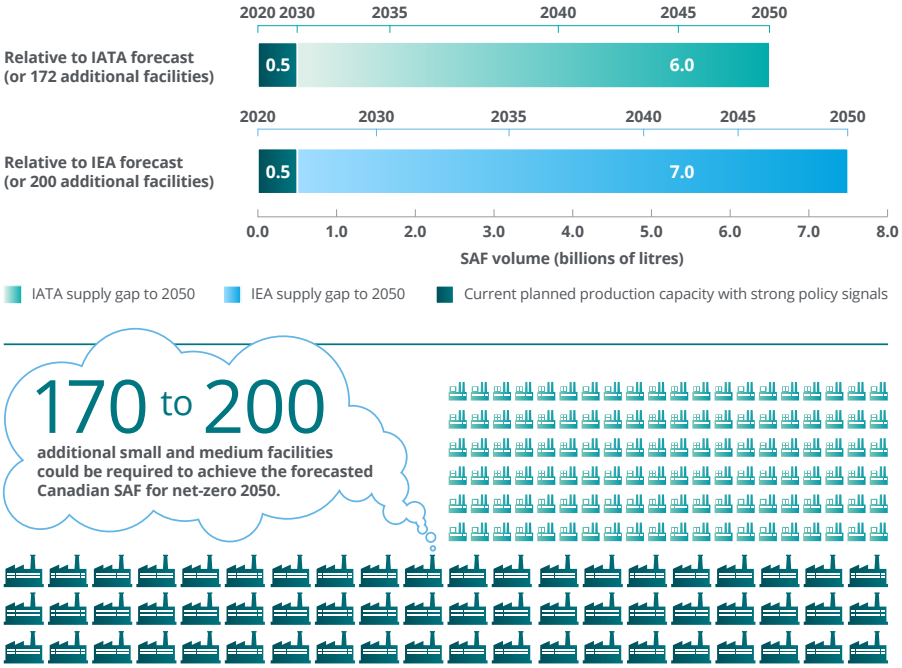
The federal government and Canadian stakeholders have been working with international organizations—including the International Civil Aviation Organization (ICAO), the Commercial Aviation Alternative Fuels Initiative (CAAFI), IATA, Aerospace Industries Association of Canada (AIAC), and the Global Air Forces Climate Change Collaboration—to decarbonize the aviation industry.

At COP-26 in Scotland in November 2021, Canada signed the International Aviation Climate Ambition Coalition declaration. The 23 signatories committed to, among other things, "(p)romoting the development and deployment, through international and national measures, of sustainable aviation fuels."

Here in Canada, a growing number of Canadian-based producers have acted on this commitment by investing in pilot production facilities, while investors and government programs are also supporting fuel-producing pilot projects. Feedstock providers and fuel producers are entering into agreements, as are fuel producers and airlines. Various airlines and corporate customers have announced initiatives to demonstrate the demand for it in business travel.

The price differential to produce SAF is three to five times that of conventional jet fuel.[23] To accelerate market development in Canada, incentives on both the supply and demand sides will be necessary to encourage companies to produce SAF and for airlines and customers to increase adoption and commitment.

Figure 1: Scale of gap to meet industry decarbonization objectives



IATA assumptions: (i) Assumes 10 billion people to fly in 2050. (ii) Does not account for efficiency improvements in the model. (iii) SAF production in 2025 relies on appropriate government support. | **IEA assumptions:** (i) Assumes air travel increases by 3% per year to 2050 relative to 2020. (ii) Accounts for operational improvements in the model. (iii) Includes dedicated freight and general (military and private) aviation, which account for 10% for fuel use and emissions, in the model. (iv) IEA model only includes forecasted SAF for 2030 and 2050, we assumed a straight line for the intermediate years. | **Assumptions in Canadian SAF production projections:** (i) 10% of the production volume from renewable diesel plants that mention aviation fuel is attributed to SAF production. (ii) 50% of the production volume of facilities that will focus primarily on SAF is attributed to SAF production. (iii) A lead time of four years to reach full production capacity.

Clearly there's a mismatch between potential production and forecasted demand. The good news is that the industry is ready to collaborate to bridge that gap.

Cost of SAF over petroleum jet fuel

The industry best practice to compare SAF and fossil jet fuels goes beyond the market price paid by assessing abatement cost: the price per tonne of abatement (e.g. per tonne of carbon reduction). To evaluate this difference would require dividing the difference in price (between petroleum jet fuel and SAF) by the life cycle emissions gap between the two fuels. This is especially important in the case of emerging clean fuels, like SAF, that have a range of life cycle emissions since they are created from a wide range of pathways that each have a different range of emissions associated with their production (e.g. SAF production pathways range from canola seed oil, to used cooking oil, to carbon captured from the atmosphere).[24]

Other jurisdictions are moving quickly on policies to incentivize the use of SAF. This is leading to the expansion of the renewable diesel and SAF markets outside Canada, and leading to exports of raw Canadian feedstock, which results in lower value than exporting converted feedstock.

- With the publication of the ***ReFuelEU Aviation*** initiative report in April 2020, the European Union announced its intention to propose measures to increase the use of SAF.

- In 2021, the United States announced the SAF Grand Challenge, strengthening US federal aviation leadership and providing up to US$4.3 billion in funding for SAF as well as related job-growth and emissions commitments. If passed, the Sustainable Skies Act, introduced to Congress in 2021, would also launch a tax credit to encourage blending.

At one of the workshops held in the lead up to this report, industry stakeholders were asked to identify the role they felt Canada should play in the development of SAF. Naturally, their responses varied, but the majority agreed the reason they're participating in this initiative is a belief that Canada has to play an important role in a global transition to SAF—as innovator, fast follower, pioneer, or leader—and most of them broadly agreed that collective systemic action is needed to scale Canadian SAF and reduce the risk of falling behind or losing sovereignty over the national aviation fuel supply.

At the beginning of this report, we identified some of the pathways and feedstocks that can be used to produce and accelerate the adoption of SAF. Canada has the unique advantage of diverse feedstocks and a mature energy sector, but its supply chains have not yet been demonstrated at commercial scale. Currently, the country needs to buy and transport SAF produced from outside Canada, and without incentives to produce, blend, and use this fuel, any Canadian feedstock providers and producers may start shipping to other countries where more mature markets and favourable economics exist.

To understand potential gaps in production capacity, we developed a picture of Canadian SAF needs with a market scan supplemented by stakeholder interviews. We compared what we learned about Canada's committed and planned production capacity to IEA and IATA forecasts about how much aviation fuel needs to be SAF to reach net-zero emissions **(see Figure 1)**. We found that although Canadian production could match its consumption, this may only materialize with strong policy in place and it wouldn't be long-lasting anyway: production would begin to fall short of the consumption targets needed to meet industry objectives by 2025. When considering industry-forecasted growth out to 2050, there will be a significant production gap (from 3.7 billion to 4.6 billion litres) without additional production.

Barriers to SAF development in Canada

With no commercial facilities operating in this country, there's not much SAF available for uplift at Canadian airports. When stakeholders from across the aviation ecosystem met to discuss the challenges they experience, there was broad agreement around a key set of barriers.

As noted earlier in this report, the barriers and the opportunities are connected through four themes, each one a short hop to accelerating the use of SAF in Canada. There are clear interdependencies between barriers and opportunities within and across themes.

1

Leadership and accountability

Government and industry must coordinate, communicate, create awareness, and be accountable.

- **Unclear government leadership and coordination:** A national framework and accountability structure is needed to establish responsibility for the oversight of SAF, to incentivize Canadian production and distribution, and to ensure competitiveness with the United States and other jurisdictions where the market and economics for SAF feedstocks, production, blending, and consumption are more favourable.
- **Logistics and distribution challenges along the supply chain:** The locations of feedstock supply and proximity to producers, blenders, and distribution infrastructure pose roadblocks in many regions. Biomass conversion facilities located near feedstock-dense areas lead to lower supply chain emissions because they reduce the transport needed for feedstocks, which are characterized by low volumetric energy density. Centralized biorefining facilities located near blending facilities can lead to cost reduction as a result of economies of scale. Ideally, SAF could be transported in existing pipelines and stored in existing facilities, although the transition from blended fuel to higher concentrations of SAF could mean that two systems will need to coexist for a while, with new infrastructure built close to airports and rail, road, and marine distribution points to enable final blending and insertion into comingled storage.

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2
Policy mechanisms and funding

Both the aviation industry and the clean-fuel sector need help to establish a sustainable SAF market. Canada is developing a federal clean-fuel policy, and has identified steps forward as part of its 2030 Emissions Reduction Plan, including a program to purchase low-carbon fuel for federal air fleets, and an indication that it will develop a whole-of-government approach to decarbonizing aviation. During interviews for this report, many stakeholders noted that a balanced combination of incentive and compliance mechanisms is required to minimize investment risk and increase production, building on Canada's clean-fuel leadership to specifically address this hard-to-abate sector.

- **Unclear, inconsistent policy mechanisms:** Most aviation fuel is currently exempt from Canadian emissions-reduction policies. For example, the federal Clean Fuel Standard carbon-intensity reduction requirements targeting liquid fuels do not apply to liquid aviation fuels. In fact, the only climate policy that does—the federal carbon price requirement on fuel used for intra-provincial flights—does not differentiate between SAF and petroleum jet fuel.

- **Competition with renewable diesel and biodiesel:** Current Canadian policy favours renewable diesel production. The most efficient way to produce renewable fuels from biomass yields three units of renewable diesel for every unit of SAF. The current market environment means that producers are focused on producing more renewable diesel to meet policy-driven demand. Without the necessary incentive, biofuel producers are less likely to incur the additional costs required to invest in SAF production.[25] Since SAF is required to decarbonize aviation, aviation-specific policy incentives will be needed to spur increased SAF production.

- **Higher prices:** Current SAF prices can be three to five times higher than the price of petroleum jet fuel depending on feedstock, transportation, and blending costs, and industry (or government) doesn't agree on who's responsible for incurring those costs.[26]

  There is concern that the potential added cost of flying with lower-carbon fuel may not be appreciated by end consumers and may have further equity implications. Indeed, in January 2022, KLM announced it would add an automatic SAF surcharge to ticket prices, the proceeds of which will be invested directly in the purchase of sustainable fuel. KLM estimates this surcharge will vary from €1 to €12 per ticket, depending on the distance flown and the type of seat booked (economy or business).[27]

  A recent survey of over 900 Canadian leisure and business travellers confirmed that overall their knowledge of SAF is relatively low (with over 90% of leisure travellers and 85% of business travellers either unaware or lacking an understanding of the benefits of SAF).[28] An increase in consumer understanding of the benefits and potential costs of flying with SAF is clearly needed.

- **Infrastructure not scaled to production needs:** SAF production in Canada may at first develop under a regional hub-and-spoke model using local feedstock supplies. However, petroleum aviation fuel producers own and manage the hubs and the pipelines. During the transition to incorporate SAF into existing jet fuel production and distribution, new partnerships will need to be made between new-to-market providers and established infrastructure owners to enable market access.

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3
Partnerships and collaboration

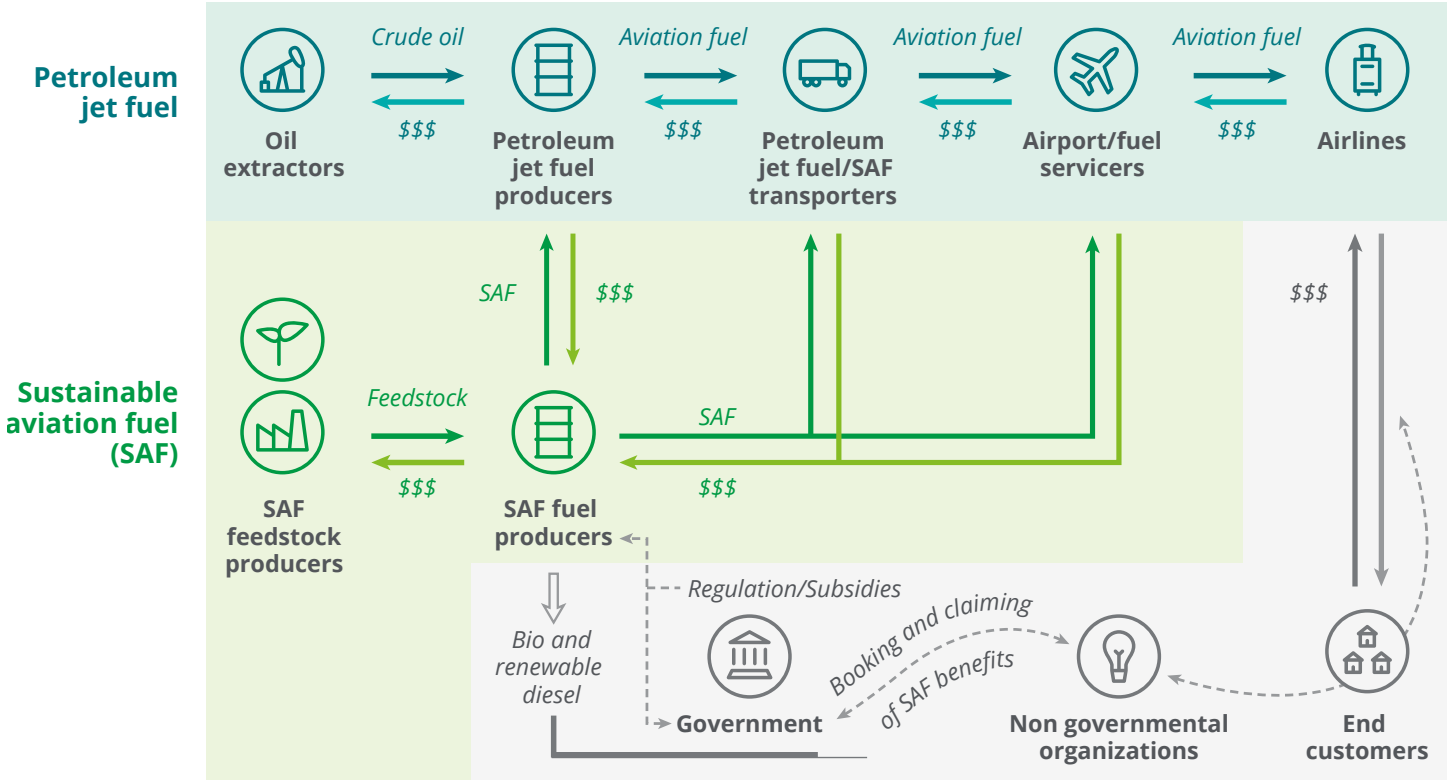
A coordinated response is required across the value chain.

- **A lack of clarity on how Canadian feedstock sourcing and supply can scale for SAF:** SAF is derived from bio- or synthetic-based feedstocks. A stable feedstock supply and a good understanding of quantity, sustainability, and procurement needs (e.g., long-term access to guaranteed volumes) is required to de-risk investment in its production. Since feedstocks for SAF are also the inputs required to produce renewable diesel and are experiencing market pull from the United States, without policy change, available volumes may not be sufficient to meet the amount required to scale the SAF market in Canada. Some bio-based feedstocks are land-intensive while others are by-products of other industries that would otherwise be waste. It's anticipated that Canadian producers will have to address consumer concerns around land-intensive feedstock and more fully develop the value chains from waste products (e.g., recovered oils, biosolids, and wood waste).

  The widespread adoption of synthetic SAF is constrained by high costs and a lower level of technology readiness. These are both likely to change over the medium to long term, however, synthetic SAF is ultimately expected to be the lowest-cost production process.

- **Limited volume of feedstocks derived from non-edible sources:** Due to the lower technology-readiness level, SAF producers have not scaled production from waste and lignocellulosic (woody) biomass, which are the most sustainable feedstocks.[29] Additionally, while agricultural and forestry residues represent an opportunity, volumes will be limited and there is the same market competition for these feedstocks as there currently are for oil-based feedstocks.[30] Municipal solid waste poses challenges too, since only limited volumes can be aggregated and transported economically[31] and there are limited incentives to divert it from landfills. Lipids from waste-water treatment facilities also offer potential.[32]

  Studies underway using hydrothermal liquefaction of lipids from wastewater treatment facilities show promise and could provide a steady supply in urban areas. Over time, as biogenic and waste feedstock availability drops and emerging-technology costs decline, including for direct air capture and green hydrogen, synthetic power-to-liquid fuel production will become the most viable and lowest cost SAF supply pathway.



4

Accounting, transparency, and reporting

There needs to be an efficient system to facilitate the purchase of environmental attributes (or benefits) associated with SAF, and a standard methodology to quantify emissions reduction. There are three critical players that need to align on how SAF is accounted for and reported globally: Greenhouse Gas Protocol (GHGP) is focused on accounting and reporting standards and sector guidance; Science-Based Targets initiative (SBTi) is focused on target-setting; and the UN's International Civil Aviation Organization (ICAO), which has developed the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

Absence of alignment of sustainability standards, including the lack of a standard method to quantify emissions reduction from the use of SAF: Credible emissions reduction is the driver to scale SAF demand. For airlines, SAF can provide a direct reduction of their Scope 1 emissions. Most corporate entities investing in SAF are looking for reductions to their travel emissions (these are called Scope 3 emissions, since they are sources that are not owned or controlled by the company). Both the airlines and corporations anticipate that SAF purchases will eventually enable them to meet emissions reduction targets approved by SBTi and reporting in accordance the GHGP but require standards and methods to be in place to enable credible reporting.[33]

Credible Scope 3 accounting methodology, emissions reduction claims and disclosures that specifically count toward business travel emissions accounting will be required for Deloitte and other organizations to support emissions reduction associated with use of SAF.[34] The lack of a universal, transparent framework to provide credibility over life cycle emissions reduction and feedstock integrity has a direct impact on SAF demand.[35]

Despite corporate buyers' interest, standard setters have not yet converged on an approach for reporting on SAF.[36] Most importantly, the GHGP does not currently recognize SAF as a potential mitigation option to address Scope 3 travel emissions. While the SBTi's aviation sector guidance[37] identifies criteria and methodology that can be used to account for SAF, it is subject to GHG protocol methodology. The conservative interpretation of this means that the SAF environmental attributes (e.g. emissions reduction) purchased through a book-and-claim system cannot be claimed today. Critical infrastructure is needed to both scale SAF certificates as a market mechanism and support the case for SAF to be recognized in future updates to GHGP; this includes the needs for formal structure around how SAF certificates are defined (to avoid double counting), and robust physical tracking mechanism and independent registry.

Currently, there are multiple common ways to calculate the life cycle emissions benefits from using SAF, which complicates analysis and reporting. Environment and Climate Change Canada (ECCC) has developed a tool to account for life cycle emissions for fuels, but it is not currently aligned with global standards, and it does not yet include aviation. While global industry-wide efforts are underway to clarify SAF accounting, it continues to represent a grey area along the entire supply chain, and Canada should be involved in solving this problem to support the uptake of SAF.

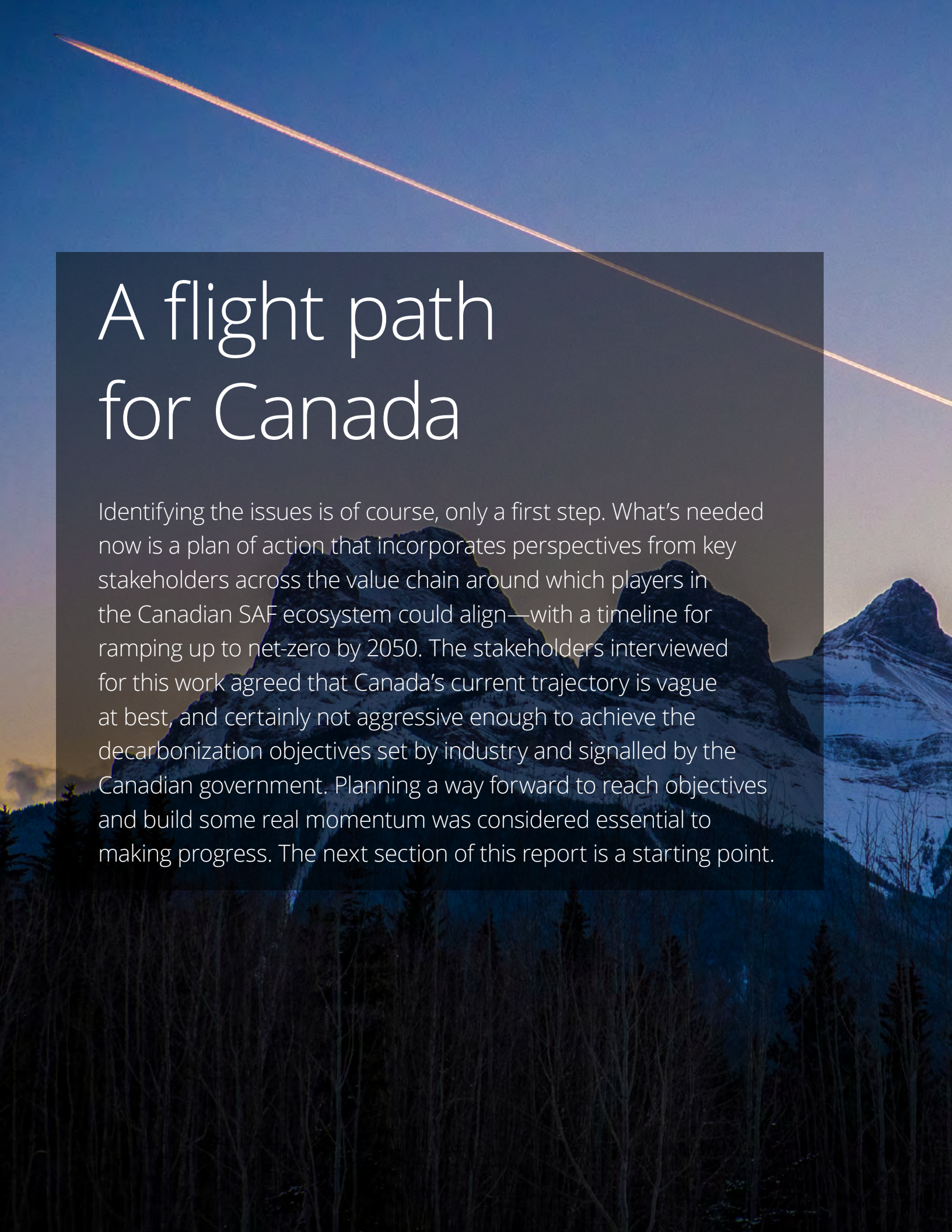
> The lack of a universal, transparent framework to provide credibility over life cycle emissions reduction and feedstock integrity has a direct impact on SAF demand.

Petroleum jet fuel

Petroleum fuels are extracted from underground, refined, and burned, **increasing overall CO_2 concentrations** in the atmosphere

Sustainable aviation fuel

SAF is generated using bio-based feedstocks or atmospheric carbon, **reducing life cycle emissions compared to traditional jet fuel** as emitted CO_2 is reused in feedstock production (estimated 75% reduction in CO_2 emissions[1])



A flight path for Canada

Identifying the issues is of course, only a first step. What's needed now is a plan of action that incorporates perspectives from key stakeholders across the value chain around which players in the Canadian SAF ecosystem could align—with a timeline for ramping up to net-zero by 2050. The stakeholders interviewed for this work agreed that Canada's current trajectory is vague at best, and certainly not aggressive enough to achieve the decarbonization objectives set by industry and signalled by the Canadian government. Planning a way forward to reach objectives and build some real momentum was considered essential to making progress. The next section of this report is a starting point.

No time to waste: actions leaders must take this year

Stakeholders who participated in our initiative generally agreed that to establish Canada's position as a leader in clean aviation fuel in the near future, the following actions could be considered a short-term priority.

Establish clear national leadership and coordination across all levels of government

Canada needs a clear mandate for SAF leadership and governance, including, for example, a lead government entity responsible for a multi-agency task force that mirrors the complexity of this emerging market and represents aviation, clean fuel, innovation, and investment expertise. After the lead agency is nominated, the next step could be to develop a government-led SAF working group with experience in aviation and clean fuel that could collaborate directly with industry to:

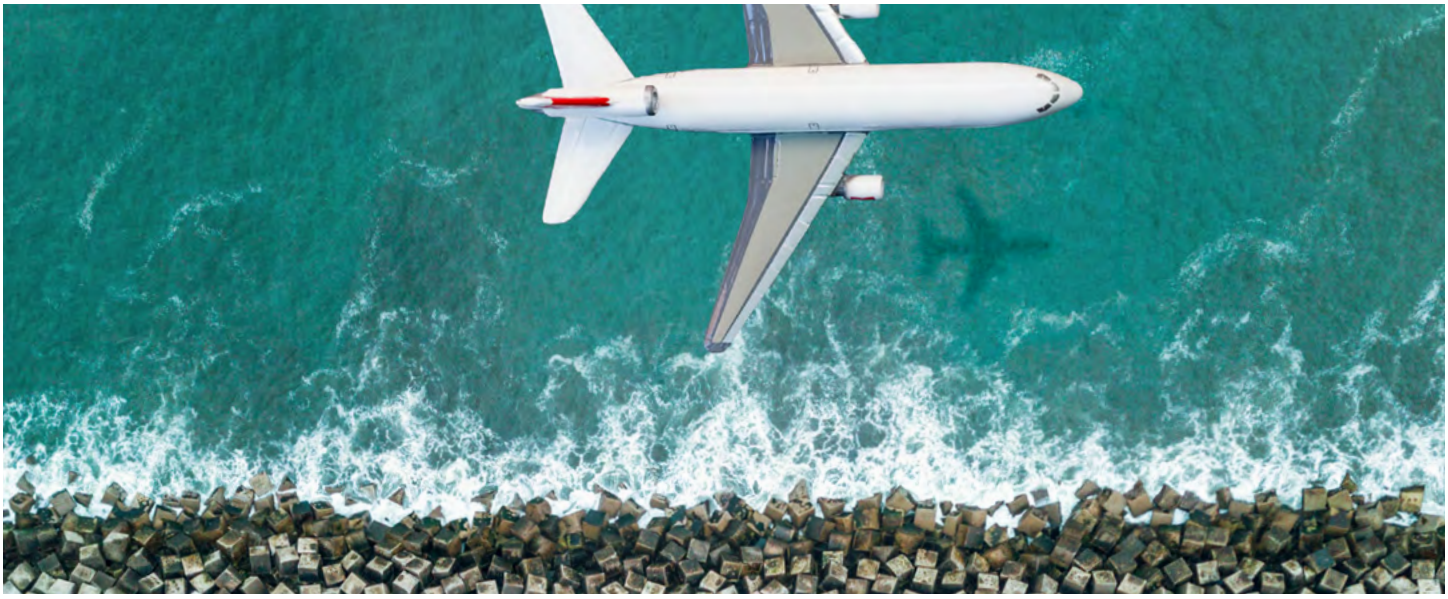
- **Develop and implement SAF policy in a coordinated manner**
- **Support research and development (e.g., to accelerate production)**
- **Drive commercial development and lower the cost of SAF**
- **Improve the investment environment for SAF**

A multi-agency approach is required because the SAF market establishes a completely new value chain and this task force could incorporate an understanding of innovation and investment in new markets, along with experience in aviation and clean fuel. That said, leadership from a single entity is also essential; as the responsible party for Canada's action plan to reduce GHG emissions in aviation, Transport Canada could be a natural lead.

It's urgent to form this national task force quickly. It will be a critical component of Canada's SAF success, and its members could work to ensure that policies are developed holistically and cohesively, and to provide a clear point of contact. Without such leadership at the federal level, agencies and policies at both the national and provincial/territorial level will likely continue to be fragmented.

Another critical component of success will be industry engagement, with companies working closely with organizations such as the newly formed Canadian Council for Sustainable Aviation Fuels (C-SAF). This industry-led not-for-profit was launched in February 2022 with a mission to facilitate and accelerate the production and use of SAF in Canada.

It's urgent to form this national task force quickly. It will be a critical component of Canada's SAF success, and its members could work to ensure that policies are developed holistically and cohesively, and to provide a clear point of contact.



Develop and evaluate the Canadian policy approach

Under the leadership of a single entity that is responsible for a multi-agency federal task force, governments could consider a broad range of policies that feed into a comprehensive regulatory framework for decarbonizing the aviation sector. These discussions might address:

- *Complementary policies across the landscape.* How will we manage supply chain constraints? How can Canada ensure that the sources of support or funding go to the right locations?

- *Short-term policies that can help close the price differential over the medium term and kickstart SAF production today.* How could these be stacked, and how can they be articulated to share with both the public and policymakers? The evaluation could also consider how policies can provide certainty and address longevity concerns in Canada's approach to aviation, which will hasten incremental investments.

- *Economic cost/benefit analysis of different policies,* both now and on a recurring basis as the market develops. If each policy option includes direct costs per tonne of carbon reduced or removed, should these direct costs be tied to the commodity or borne by taxpayers in a way that is disconnected from the action of air travel? Overall, a policy that ties the cost to the commodity runs the risk of incentivizing carrying extra fuel from other countries and changing flight patterns due to fuel price arbitrage.

- *Mechanisms that disincentivize SAF* in the current policy landscape.

Indigenous led-projects and partnerships should be at the front of the line for funding and policy support.

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Early voluntary SAF procurement and agreement from public and private sectors

Government, defence sector, and Crown corporation commitments to procure SAF or update travel policies can signal support for the local SAF market, adding to the demand being generated through agreements between airlines, fuel producers, and corporations. The Canadian government has indicated it's interested in procuring low-carbon-intensity fuels, while the mandate of its Centre for Greening Government is to ensure Canada is a global leader in government operations that are net-zero, resilient, and green.[38] The expansion of these efforts would serve as a strong signal for market demand and leadership.

The industry has also seen voluntary SAF-procurement commitments come directly from corporations, under scenarios that include investments across multiple airlines or other partnerships, but more such pledges will be necessary to continue to demonstrate demand. Generating momentum for such commitments may involve a knowledge-building program with corporations to help them identify the benefits and to share lessons learned from early transactions.

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That's only the beginning

With so many players across the SAF ecosystem, each has a chance to lead and participate in incremental actions that will help close the SAF production gap, provide access to Canadian-produced SAF, transition jobs from petroleum to SAF fuel opportunities, and enable the economy to meet its decarbonization objectives.

There's also an opportunity to strengthen Indigenous voices and decision-making in SAF capacity and resource development. Conditions for success would include first meeting with Indigenous communities and businesses to build awareness of the value proposition for leadership in decarbonizing aviation, and where a need is identified, in special programs for training and mentoring related to SAF development and scale. Through this, Canada can then provide agency to Indigenous communities through active engagement and economic empowerment.[39]

Let's now look at the highest-priority opportunities our stakeholder group mapped out under each theme.

Enabling policy mechanisms and funding

Multiple policy mechanisms, that focus on a balance of requirements and incentivizing stakeholders all along the supply chain, will be required to drive SAF development and adoption. Policies will need to be sequenced; some may only be needed for a short time (potentially less than 10 years) while SAF is scaling up,while others will be needed for the long term.

The policies highlighted below are not mutually exclusive. Some act on demand to ensure there's a market, while others provide support for production within Canada. Advancing the right policies will be critical for:

- Achieving domestic production and supporting the scale of distribution infrastructure

- Enabling SAF feedstock and production to compete with other renewable fuels and products, and other jurisdictions (primarily the United States and Europe)

- Generating a demand signal to decarbonize Canadian air travel and incentivize production

Regardless of the policy or combination of policies that are chosen, they should enable a sustainable market going forward and any unintended consequences of government interventions should be mitigated. This requires the development of a robust policy assessment framework and considers implications of other potential interplaying policies.

This report identifies the advantages, disadvantages, and considerations for various policy options and mechanisms that participating stakeholders considered to be the most promising in a Canadian context. The table **(see Figure 2)** encapsulates these discussions, which took place during workshops conducted for the report.

While it isn't a complete policy analysis or a specific set of recommendations, it is a solid starting point for a government-led task force that could lead further analysis to determine which balanced set of incentive and compliance mechanisms should be prioritized.

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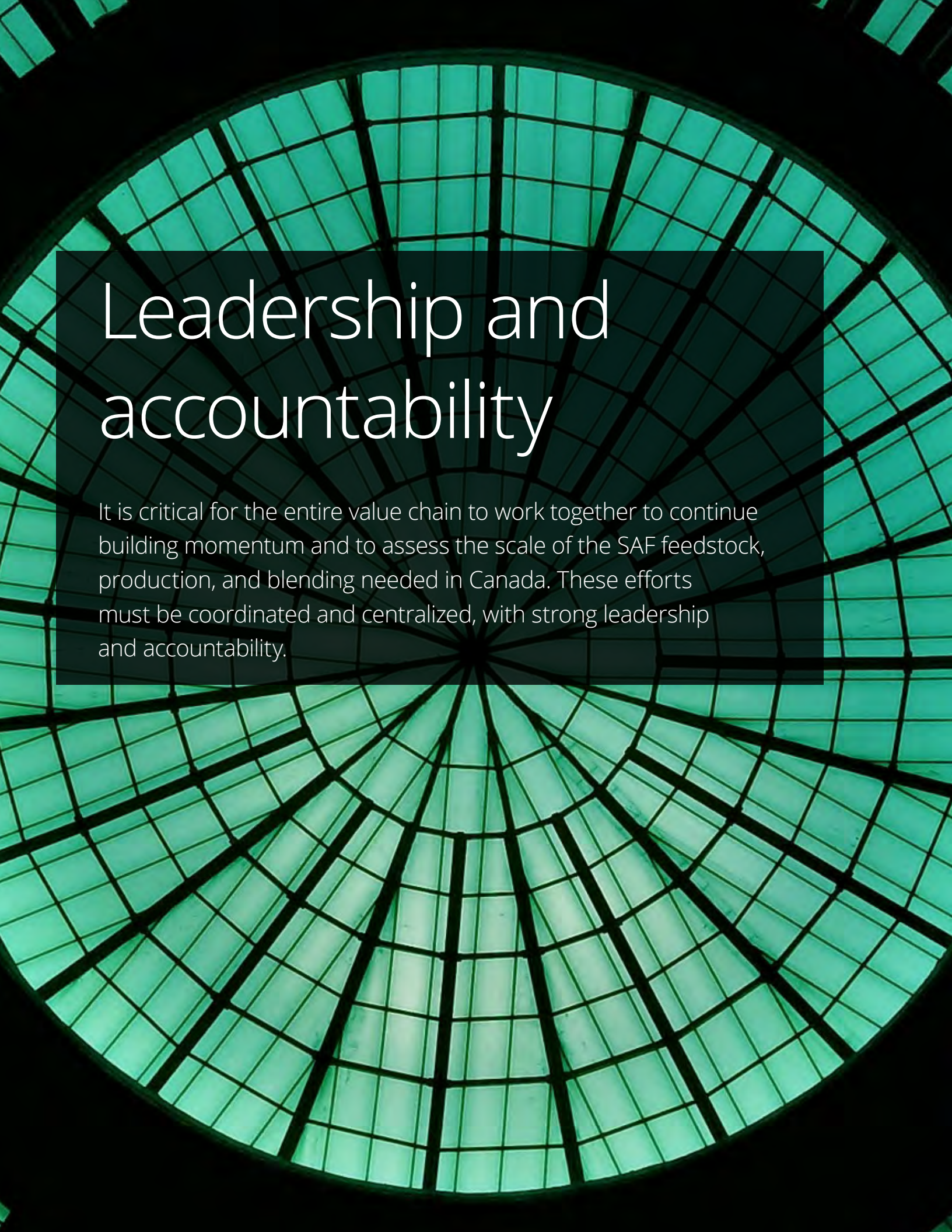
Figure 2

Objective	Intended outcome	Policy *	Overview		Pros/Cons	Considerations
Increase SAF supply	Reduce capital cost associated with SAF production	Loan guarantee/ Low-cost debt Investment tax credit	Loan guarantees help lower the risk of early investment in production facilities by covering the obligation in the event of a default. Governments can offer these, as well as low-cost or no-interest debt.		**Pros** Capital expenditure reductions de-risk the deployment of a new technology or spark capacity development for production facilities | Access to low-cost capital to support initial scale-up cost (the lower cost of capital can reduce the market price of SAF) | Provides long-term certainty—this both encourages investors and spurs project financing | Can be employed to help move domestic technologies along the development curve (i.e., for pilot and demonstration projects) | Lower debt-to-equity ratios like those offered in traditional wind/solar projects would help lower the cost of capital and reduce the SAF market price **Con** Requires public investment	Needs to be combined with other policy mechanisms to drive demand. (On its own, it would likely not be enough to encourage domestic SAF production). Provides additional funding for advancing technological maturity (and drives down cost curve) of innovative technologies with higher emissions-reduction potential, such as synthetic-based SAF pathways.
Increase SAF supply and demand	Accelerate production and adoption	Low carbon fuel standards	SAF should be its own compliance category; it should not be jointly regulated with road transport fuels. The regulated entity must demonstrate the fuel produced or imported meets the legislated carbon intensity. Otherwise, the regulated entity must purchase credits from another regulated entity or pay a penalty.		**Pros** Technology-neutral, performance-based, flexible regulations drive down carbon intensity and incentivize innovation | Using carbon intensity as the performance measure, rather than the volume of SAF produced, allows for variability in SAF types and encourages greater emissions reduction. This accounts for the fact that each SAF production pathway does not result in the same reduction in carbon intensity (a 90% reduction should be favoured over a 50% reduction, for example) | If mandatory, sets clear target(s) for emissions reduction and creates demand; this provides a longer-term investment signal **Con** If applied to producers and importers of aviation fuel, there's a risk of losing aviation travel and fuelling markets (i.e., risk of losing transit-flight market share to nearby jurisdictions that don't have climate policies on aviation fuels)	An opt-in framework is moot, because renewable feedstock will flow to road transport due to cost differential, though opting in may be allowable for a short transition period to allow the preparation of supply. Uncertainty regarding regulated entity—should it be fuel suppliers or importers, carriers, or airports?
Increase supply Demand side if applied to consumption of fuels (e.g., rebate on SAF purchase)	Market-based mechanism to reduce SAF price for users	Production tax credit Blenders tax credit Contract for difference	Reduce marginal cost of SAF production (de-risk deployment of a new technology)		**Pro** Could reduce price differential between SAF and petroleum jet fuel since it provides a payment or tax incentive based on a litre of SAF produced | Could be scaled to award larger incentive for lower-carbon-intensity solutions (i.e., minimum threshold for carbon intensity is set and increased over time) | No risk of bunkering/change in flight patterns due to increasing commodity costs **Con** For the production tax credit, there's a risk that SAF production is exported to other markets where SAF mandates exist (e.g., EU, UK)	Must be structured to be competitive with market-based mechanisms in other markets (e.g., the US). Policy could be allocated based on emissions savings rather than volumes, since the former is a better proxy of the intended outcome and can steer fuel production from advanced technologies that offer the greatest carbon reduction potential.
Increase demand	Market-based mechanism to increase price of SAF alternatives	Carbon tax on aviation fuels (based on carbon intensity)	Currently, the Federal Fuel Charge is uniformly applied by category of fuel, but interprovincial and international flights are exempt, as are registered specified air carriers. Since the fuel charge is already not relevant to the aviation sector, a specialized fuel tax program could be devised for the sector to drive its own decarbonization.		**Pro** Could reduce price differential between SAF and petroleum jet fuel by increasing penalty for use of petroleum fuels | Carbon-intensity-based carbon tax incentivizes driving down the carbon intensity of fuels (if tax structure defines a pathway to recognize continuous reduction in carbon intensity) | Explicitly recognizes the social cost of carbon **Con** Relative increase in commodity price runs the risk of tankering and flight pattern changes	Requires engagement with industry to make sure that issues around taxation are resolved, including competitiveness, impact to consumer demand for travel, and re-investment of resulting funding. A specialized fuel tax program could mandate that revenues collected be used to fund adaptation/ mitigation in the aviation sector.
Increase SAF supply and demand	Stimulate SAF demand through mandatory mechanism (designed to get SAF into wings)	SAF mandate (jet fuel producers)	A specific portion of fuel supplied or purchased must be SAF (volumetric). This percentage may increase over time. Regulated entity could be on demand side or supply side		**Pro** Could be scaled to award larger incentives for lower-carbon intensity solutions (i.e., minimum threshold for carbon intensity is increased over time) | Could facilitate technology-specific targets (e.g., mandates for PtL SAF as well as HEFA SAF) | The announcement of a mandate can provide long-term certainty of market demand—this can encourage investors **Con** Mandates define what is/what is not SAF, which runs the risk that there isn't enough incentive to reduce carbon intensity over time (i.e., the mandate is for the pathway, not explicitly incentivizing the outcome of decarbonizing aviation) | Could result in the importing of SAF with no domestic production; or, if there's limited supply, in monopoly pricing | Relative increase in commodity price runs the risk of tankering and flight pattern changes	The fundamentals of a SAF mandate could be improved if a multiplier based on carbon intensity were applied (e.g., if the mandate stipulates that SAF fuel must have a carbon intensity 50% lower than petroleum fuels, then those who achieve 75% lower are awarded 1.5 SAF credits). Would a North American mandate be required to mitigate the risk of tankering? And is that feasible?

* Other policies that were initially considered include a national fuel charge, a North American mandate, funding for research and development, price guarantees, expansion of the Canadian output-based pricing system to include aviation fuel, and policies to scale production and processing.



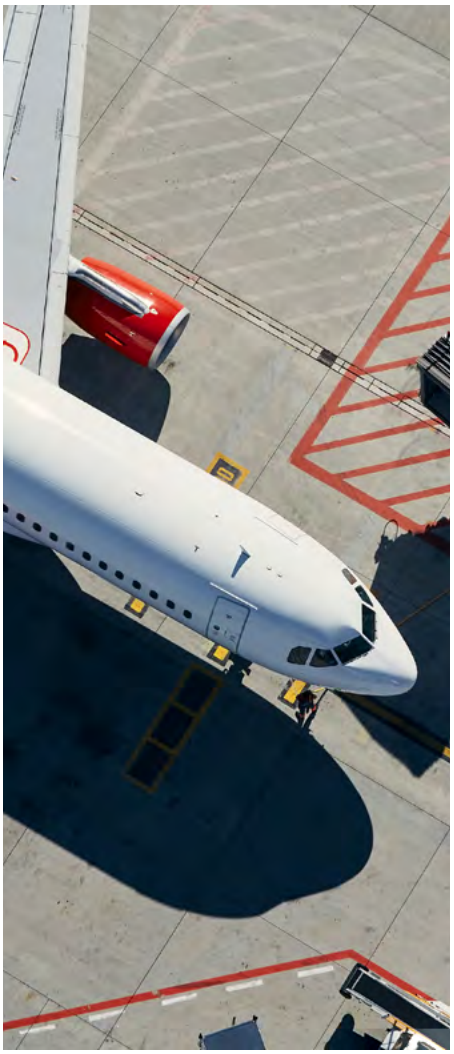
Leadership and accountability

It is critical for the entire value chain to work together to continue building momentum and to assess the scale of the SAF feedstock, production, and blending needed in Canada. These efforts must be coordinated and centralized, with strong leadership and accountability.

Develop SAF programs for airline customers and cargo carriers [short term]

Some airlines and cargo carriers are already engaging willing, strategic customers in offtake agreements to establish a demand-side signal for producers. The industry needs more of these programs and agreements to ensure that demand continues to grow.

However, in growing these programs airlines and cargo carriers should align with the recommendations emerging around accounting for emissions reduction and environmental attributes (e.g., since corporate customers will look to procure environment attributes associated with SAF on a "well-to-wake" basis) and align across the industry on which element of the value chain should bear the increased cost of SAF.



Recent examples of SAF programs include:

- Air Canada's Leave Less Travel Program, offers SAF and carbon offsets as a sustainable travel offering to its corporate and cargo customers. The program also aims to send a demand signal to industry.
- Air France-KLM, which has both passenger and cargo passenger programs, where customers can estimate their travel-related CO_2 emissions, then contribute to a program that will invest in SAF sourcing and consumption following strict sustainability criteria. The cargo program enables cargo customers to power a percentage of their flight with SAF, and provides a third-party audited report that justifies the purchased volume of SAF and reduction of CO_2 emissions achieved.
- DHL Global Forwarding, which in 2021 contributed to the purchase of 12.9 million litres of SAF as part of United's Eco-Skies Alliance program, passing carbon benefits on to its customer base. DHL recently procured over 400 million litres of SAF directly from a producer.

Major commercial airlines within the United States, including American Airlines, JetBlue, Southwest, and United Airlines, have all developed programs for corporate customers. Canadian programs have begun to target corporate customers, but they could consider also following Air France-KLM's example by providing an opt-in program for leisure customers.

Identify partnerships with airports [short term]

Several Canadian airports have demonstrated strong support for decarbonizing the aviation sector. They can coordinate their actions with industry and government to help increase the supply of SAF by capitalizing on infrastructure and partnerships to enable production or distribution. For example, building innovative SAF elements onsite, working with fuel distributors to identify future fuel system requirements, and considering SAF during planning cycles could enable airports to add value in the infrastructure supply chain.

Evaluate the roles and levers airports have to advance the use of SAF

With different provincial policy regimes and financial structures, individual Canadian airports will need to assess their role in adopting polices supporting the use of SAF. Sharing best practices and approaches can take place through the Canadian Airports Council (CAC) and C-SAF.

They can coordinate their actions with industry and government to help increase the supply of SAF by capitalizing on infrastructure and partnerships to enable production or distribution.

Align the industry via associations and collaborations [short term]

Joint activities across the value chain could help create ongoing industry alignment to ensure that Canada has the right momentum at a national level. Alignment will also be generated through the expansion of and collaboration among industry groups, including the national C-SAF and regional SAF+ (based in Quebec), as well as broader industry groups such as Advanced Biofuels Canada, Clean Resource Innovation Network (CRIN), and others that are supporting SAF development. As an example of a collaboration, Air Transat, an airline, is an active partner with the SAF+ Consortium, which includes support for the development of SAF technology.

It is equally important that there be alignment among producers. Airports can play a role in communication, advocacy, and facilitation.

Corporate commitments could also lead to a **corporate buyers' alliance in Canada [long term].** Similar to the Sustainable Aviation Buyers Alliance (SABA) in the United States, such an alliance could create coordinated demand-signalling through a Canadian request for proposals (RFP), which would in turn support the further scaling of SAF production. SABA is working to drive investment in SAF, catalyzing SAF production and technological innovation, and supporting member engagement in policymaking efforts.[40]

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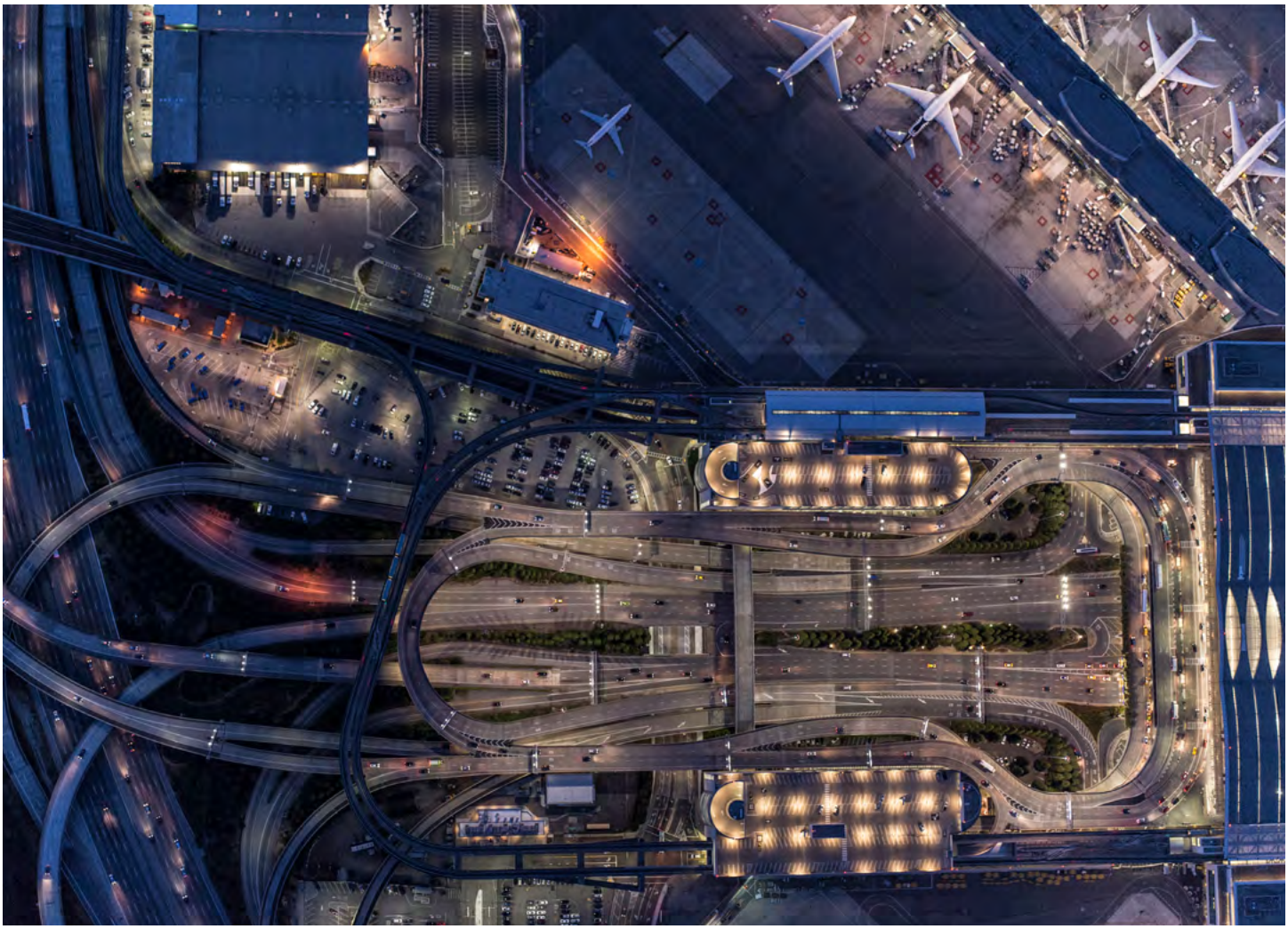


Accounting, transparency, and reporting

The ability to credibly count SAF usage toward Scope 1 (for airlines) and Scope 3 (for airline customers, corporations, and government travellers) emissions reduction and to credibly recognize carbon abatement from SAF procurement is seen as a necessary step to scale demand.
The following actions could address accounting and transparency.

Align Canadian methodologies to global standards and marketplace [short term]

As the accounting for emissions reduction and environmental attributes associated with SAF matures, Canadian standards will need to be reconciled to align with global reporting frameworks when they are available. This will be more a question of standardization and alignment than of technical complexity, and the opportunities under this theme depend on this alignment.

SBTi aviation sector guidance[41] outlines that for a corporation to account for SAF use toward SBTi Scope 3 targets, it must: obtain proof of fuel consumption/combustion; demonstrate environmental benefits associated with the SAF (including SAF life cycle values); prove clear chain of custody for the SAF consumption down, rather than across, the value chain; and include full well-to-wake emissions from all fuel consumption (SAF + fossil fuel) in its Scope 3 inventory.

Since standardized guidance on SAF accounting is not available and has yet to be endorsed by GHGP, most disclosures of SAF environmental attributes that have occurred to date have been in the form of standalone disclosures (corporates have been cautious to consider the SBTi guidance and thereby avoid disclosing within the existing scopes). These standalone disclosures are setting a precedent for SAF reporting and have largely been consistent with SBT guidance in accounting for the full life cycle emissions from feedstock production through combustion. While the ICAO CORSIA compliance program was established to address only direct emissions—and thus upstream emissions from extraction, refining, and transport of the fuel ("well-to-tank") are not accounted for—it is however reasonable to expect that ICAO will adopt the full well-to-wake approach in the long run.

In contracting SAF, both producers and airlines should consider that well-to-wake disclosure is emerging as the preferred approach.[42] A best practice is emerging that corporations should report the full life cycle emissions from SAF in standalone disclosures. In order to secure demand-side opportunities through voluntary SAF purchases, upstream suppliers should consider that corporate customers will look to procure environmental attributes associated with a batch of SAF on a well-to-wake basis.

Aircraft fuel emissions scope → **Well-to-wake**		
	→ **Well-to-tank** →	**Tank-to-wake** →
Airline or freight provider	Scope 3	Scope 1
Business traveller/customer	Scope 3	Scope 3
Freight customer	Scope 3	Scope 3

Source: Deloitte US—Pioneering early SAF transactions

Adopt an environmental attribute ownership transfer system [short term]

For airlines to claim Scope 1 emissions reduction and for corporations to claim the same for Scope 3, there could be a system in place to facilitate the trade of SAF volume or GHG emissions reduction credits: a book-and-claim system, for example.[41]
A book-and-claim system allows anyone to pay for and own the rights to the environmental attributes associated with a batch of SAF, irrespective of the airport where the physical fuel volume is delivered. A standardized system allows SAF to be used where it is produced, while the environmental benefit can be owned by purchasers of SAF environmental benefit certificates anywhere.

Numerous organizations are currently developing book-and-claim guidance; converging on a single system will help to minimize risk and provide certainty for SAF purchasers and consumers.

Several Canadian organizations have joined the World Economic Forum's Clean Skies for Tomorrow (CST) coalition, including Airbus, Air Canada, C-SAF, Carbon Engineering, Deloitte, Enerkem, Greater Toronto Airport Authority, SAF+ Consortium, Shell, Suncor, and YVR. The coalition's vision is for SAF to reach 10% of global jet fuel supply by 2030, and it's working toward developing a sustainable aviation fuel certificate (SAFc) framework and a SAFc registry.[44]
The framework is being designed to consider GHGP, SBTi, and CORSIA standards and guidance.

SABA is also designing the SAFc book-and-claim registry for SAFc, in collaboration with CST and other stakeholders.[45]

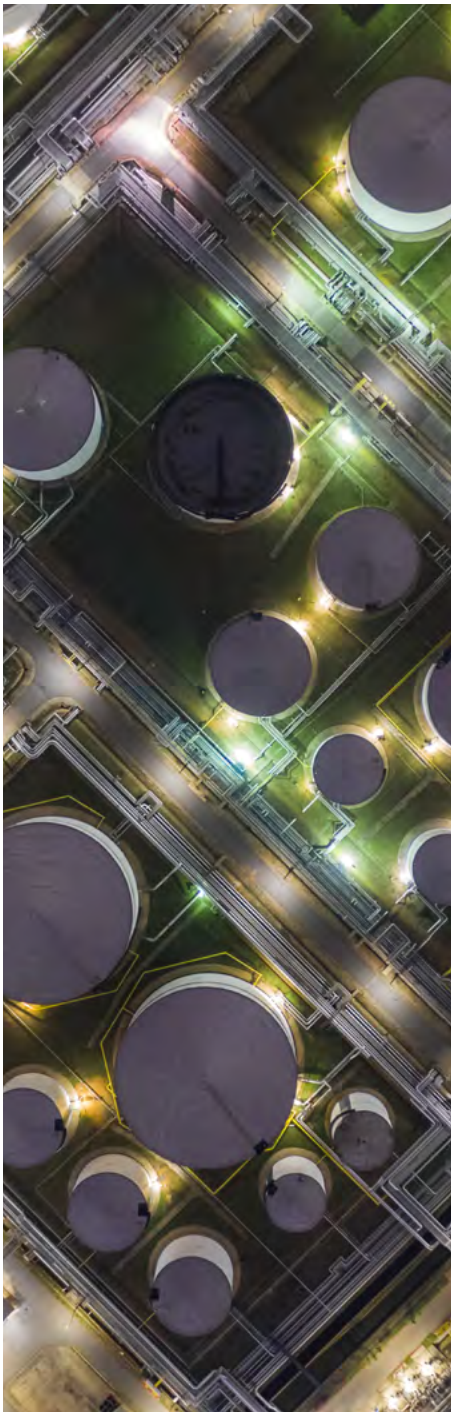
The Roundtable on Sustainable Biomaterials (RSB) is a global, multi-stakeholder independent organization that is collaborating with SABA to support the uptake of book-and-claim at a larger scale, and is currently piloting book-and-claim. It recently completed an official stakeholder consultation process for the RSB Book & Claim manual—a revised version is scheduled to be published in the second quarter of 2022.[46] Once a SAFc registry is developed and maintained by an independent body, likely in a few years' time—with a demonstration version in place by COP27 (late 2022)—it may prove a viable instrument to be considered in the GHGP (SABA is advocating for its system's inclusion in Scopes 1 and 3).[47] Canada can recognize an existing system, such as the SAFc system SABA is developing or other existing coalitions. Either way, there needs to be a way to claim SAF's environmental attributes with integrity through a system that registers, transfers, and retires the entitlement in a standardized manner.

Initiate a process to standardize sustainability criteria and methodology for calculating life cycle emissions benefits and minimum life cycle emissions reduction [short term]

The process of setting standardized sustainability frameworks frameworks for SAF would support demand generation. Harmonizing feedstock sustainability standards nationally and globally will improve transparency around sourcing and land-use change implications. SABA is developing a sustainability framework that includes more rigorous safeguards for SAF feedstocks than currently exist.

The research conducted on intersectoral feedstock allocation can feed into the feedstock guardrails, or guidelines, that Canada decides to implement. Industry groups including SABA are already leading this work; Canada should follow their lead by aligning to leading guidance to establish guiderails in this country.

As feedstock producers and stakeholders enter into supply agreements, shorter-term agreements may be preferable to accommodate the maturing feedstock sustainability standards. As described above, there is a need to standardize emissions life cycle calculations to provide a consistent and credible approach to Scope 3 buyers. The sustainability framework that SABA is developing will include standards for emissions-reduction thresholds and a standardized methodology for calculating that reduction.[48] Proposed international mandates, such as the United Kingdom's, have stipulated that SAF must lead to at least a 60% life cycle emissions reduction to be eligible.[49,50] Corporate buyers' alliances, including the WEF CST coalition members, have indicated a similar preference for at least a 60% life cycle emissions reduction for SAFc.



Partnerships and collaboration

A number of organizations in the clean-fuel and aviation industries are solidifying their leadership and joining forces in the sustainable aviation space. Partnerships are not only important domestically but also internationally, since aviation is a global ecosystem and there are multiple international governing bodies, including ICAO and IATA. Ultimately, the actions within this theme are designed to ensure a collaborative and consolidated response, minimize the duplication of work, and take coordinated action. There are two components to this theme: research and analysis (supported by academia) and partnerships. Joint, fact-based research to align the Canadian SAF industry is necessary. Research organizations—such as CRIN, Advanced Biofuels, the University of British Columbia, and the University of Waterloo—also have a role to play.

Analyze potential market size and understand KPIs to maintain competitiveness [short term]

Governments and industry can continue to evolve the collective understanding of the policies required to maintain a SAF market in Canada, identify the size and scale of the market, determine the timing and scope of transition to different feedstocks, and analyze capabilities to make sure Canada can scale SAF that is technology- and feedstock-agnostic. This research can also specifically track how the market is responding. The government, in conjunction with universities, think tanks, and/or industry-related consortiums, can lead this ongoing effort as technology evolves and a better understanding of sustainable feedstock emerges. This effort can be initiated with the formation of a working group.

The seventh generation principle refers to the practice of considering how every decision made will result in a sustainable world seven generations into the future. The government taking steps to modernize forest management will also enable opportunities for partnerships with Indigenous peoples, particularly in the context of feedstock inventory and supply.

Analyze intersectoral feedstock allocation, including a data-based analysis of the food vs. fuel debate [short term]

A pan-Canadian research initiative, funded by cross-industry stakeholders, would enable a broader understanding of feedstock supply, determine where there might be feedstock competition from other uses and sectors, and provide the data required to create policies from a pan-Canadian perspective. This should include an understanding of the potential impacts, if any, to Canadian food systems and other displaced sectors. It's important that this analysis make use of, and align with, work that was initiated through the creation of the Clean Fuel Standard and its land use/biodiversity criteria.

Research should also draw on Indigenous expertise and traditional ecological knowledge to bring a unique perspective to how feedstock is sourced and how environmental and cultural impacts can be mitigated, including making decisions using the seventh generation principle. This refers to the practice of considering how every decision made will result in a sustainable world seven generations into the future. The government taking steps to modernize forest management will also enable opportunities for partnerships with Indigenous peoples, particularly in the context of feedstock inventory and supply. A national strategy that focuses on biomass partnerships with Indigenous organizations like the Canadian Council of Aboriginal Business or National Aboriginal Forestry Association could provide opportunities for Indigenous-led discussions, shared decision-making, and supporting the diversification of forest sector participation.

As an understanding of how synthetics play into production volumes is developed, a national strategy for sectoral and export-versus-national feedstock allocation can be defined.

This research can also specifically track how the market is responding. The government, in conjunction with universities, think tanks, and/or industry-related consortiums, can lead this ongoing effort as technology evolves and a better understanding of sustainable feedstock emerges. This effort can be initiated with the formation of a working group.

Introduce mechanisms to incentivize the collection and refining of non-conventional (non-edible oil) feedstocks [short term]

Non-conventional feedstocks, including municipal solid waste and agricultural- and forestry-based residues, require substantial effort to scale due to their localized nature. Where Indigenous communities are securing forest tenure, Indigenous practices—which prescribe taking from the land only what is needed and only what nature can replace—can be employed to drive sustainable economic opportunities. Since Canada has long been a leader in forestry, there is an opportunity to study how forestry-based feedstocks could be enabled by partnerships with Indigenous communities. Waste collection policies and disposal fees can incentivize the use of these non conventional inputs. It will again be important to make use of and align with work that was initiated through the creation of the Clean Fuel Standard and its carbon-intensity/life cycle cost analysis of varying feedstocks.

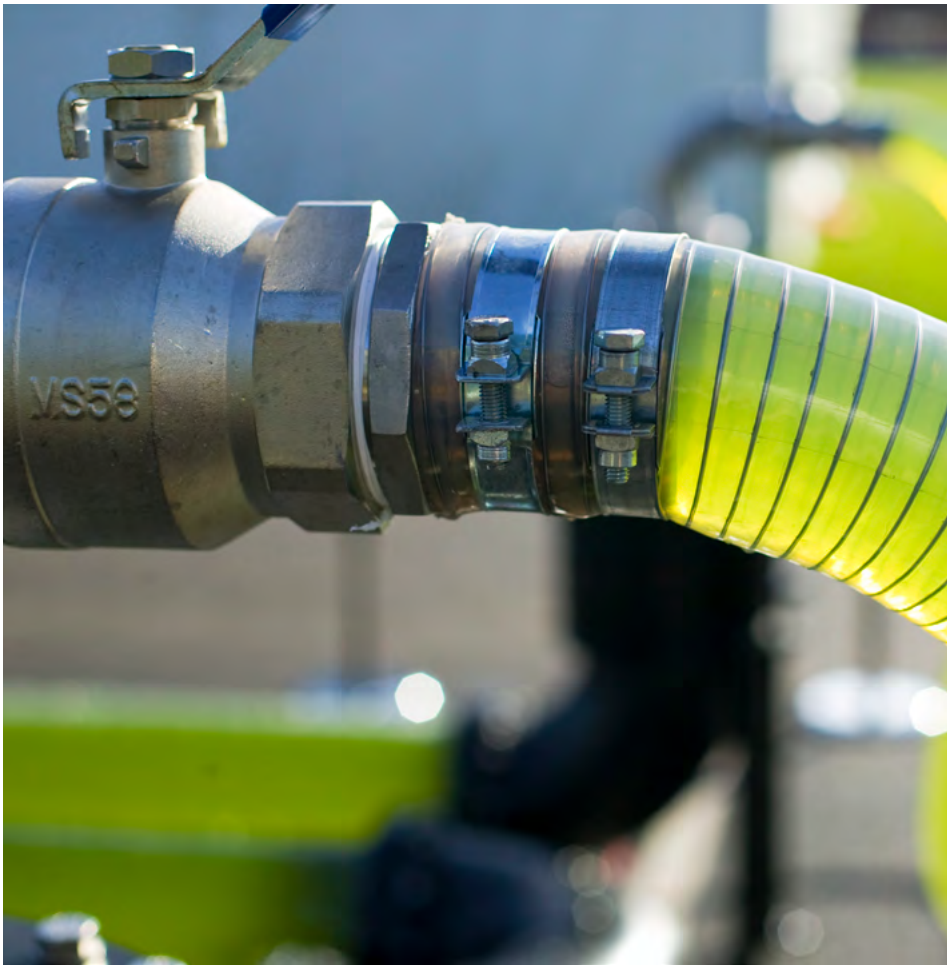
Develop a Canadian strategy for a shift from biogenic to synthetic fuels [short term]

Canada has a competitive advantage because of its vast quantity of bio-based feedstocks. However, on a global level, even if all such feedstocks are sustainably sourced to scale by 2050, the availability of bioenergy will still fall short by three to four times the global SAF demand.[51] So, any policy Canada develops today must not exclude or hinder developments that aren't for a bio-based fuel; for example, synthetic fuels. The IEA forecasts that in 2050, biogenic SAF will account for around 45% of total fuel use in aircraft globally, while synthetic hydrogen-based fuels will account for about 30%. Assuming a similar breakdown in Canada, we can start to figure out what a national strategy might look like, forecasting the timing and determining how policy mechanisms might be used to help shift the weight from biogenic to synthetic fuels. To do so, Canada can encourage the production of hydrogen and renewable energy, which are expected to be the primary inputs to the production process of synthetic SAF.

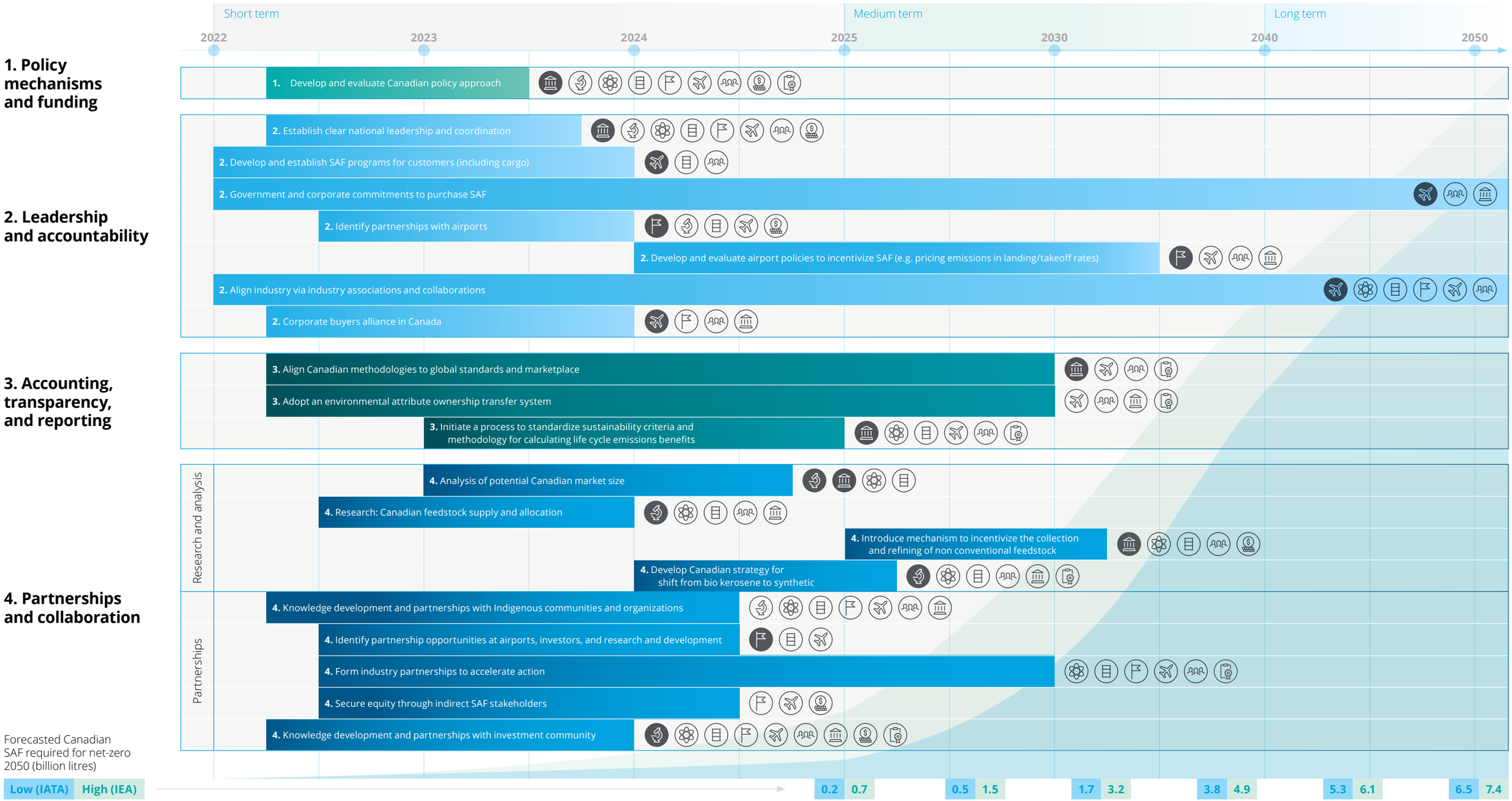
Secure equity through indirect SAF stakeholders [short term]

There is an opportunity for stakeholders with indirect needs for SAF (such as airport operators, distributers, and airline manufacturers) to partner to amass an equity position to fund SAF projects. This would enable these parties to contribute to the extensive capital costs involved in SAF infrastructure and production.

The IEA forecasts that in 2050, biogenic SAF will account for around 45% of total fuel use in aircraft globally, while synthetic hydrogen-based fuels will account for about 30%. Assuming a similar breakdown in Canada, we can start to figure out what a national strategy might look like, forecasting the timing and determining how policy mechanisms might be used to help shift the weight from biogenic to synthetic fuels.



SAF flight path



Conclusion

In the future, we want Canadians who choose to travel to be confident that they're contributing to a safe and healthy planet. The choices Canada makes now could enable that. If mobility is a priority and there is desire to ensure Canada does not become a net importer of clean aviation fuel, choose to act on the recommendations identified in this report. We welcome you to the table.

With intent and action, the hard work to decarbonize becomes achievable. Let's help to create a sustainable decarbonized aviation sector, and keep Canada connected.

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Canfor
Carbon Engineering
Collins Aerospace Canada
EDC
Environment Canada
FSM Group/C-SAF
Greater Toronto Airports Authority
Irving Oil
McCrimmon Innovation Consulting
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Nawitka Capital Advisors Ltd.
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Parkland Corporation
Purolator
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