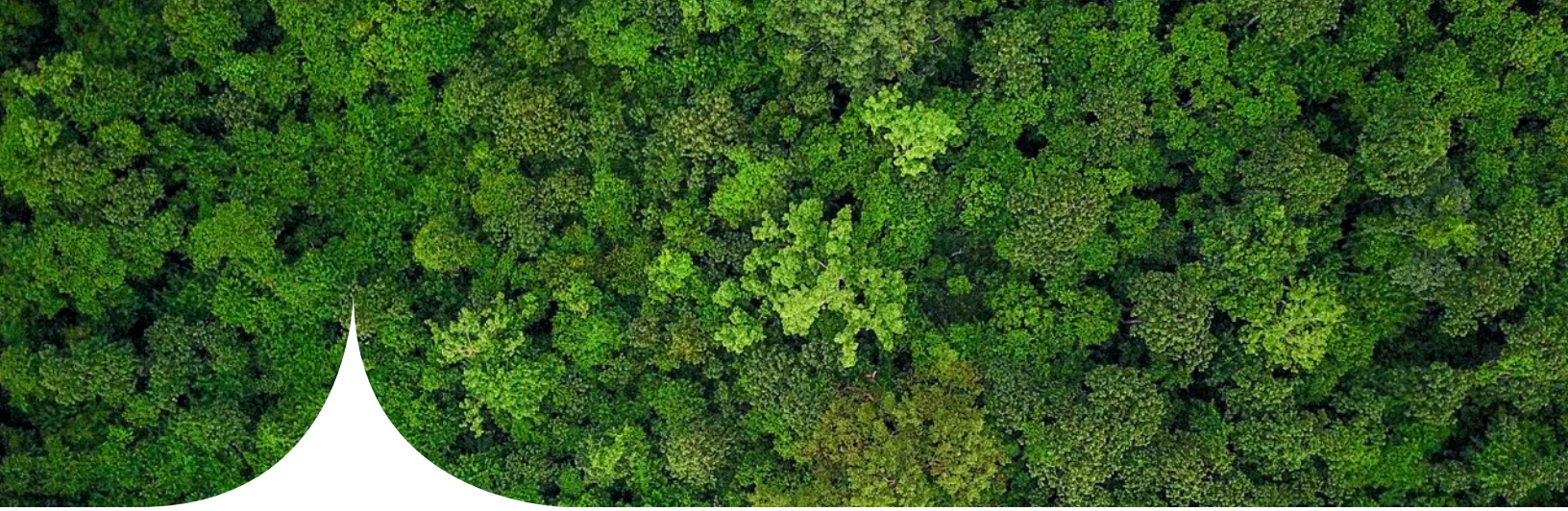
CANADA'S AVIATION CLIMATE ACTION PLAN

2022–2030

Government of Canada
Gouvernement du Canada

Canada



Catalogue No. T42-29/2022E-PDF
ISBN 978-0-660-45084-1

An electronic version of this publication is available at www.tc.gc.ca/aviation-emissions/.

For questions regarding Canada's Aviation Climate Action Plan, contact: TC.AviationEmissions-Emissionsaviation.TC@tc.gc.ca

While air travel supports Canada's economy, trade, and tourism, and connects Canadians separated by great distances and rugged terrain, it also generates greenhouse gas emissions, which contribute to an increased rate of climate change. Recognizing the need for coordinated action, this voluntary initiative sets a vision for net-zero aircraft emissions by 2050 and identifies how the parties intend to collaborate to reduce greenhouse gas emissions from aviation activities over the course of this plan.

It does not contain legal obligations of any kind or impose unreasonable expectations on any party, or intend to negatively impact any party's ability to do business in Canada. To ensure the success of the Action Plan, the Government of Canada commits to work alongside the parties to develop concrete deliverable actions. The Government of Canada commits to seek the support of the signatory partners at each update of the Action Plan in order to renew each party's commitments and ensure a common and cohesive approach to achieving net-zero emissions.

The Government of Canada reserves the right to develop and implement appropriate regulatory or other measures to achieve clean air and climate change goals. Nothing in this Action Plan will keep the Parties from taking further ambitious actions relating to greenhouse gas emissions or fuel use.

Dated this 13 day of September 2022.

Honourable Omar Alghabra, Minister of Transport
Transport Canada

Mike Mueller, President and CEO
Aerospace Industries Association of Canada

John McKenna, President and CEO
Air Transport Association of Canada

Monette Pasher, President
Canadian Airports Council

Anthony Norejko, President and CEO
Canadian Business Aviation Association

Jeff Morrison, President and CEO
National Airlines Council of Canada

Raymond G. Bohn, President and CEO
NAV CANADA

CONTENTS

1. EXECUTIVE SUMMARY

OUR PURPOSE: A COMMON VISION TO NET-ZERO BY 2050

Canada's Aviation Climate Action Plan (the Action Plan) sets out a vision for net-zero greenhouse gas (GHG) emissions –both domestic and international – by 2050 for Canada's aviation sector and identifies the key measures to get there. The Action Plan is the result of the collaborative efforts between the Government of Canada and the aviation industry, and meets Canada's international commitments to submit an updated action plan to the International Civil Aviation Organization (ICAO).

The Government of Canada has set binding commitments to achieve net-zero emissions by 2050 in the *Canadian Net-Zero Emissions Accountability Act*. As required by the Act, Canada published the first *Emissions Reduction Plan* (ERP) in 2022, establishing an ambitious and achievable roadmap for reaching Canada's 2030 emissions reduction target.

We acknowledge that meeting our commitments to net-zero emissions by 2050 will require ongoing efforts and that this Action Plan is an important first step in working to meet the ERP commitment for the Government of Canada to develop a whole-of-government approach on the long-term decarbonization of aviation. This Action Plan will serve as a foundation upon which the Government of Canada will further engage stakeholders, key experts, and the public on the most effective and equitable path forward to delivering on this vision.

To ensure we maintain our commitments in the mid- to long-term, Canada's Aviation Action Plan will undergo a series of reviews, planned for 2024, 2027, and 2030. These review periods will involve re-assessing long-term projections, strengthening near-term commitments, establishing interim targets, and ensuring continued alignment with Canada's climate commitments.

PATHWAYS

To achieve net-zero by 2050, a basket of measures needs to be implemented – this challenge is complex and there is no single solution.

The **development and adoption of green aerospace technologies**, including electric, hybrid and hydrogen propulsion, will be one of the key drivers to reducing the aviation sector's emissions in the longer term. The Government of Canada is committed to supporting the

aerospace sector's green transformation and preserving its global leadership and competitiveness. Through federal programs such as the Strategic Innovation Fund and the Low Emission Aviation Program, the Government of Canada has, and will continue to, invest in a range of innovative sustainable aerospace technologies. Additionally, federal action is being taken to enhance standards and test methodologies for certification to enable the commercialization and adoption of green technologies. Canadian airlines are also exploring options to adopt greener aerospace technologies, and are looking to investing in future training programs to advance decarbonization under this key driver.

Improvements in ground and air operations are an important component of the strategy to decarbonize the aviation sector, with further optimization of air traffic management (ATM), ground and aircraft operations. The Government of Canada is committed to working with airports, airlines and third-party equipment owners and operators on an approach for supporting the adoption of electric/low-carbon ground fleet, equipment, and green infrastructure, and to develop an inventory of ground support equipment and infrastructure to better understand the landscape. This Action Plan proposes additional work to accelerate the implementation of industry best practices on operational efficiencies from aircraft operations on the ground and in the air. Design and implementation of Trajectory-Based Operations will also enhance system efficiencies and lead to additional GHG reductions in the air sector.

The widespread availability and use of **sustainable aviation fuels (SAF)**, an alternative to conventional jet fuel with a smaller carbon footprint, is an essential decarbonization pathway as it will have the ability to drive down a significant portion of GHG emissions to 2050. This plan sets an aspirational goal of 10 percent SAF use by the year 2030, with a view to sending a clear signal that Canada and the aviation sector recognize the need for significant volumes of sustainable low-carbon fuel to achieve its vision of net-zero by 2050. In order to support this aspirational goal, all parties to the Action Plan commit to developing a Canadian roadmap for SAF. Moreover, the Government of Canada will explore options for supporting SAF, such as leveraging federal measures to create a supportive policy environment; signaling demand by purchasing SAF for its federal fleet through the upcoming Low-carbon Fuel Procurement Program; considering SAF in the context of Natural Resources Canada's BioEnergy Strategy to ensure Canada maximizes its bioenergy potential to reduce emissions while growing the economy; and through Transport Canada's collaboration with the U.S. Department of Transportation on commitments under the Joint Statement on the Nexus between Transportation and Climate Change. Finally, Canadian air carriers will signal SAF demand with offtake agreements, as appropriate and financially sound.

Out-of-sector reductions will be required to achieve net-zero GHG emissions by 2050. This means that, in addition to in-sector reductions, net-zero can be achieved by balancing the remaining emissions with emissions reductions or removals achieved outside of the boundaries of the aviation sector. A portion of emissions from international flights will be offset as part of ICAO's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). The Action Plan recognizes that additional work is needed to explore how the federal, provincial or territorial offset systems, including Canada's Greenhouse Gas Offset Credit system, can play a role in supporting GHG emissions reductions above and beyond what can be achievable with in-sector reductions for domestic flights.

In addition to these primary measures, other supporting and enabling measures are needed to ensure the vision is achieved, including research, development and demonstration, infrastructure investment, non-aircraft related ground operations, and policy and regulatory development.

2. INTRODUCTION

Aviation is a critical component of Canada's transportation network and is essential to connecting Canadians from coast to coast to coast, and to the rest of the world. In addition, the air transportation industry fosters Canada's economic growth through domestic and international trade.

Canada's air transportation system connects a territory that spans six time zones and covers about 18 million square kilometers. The benefits of aviation are particularly important to Canadians due to our country's geography, and even more so for remote communities, to whom air transportation is often the only way people can access vital services and basic commodities.

In 2019, over 160 million passengers boarded or disembarked planes across Canada. From a livelihood and economic perspective, the sector directly employed over 100,000 Canadians and benefited many more indirectly within other sectors, including hospitality, tourism, etc. Furthermore, Canada's aerospace industry contributed over $24 billion in gross domestic product (GDP) in 2021.

Given the value of the aviation sector to Canada and its citizens, it is crucial to advance solutions that address the environmental impacts of air transportation, as Canada and the rest of the world move toward a net-zero GHG emissions future.

The Intergovernmental Panel on Climate Change (IPPC) concludes that the achievement of net-zero emissions on an economy-wide basis is a pre-requisite for keeping global temperatures below 1.5 degrees Celsius to avoid the irreversible and catastrophic effects of climate change.

The aviation industry has been actively working to address its emissions. Over the years, the sector has invested in innovative technologies and operational improvements, which have led to meaningful efficiency gains, lessening the relative impact that air travel has had on the environment. However, despite these significant improvements, fuel efficiency gains over the last several decades have been outpaced by the growth of the sector, resulting in a significant increase in absolute emissions. In the absence of additional, coordinated

decarbonization measures, the sector's carbon footprint is expected to continue to grow. Given Canada's commitments under the Paris Agreement, which include 2030 and 2050 economy-wide emission reduction targets, it is critical for government and industry to develop and implement a new strategy that will enable the aviation sector to contribute towards Canada's low-carbon future.

The global aviation industry has recognized the need to accelerate its decarbonization. Canadian aviation stakeholders are no exception. In fact, some have already shown leadership and set ambitious goals to achieve net-zero GHG emissions by mid-century. This self-propelled push for change not only benefits the environment, but makes economic sense as passengers, partnering companies, and investors increasingly look for organizations to prioritize sustainable operations.

Canada's aviation sector will require a long-term transformation to significantly reduce its GHG emissions. Canada's Action Plan to Reduce Greenhouse Gas Emissions from Aviation has been an important initial phase in this process. For the first time, in 2012 it brought the collective efforts of Transport Canada, Canadian airlines, airports, the air navigation service provider, and aircraft manufacturers, and aircraft engine manufacturers together to address the sector's GHG emissions. Building on this foundation, and with the addition of a whole-of-government approach, this new Action Plan defines a long-term vision for which parties can set their sights and collectively work to achieve.

To ensure this Action Plan remains current and continues to meet the needs and climate commitments of Canada and the aviation sector, it will undergo a series of scheduled reviews between now and 2030 (i.e., 2024, 2027, and 2030). This will provide the opportunity to re-assess long-term projections, strengthen near-term commitments, and ensure alignment with Canada's 2030 Emissions Reduction Plan.

In 2021, the Government of Canada committed to an enhanced Nationally Determined Contribution (NDC) under the Paris Agreement, of 40-45 percent below 2005 levels by 2030, and enshrined this goal, and Canada's commitment to achieve net-zero emissions by 2050, in the *Canadian Net-Zero Emissions Accountability Act*. As required by the Act, Canada published the first Emissions Reduction Plan (ERP) in 2022, establishing an ambitious and achievable roadmap for reaching Canada's 2030 emissions reduction target. The ERP builds on the *Pan-Canadian Framework on Clean Growth and Climate Change*, Canada's first national climate plan, published in 2016, and Canada's Strengthened Climate Plan (SCP), a *Heathy Environment and a Healthy Economy*, published in 2020, which included several concrete climate actions and commitments, and highlighted that continuing to take climate action presents a critical economic opportunity to create a stronger economy, maintain and create jobs, and ensure strategic Canadian industries remain competitive, including Canada's aerospace sector.

In addition to broader measures, such as carbon pollution pricing and new *Clean Fuel Regulations*, which encourage low carbon choices across the economy, the ERP includes a suite of new commitments to reduce emissions from the transportation sector and accelerate new clean transportation technology deployment across all modes, including aviation.

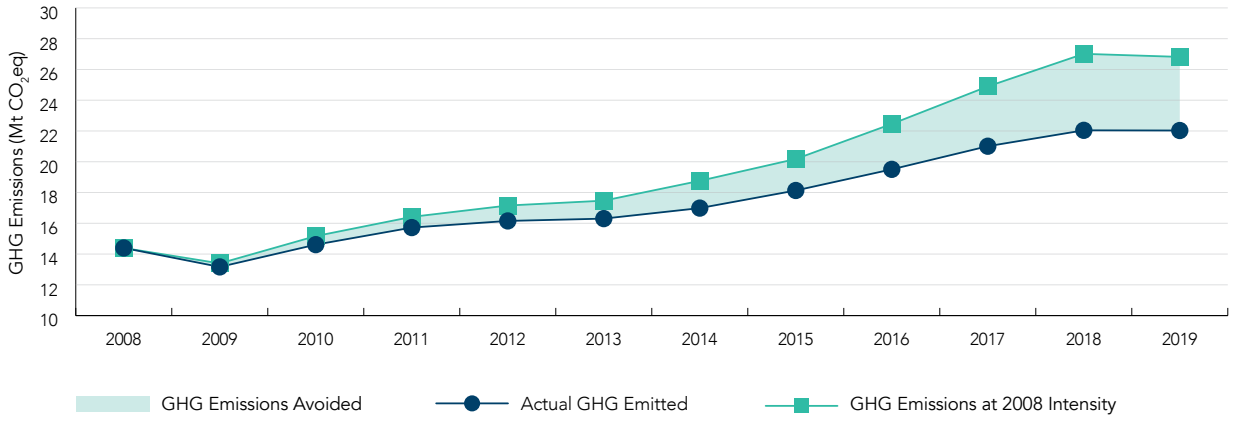
EMISSION PROFILE

Canadian air operators[1] released approximately 22 megatons (Mt) of carbon dioxide equivalent (CO_2e) emissions in 2019, from both domestic and international operations – a 75 percent increase since 2005. For reference, this is roughly equivalent to the GHG emissions generated from driving 4.8 million cars for a year[2].

Continual investment in new aircraft, new aircraft engines, and improved operations have resulted in meaningful efficiency gains that have significantly lowered the intensity of emissions generated from air travel. According to Air Transport Action Group (ATAG), the development of new airframes and engines alone has delivered more than 80 percent improvement in the fuel efficiency of aviation since the 1960s.

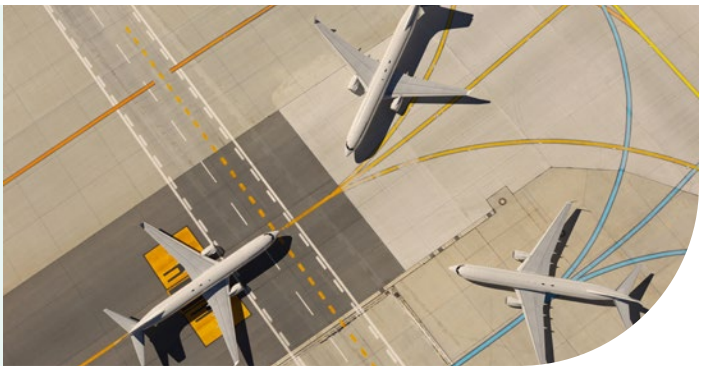
The following chart illustrates the recent effect of efficiency gains in Canada, during the 2008-2019 timeframe. The green shade represents the emissions avoided as a result of these actions. However, the chart also clearly shows that the efficiency improvements have been outpaced by the growth of the sector during this same time.

CHART 1. Impact of Emission Intensity Improvements, 2008-2019



Source: 2019 Annual Report under Canada's Action Plan to Reduce Greenhouse Gas Emissions from Aviation

In 2019, 70 percent of GHG emissions from Canadian air carriers came from international flights, while 30 percent came from domestic flights. This Action Plan defines international activity as flight segments that begin or end outside of Canada, whereas domestic activity includes flight segments within Canada.



[1] Participating National Airlines Council of Canada and Air Transport Association of Canada members, referenced in the 2019 Annual Report under Canada's Action Plan to Reduce Greenhouse Gas Emissions from Aviation. The scope of emissions is limited to the operations of Canadian air carriers as identified within ICAO's Guidance on the Development of States' Action Plan on CO_2 Emission Reduction Activities (Doc 9988).

[2] Based on the assumption that the average Canadian vehicle burns 2,000L of gasoline every year, corresponding to 4.6 tons of CO_2.

The following table shows the percentage of growth for domestic and international operations from 2012-2019. The significant growth of emissions of the sector over this time can be explained by the large increase in international operations, which used nearly 50 percent more fuel by 2019 and generated nearly 50 percent more emissions. For more data, visit the Action Plan's webpage.

TABLE 1. International and Domestic Emissions, 2012-2019

	2012	2019	Growth over the 2012-2019 period
Domestic GHG emissions (Mt)	5.7	6.5	+15%
International GHG emissions (Mt)	10.3	15.5	+50%
Total GHG emissions (Mt)	16	22	+38%

Source: 2019 Annual Report under Canada's Action Plan to Reduce Greenhouse Gas Emissions from Aviation

In 2019, before the COVID-19 pandemic drastically reduced air travel, global aviation was responsible for 2 percent of total GHG emissions. With pandemic-related travel restrictions easing, it is anticipated that the demand for Canadian air travel could rebound reaching 2019 activity levels in 2024 and continue to grow at an annual rate of 2.5 percent.

COVID-19

The COVID-19 pandemic had an unprecedented impact on the Canadian air sector. As a result of necessary public health measures to protect the health and safety of Canadians, passenger volumes dropped by over 90 percent in 2020 and remained extremely low through most of 2021. In response, air industry stakeholders (air carriers, airports, and NAV CANADA, as well as affiliated employers) took drastic measures to survive, including massive lay-offs, reduced operations, additional debt financing, increased fees, as well as deferred capital investments.

Due to the corresponding drop in demand for new aircraft and services, the Canadian aerospace manufacturing and maintenance, repair and overhaul (MRO) industries were also significantly impacted by COVID-19. Between 2019 and 2021, the Canadian aerospace sector's contribution to employment in Canada declined by 35,200 jobs and its contribution to Canada's GDP shrank by $9.4 billion.

The Government of Canada took immediate action through the Canada's COVID-19 Economic Response Plan to support people, businesses and organizations facing hardship as a result of the COVID-19 outbreak.

In response to the disproportionate impact of the pandemic on the aviation sector, the Government introduced or enhanced a number of programs, offering support funding (e.g., the Airport Critical Infrastructure Program (ACIP), enhancement of the Airports Capital Assistance Program (ACAP), the Canada Emergency Wage Subsidy (CEWS), Remote Air Services Program (RASP), etc.).

Budget 2021 also included $2 billion in direct support for the recovery of the aerospace industry in recognition of the significant and long-lasting impacts of the pandemic on the sector, including:

- Strategic Innovation Fund (SIF): $1.75 billion, over seven years, in targeted funding for aerospace projects that help to bolster innovation, strengthen competitiveness, and accelerate the industry's green transformation; and
- Aerospace Regional Recovery Initiative (ARRI): $250 million, over three years, to be delivered by the Regional Development Agencies to support small- and medium-sized enterprises (SMEs) strengthen the productivity and commercialization capacity of the aerospace supply chain, and green their operations and products.

As of Spring 2022, there are signs that the air sector is on a path to recovery, with passenger volumes at over 80 percent of 2019 volumes in advance of the peak summer season. While there have been challenges due to the rapid recovery of passenger volumes, work is ongoing between all air sector stakeholders, both government and industry, to address the immediate challenges and ensure Canadians have a safe, secure, accessible, and sustainable air sector.

CANADA'S PREVIOUS ACTION PLAN (2012–2022)

Transport Canada and representatives from the Canadian aviation industry have a long history of collaborating to address emissions from the sector. In 2012, the Action Plan was formed. This voluntary initiative brought together the collective efforts of Transport Canada, and key industry stakeholders to work together to address aviation emissions.

The previous Action Plan:

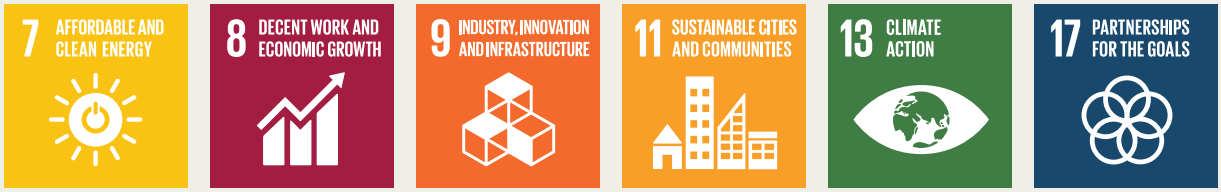
- Formed the basis for Canada's response to ICAO request for Member States to develop action plans to address GHG emissions from aviation.
- Focused on addressing emissions from both international and domestic operations.
- Set a 1.5 percent annual average fuel efficiency improvement target by 2020 (2008 baseline).
  - As of 2019, the Canadian air sector is on pace to exceed the target with a 1.8 percent annual average improvement from 2008.
- Set a 2 percent annual average fuel efficiency improvement aspirational goal by 2020 (2005 baseline).
  - As of 2019, the Canadian air sector is not on pace to achieve the aspirational goal with a 1.6 percent annual average improvement from 2005.
  - Fuel efficiency will continue to be publicly reported as part of the implementation of the new Action Plan. This is an important indicator that helps demonstrate progress and the benefits of fleet renewal and improved operations.
- Identified and implemented a basket of measures to improve efficiencies and minimize GHG emissions.
- Established an Action Plan Working Group to oversee the implementation of the Action Plan.
- Delivered on the commitment to publish annual reports demonstrating progress towards the fuel efficiency targets and emission reduction measures.

The previous Action Plan was initially set to expire in December 2020, but was extended until December 2022. Recognizing the changed landscape and need for higher climate ambition, including a whole of government approach and a long-term vision for the sector, this period enabled the federal government and aviation sector partners to work together to develop this new Action Plan (2022-2030).

Canada's commitment to the United Nations' 2030 Agenda

In September 2015, Canada and 192 other United Nations member states adopted the 2030 Agenda for Sustainable Development. The 2030 Agenda is a 15-year global framework centered on an ambitious set of 17 Sustainable Development Goals (SDGs), 169 targets and over 230 indicators. The 2030 Agenda is a global framework of action for people, the planet, prosperity, peace, and partnership. It integrates social, economic, and environmental dimensions of sustainable development, as well as peace, governance and justice elements.

Through Canada's 2023-2030 Canada's Action Plan to Reduce Greenhouse Gas Emissions, the Government of Canada and the Canadian aviation industry will contribute to the following 6 of the 17 SDGs:



3. THE VISION – NET-ZERO BY 2050

This Action Plan (2022-2030) is the result of the collective efforts of its signatory members in setting out a vision for the Canadian aviation industry to achieve net-zero greenhouse gas emissions by 2050 and identify the pathways to get there.

Canada and the aviation industry recognize that a coordinated effort is critical to advance pathways needed to achieve this goal. Though the Action Plan predominantly focuses on aircraft emissions[3], members of the plan recognize that sector-wide emission reductions are critical towards achieving Canada's national climate goals. This includes emissions from ground and airport operations[4].

To achieve net-zero by 2050, a basket of measures needs to be implemented – this challenge is complex and there is no single solution. These measures align with those prescribed by ICAO and referenced within other international roadmaps and action plans[5].

The following measures are expected to be needed for the Canadian aviation sector to reach net-zero by 2050:

1. Development and adoption of new green aerospace technology, including the gradual transition to new electric, hybrid and hydrogen propulsion;
2. improvement in ground and air operations;
3. the widespread availability and use of sustainable aviation fuels (SAF); and,
4. out-of-sector reductions (offsets to address residual emissions).

In addition to these primary measures, the Action Plan members commit to advance supporting and enabling measures, such as research, development and demonstration, infrastructure investment, non-aircraft related ground operations, and policy and regulatory development to ensure the vision is achieved. The Government will also conduct consultations with all impacted stakeholders to identify the most effective and equitable path forward to deliver on these measures.

---

[3] Under the Action Plan, greenhouse gas emissions from Canadian air carriers will be reported, including members of the National Airlines Council of Canada, the Air Transport Association of Canada, and the Canadian Business Aviation Association. In this context greenhouse gas emissions refers to carbon dioxide equivalent (CO_2e) which includes CO_2, CH_4 (methane) and N_2O (Nitrous Oxide).

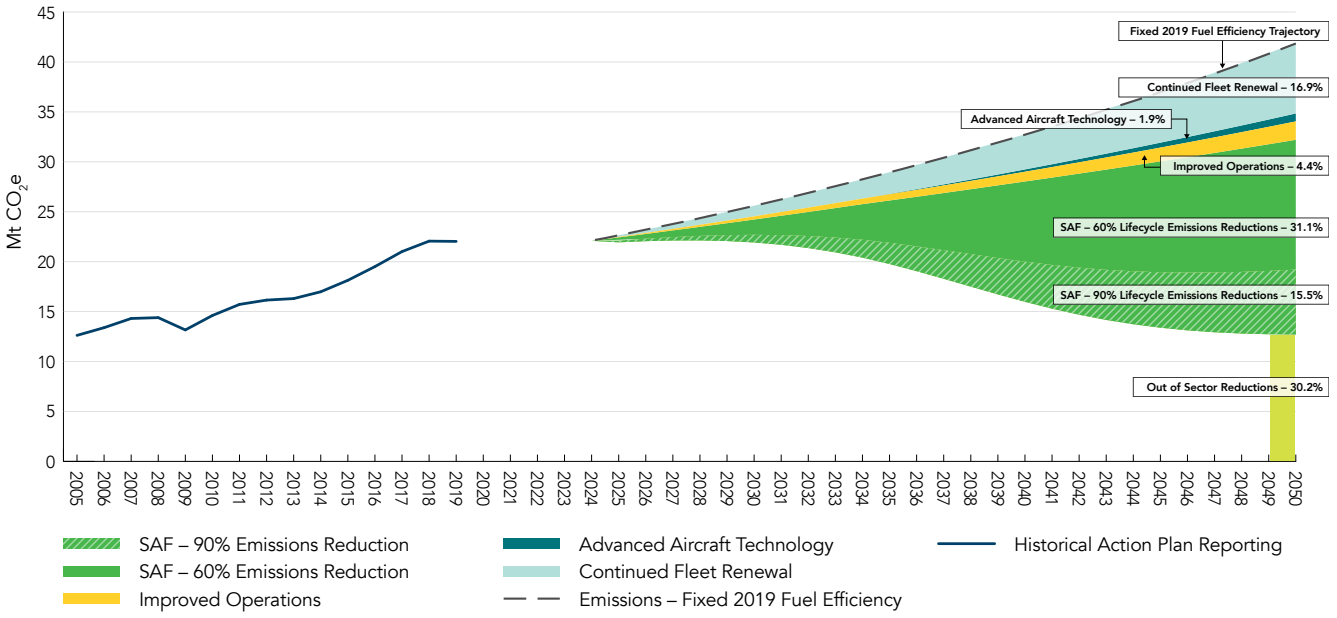
[4] For more information on efforts to reduce non-aircraft CO_2 emissions, see section 9.

[5] Many domestic and international publications were reviewed, and their findings considered throughout the development of this Action Plan and 2050 emissions forecast. This includes ICAO's LTAG feasibility report and State Action Plan Guidance; Waypoint 2050; Destination 2050, Deloitte's Reaching Cruising Altitude report, and the United States 2021 Aviation Climate Action Plan.

THE PATHWAYS TO ACHIEVE NET-ZERO BY 2050

The following chart shows how each of the key measures may contribute to reduce aircraft emissions by the 2050.

CHART 2. 2050 Canadian Aircraft Emissions Forecast – A Vision to Net-Zero



In Chart 2, the Emissions-Fixed 2019 Fuel Efficiency line represents a baseline aviation growth trajectory absent any measures to lower emissions. This forecast of potential emissions by 2050 uses 2019 emission intensity[6] and assumes that the sector will rebound to pre-COVID-19 pandemic levels in late 2024, and proceed to grow at an annual rate of 2.5 percent. The baseline suggests that, with these assumptions and no mitigating actions taken, emissions could be twice as high in 2050 as they were in 2019.

The "wedges" in Chart 2 represent the potential emission reductions associated with key mitigating measures. The Continued Fleet Renewal wedge represents the estimated potential reductions from the continued renewal and adoption of new, more efficient aircraft. This represents an annual 0.7 percent reduction in emissions, which translates to 16.9 percent of the necessary reductions towards net-zero by 2050.

The integration of advanced aircraft propulsion technologies (battery electric, hydrogen and hybrid) is assumed to become commercially available for regional, turboprop and smaller aircraft in the 2030-2035 timeframe, and single-aisle hybrid technology in the 2040-2045 timeframe. It is also assumed that long-haul wide-body aircraft flights would continue to use liquid hydrocarbon fuel (i.e., use conventional fuel and/or SAF) throughout the forecast period, due to Canada's geography and the range limitations on new energy powered aircrafts at the expected rate of technological progress. Recognizing the challenges of integrating non-traditional powered aircraft, the initial rate of adoption for this forecast is conservative. As a result, the Advanced Aircraft Technology wedge represents 1.9 percent of the reductions by 2050.

[6] In 2019, reported emission intensity was 837 g CO_2e / Revenue Tonnes Kilometres (RTK).

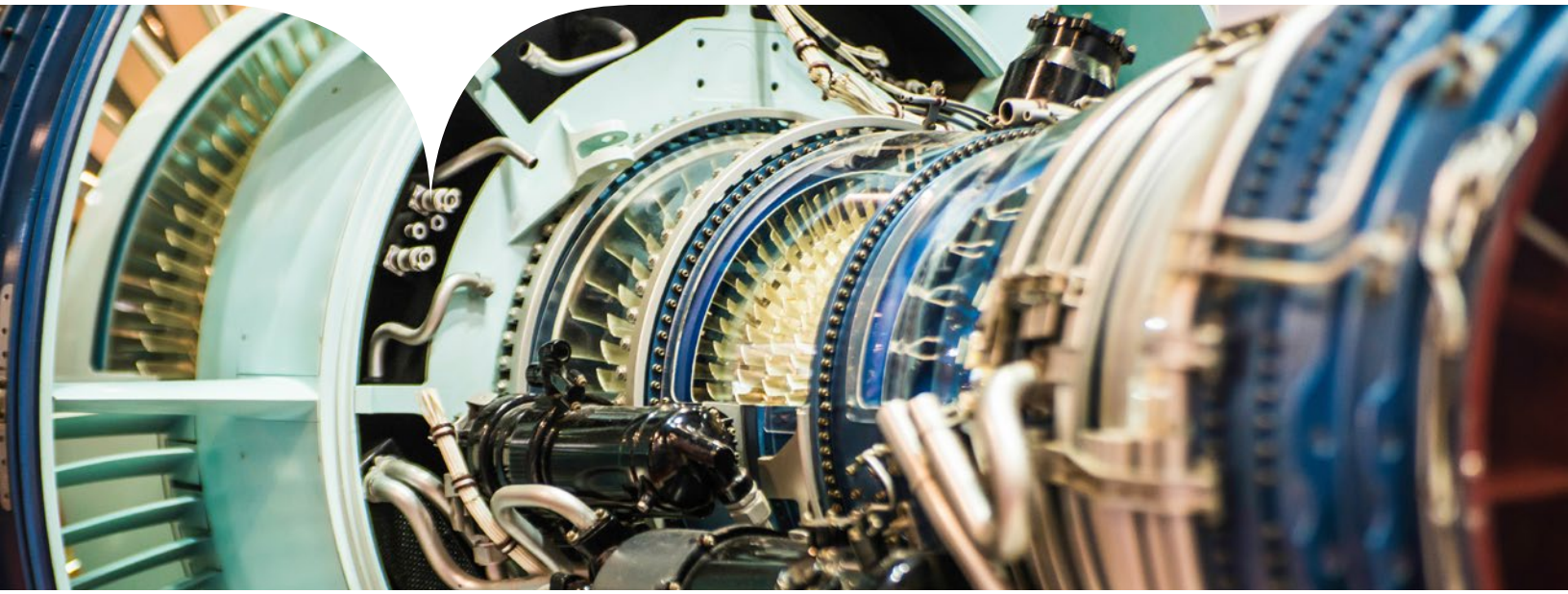
The Improved Operations wedge includes measures such as improved air traffic management, airport operations and infrastructure that help reduce aircraft fuel consumption, and airline/aircraft operations. Given the already high efficiency of aviation in Canada, the expected continual reductions from these activities are lower than other measures, but still significant as a contributor to Canada's GHG reduction targets. The overall projected reduction is 4.4 percent by 2050.

The largest emissions reduction potential is through the widespread adoption of SAF. It was estimated that roughly 70 percent of fuel used by 2050 would be SAF[7]. Chart 2 shows two wedges for SAF, reflecting the two different scenarios in terms of their lifecycle emissions reduction, assessed as a percentage reduction from conventional fuel. The first scenario assumes SAF use with a 60 percent lifecycle GHG emission reduction, and a second scenario represents a 90 percent lifecycle GHG emission reduction. This translates to 31.1 percent (for 60 percent SAF) and 46.5 percent (for 90 percent SAF) of the total reductions towards net-zero from the fixed 2019 fuel efficiency baseline. For more detail regarding SAF's lifecycle emission reduction potential, see Section 6.

While each of these measures will provide an important source of emissions reductions, there is not yet sufficient in-sector alternatives to reach net-zero by 2050, assuming the projected demand for air travel. Moreover, the sector will require breakthrough technology that typically requires long development and lead times for certification. This is not a situation unique to Canada, but a consequence of the nature of the global aviation industry, which is heavily capital intensive and requires a long timeframe for the adoption and certification of alternative low- and zero-emission technology. Therefore, the aviation sector's pathway to net-zero by 2050 will include a significant contribution from out-of-sector reductions.

[7] This is consistent with Deloitte Canada's Reaching Cruising Altitude – A plan for scaling sustainable aviation fuel.

4. DEVELOPMENT AND ADOPTION OF NEW GREEN AEROSPACE TECHNOLOGY



The global aviation sector is being transformed by increased demand for low-carbon aviation products from airlines and other aviation sector customers. To reach net-zero by 2050 and ensure the longer-term sustainability of the aviation sector, an essential part of the transformation will be the development of innovative greener aerospace technologies and their commercialization and adoption.

Leading global aerospace original equipment manufacturers (OEMs) are developing a range of technologies to green their existing and future products. For instance, Boeing has committed to fly all of its existing and future commercial aircraft on 100 percent SAF by 2030 and Airbus has set a goal of developing the world's first zero-emission commercial aircraft by 2035, powered by hydrogen.

Canada is an early leader in the design and manufacturing of sustainable aviation products. The Canadian-designed and manufactured Bombardier C Series, now Airbus A220, was the first aircraft in history to receive an Environmental Product Declaration (EPD) published by the International EPD System. More recently, EPDs have also been published for Bombardier's Global 7500 and Challenger 3500 business jets.

To maintain their global competitiveness, Canadian aerospace companies recognize the importance of investing in a range of sustainable technology areas, including alternative propulsion systems, greener aircraft systems and novel aircraft designs. For example, in 2021 Pratt & Whitney Canada announced its plans to demonstrate a new hybrid-electric propulsion system on the Canadian-made Dash 8-400 aircraft to reduce fuel burn and emissions by 30 percent. In 2021, both De Havilland Canada and the MHI RJ Aviation Group announced plans to work with partners to explore the potential integration of hydrogen-electric propulsion systems on the Dash 8-400 and CRJ Series aircraft. In 2022, Bombardier announced that it is working on an EcoJet Research Project, which targets a 50 percent reduction in emissions compared with today's aircraft using a novel blended wing body design compatible with SAF, hybrid electric and hydrogen propulsion. Most recently, in July 2022, CAE, a Canadian manufacturer of simulation technologies, announced that it will develop an electric conversion kit for in-service Piper Archer aircraft. CAE plans to convert two-thirds of its Archer training fleet to electric propulsion and will be the first to develop a curriculum for new pilots to train on the operation of electric aircraft.

Strategic Innovation Fund (SIF)

In recognition of the disproportionate impact of the COVID-19 pandemic on the aerospace sector, Budget 2021 targeted $1.75 billion in SIF support for aerospace innovation projects. The targeted funding will support the future global competitiveness of the sector, which has been identified as a key sector for industrial transformation in *Canada's Strengthened Climate Plan*.

To help achieve this target, in July 2021, the Government of Canada committed up to $440 million through SIF in support to new innovation projects with a focus on sustainable aviation, including up to:

1. $200 million to Bell Textron Canada Ltd. to support a project which aims to develop and commercialize environmentally friendly aviation technology;
2. $49 million to Pratt & Whitney Canada to support a project that aims to develop all the technological components for a hybrid-electric propulsion demonstrator plane; and
3. $190 million to CAE to implement a global R&D program for technologies including electric aviation and digital technology.

Innovation in the global aerospace sector is known to be complex, technologically risky, and costly. It can take years for an innovative idea to be researched, developed, tested, and certified for use as a product in the sector. Commercial aircraft typically have long production cycles and can stay in service for twenty-five plus years. As a result, it could take decades before many sustainable aviation technologies are widely adopted and next generation greener aircraft models make up the bulk of airlines' fleets.

In the *Waypoint 2050* report by the Air Transport Action Group, several scenarios highlighting the potential timelines of innovation and adoption of novel technologies by the aviation sector have been identified. In the most optimistic range, widespread electrification of aircraft in the 50-100 seat category is forecast as early as the 2030s. Under these scenarios, hybrid, fully electric and/or hydrogen-powered propulsion systems would be progressively integrated into airline fleets, becoming the main driver of emission reductions beyond 2050 toward a zero-emission future[8]. In Canada, regional flights could be the first to benefit from these technologies. However, until these capabilities become commercially viable, it will be necessary to adopt alternative fuel sources, such as SAF, to continue reducing the sector's environmental footprint.

SAF can help reduce emissions from smaller aircraft and shorter-haul flights until alternate propulsion is viable in this category as projected in the 2030s. SAF can also support emissions reductions from longer-haul flights until hybrid, fully electric and/or hydrogen-powered propulsion systems are technologically viable in the large aircraft category. Moreover, SAF could play a key role for operators who may not be able to financially consider fleet replacement in the short term to be able to reduce their emissions. Research and testing SAF on existing and future aircraft technologies is an important step for enabling the aviation sector's transition to net-zero by 2050.

Many countries, including Canada, have a long history of supporting aerospace innovation and technology development to de-risk the investments and encourage the economic, innovation and public benefits they produce. For example, through Innovation, Science and Economic Development Canada's (ISED) Strategic Innovation Fund (SIF), and its predecessor programs, numerous aerospace R&D projects, including those with cutting-edge sustainable aircraft technologies have been supported.

[8] *Waypoint 2050*, Air Transport Action Group, 2020, pg. 46

Aerospace innovation in Canada is also supported by the National Research Council (NRC), which partners with Canadian industry to take research impacts from the lab to the marketplace. The NRC's Low Emission Aviation Program (LEAP) works to accelerate the Canadian aviation sector's net-zero GHG transition by developing fast, market-ready, sustainable solutions.

Transport Canada also plays an important role in facilitating the growth of Canada's aerospace sector through its aircraft airworthiness regulatory framework and oversight responsibilities, aircraft certification services, and international engagement. Certification of new aviation technologies and new aircraft is typically a long process that can take between 5 to 10 years and the certification of disruptive green aerospace technologies will require an equally rigorous process. The development of new regulations concurrently with technological innovation is important to avoid future roadblocks that will delay technology adoption.

Supporting the green transformation of Canada's aerospace sector to preserve its global leadership and competitiveness is an important part of the Government's climate change agenda as outlined in *Canada's Strengthened Climate Plan*. Through the following proposed actions below, Canada will work with the aerospace sector to take important steps toward achieving its zero emission goals.

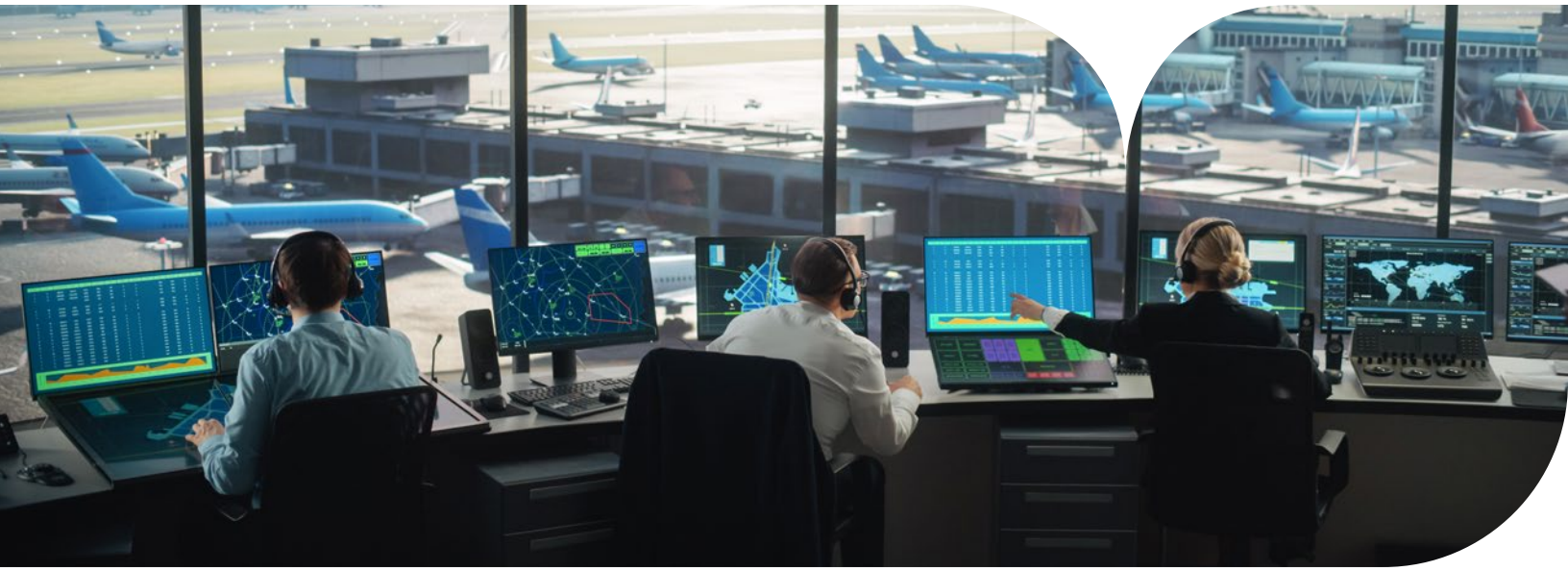
National Research Council (NRC) – Low Emission Aviation Program (LEAP)

LEAP works to transform the Canadian aviation sector's net-zero GHG transition by developing fast, market-ready, sustainable solutions, participating in collaborative ecosystems that will stimulate the aviation industry's green transition and support other government departments in developing green technology policies and regulations. To increase the impact of this program, NRC aims to work with Canadian aviation sector partners to substantially expand current LEAP activities in coming years.

Planned Actions

- ISED, through the SIF, will continue to support innovation in the aerospace sector to accelerate the sector's green transformation to preserve its global leadership and competitiveness.
- NRC, through LEAP, will continue to support the development of fast, market-ready, sustainable solutions while also de-risking potential high-impact technologies.
- NRC will also complete an ongoing facility renewal strategy to identify key required enhancements and realignments to NRC's existing world-class clean energy and aviation research infrastructure to better support joint technology development in the aviation sector and key supply chains.
- Transport Canada will work with the NRC to support the development of the required standards and test methodologies for certification of new low-emission aircraft technologies.
- Transport Canada will continue to support the certification and regulatory approvals of new aircraft technologies.
- Transport Canada will continue to help fund a variety of projects that help reduce air pollutants and GHG emissions in the aviation through the Clean Transportation System – Research and Development (CTS-RD) Program.
- Airlines will continue to pursue fleet renewal programs that reduce and retire older aircraft and introduce newer and more efficient aircraft.
- Airlines will also explore options to adopt advanced aircraft technologies when and where feasible, particularly for short-haul routes with smaller aircraft.
- Industry action plan members will invest in future training programs that incorporate the usage of electric aircraft.

5. IMPROVED OPERATIONS



Efficiency improvements in air and ground operations are an essential component of the strategy to decarbonize the aviation sector. Improved operations refer to the further optimization of air traffic management (ATM), ground and aircraft operations.

ATM improvements that enable aircraft to optimize fuel consumption include optimizing airspace design and structure, implementing reduced air traffic control separation minima[9] (particularly between aircraft on approach), allowing user-preferred trajectories, and authorizing wake energy retrieval operations, continuous climb and descent operations, and trajectory-based operations. Many of these measures are interrelated and require a high level of collaboration between aircraft operators, airport operators, avionics manufacturers, and air navigation services providers in order to implement ATM improvements and gain the fullest benefits from those improvements. Engagement on ATM improvements that may impact communities is undertaken in accordance with NAV CANADA and the Canadian Airport Council's Canadian Airspace Change Communications and Consultation Protocol.

NAV CANADA, a not-for-profit corporation, manages Canada's 18 million square kilometres of civil airspace. In April 2022, NAV CANADA unveiled its new strategic direction, including initiatives to implement trajectory-based operations, airspace modernization, and digital facilities. These initiatives will leverage available technology and help reduce emissions from aircraft.

Airport ground operations improvements that can minimize aircraft emissions by limiting the use of auxiliary power units (APU), which run on fossil fuel, include providing electrical power and pre-conditioned air to aircraft while at the gates, and improving efficiencies on the taxiway (e.g., e-taxiing, single engine taxiing, and reducing taxi time). Many Canadian airports have already invested in infrastructure that will enable an aircraft to plug-in while at the gate. Airport ground support equipment such as baggage tractors, belt loaders and catering hi-lifts are traditionally powered by fossil fuels but could over time be powered by grid electricity or other low-carbon or zero-emission fuels.

[9] https://tc.canada.ca/en/corporate-services/acts-regulations/list-regulations/canadian-aviation-regulations-sor-96-433/standards/standard-821-canadian-domestic-air-traffic-control-separation-standards-canadian-aviation-regulations-cars

Investment in air traffic control to increase efficiency and capacity

On June 29th, 2022, Transportation Minister Omar Alghabra announced that the Government of Canada and NAV CANADA will invest up to $261M ($105M and $156M, respectively) to improve efficiency and capacity of air traffic control and infrastructure at Toronto's Pearson Airport, Montréal–Trudeau International Airport, Vancouver International Airport and Calgary International Airport.

This funding will support three projects:

1. Drone traffic management services to improve management of aircraft traffic at airports
2. New software to assist traffic controllers by enhancing weather predictions and surveillance
3. New technology to improve reliability, safety, and performance of Canada's air transportation system, particularly in remote areas

Aircraft operations can help optimize aircraft and engine efficiency. These include activities such as managing load factors by minimizing weight, flight planning, fuel planning, and regular aircraft and engine maintenance. This could include greater adoption of existing digital solutions to improve fuel efficiency (and thereby reduce carbon emission) with flight optimization, such as the Flight Plan service that CAE now offers to airlines.

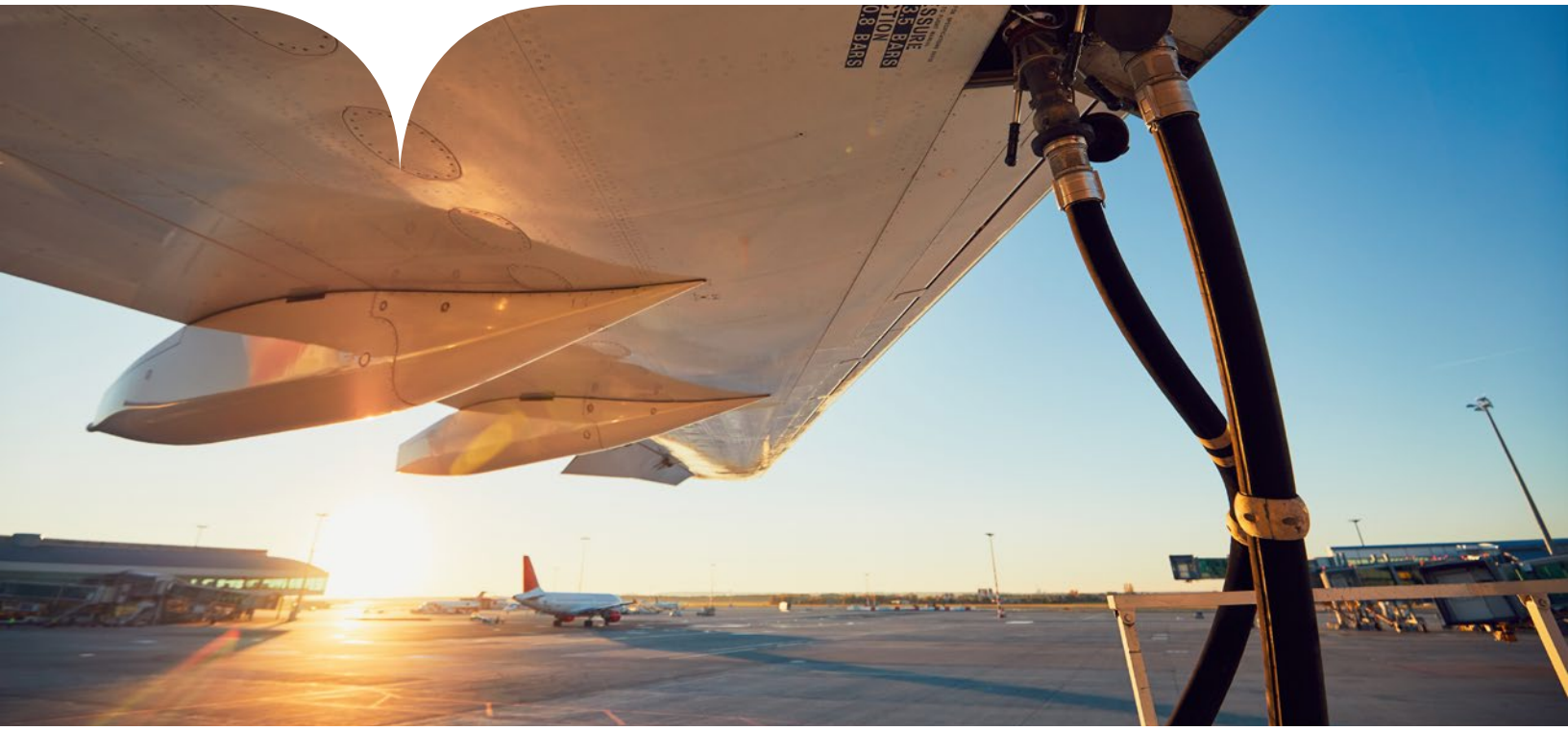
While the absolute potential reduction in emissions derived from improved operations is modest, it is an important contributor to and amplifier of the impact of other measures such as the use of new aircraft and SAF. The reason that the future benefits are limited is that the sector already operates at a high-level of efficiency. Moreover, in some instances operational efficiency is neither possible nor desirable, due to operating constraints and interdependencies, such as safety requirements, system capacity, weather variations and concerns, such as community noise impacts and local conditions.[10]

[10] *ICAO's Global Horizontal Flight Efficiency Analysis*, available at: https://www.icao.int/environmental-protection/Documents/EnvironmentalReports/2019/ENVReport2019_pg138-144.pdf

Planned Actions

- Transport Canada and Environment and Climate Change Canada will work with airports, airlines and third-party equipment owners and operators on an approach for supporting the adoption of electric/low-carbon ground support equipment and green infrastructure, and to develop an inventory of ground support equipment and infrastructure to better understand the landscape.
- Transport Canada will work with and support NAV CANADA as they determine the optimum airspace design for the Canadian domestic airspace.
- Canadian air carriers will collaborate with Transport Canada and NAV CANADA to implement airspace redesign initiatives.
- The Government of Canada will continue to pursue adoption of international best practices, conducive to emissions reductions.
- Canadian air carriers will accelerate the implementation of industry best practices with respect to operational efficiencies from aircraft operations on the ground and in the air.
- NAV CANADA will implement Trajectory-Based Operations (TBO) to enhance system efficiencies, mitigate delays and enable aircraft to fly preferred routes, leading to the use of less fuel.
- NAV CANADA will design and implement Required Navigation Performance – Authorization Required (RNP AR) approaches, which provide opportunities to adequately equipped aircraft to fly continuous descent approach profiles and reduced track-milage, reducing fuel burn and GHG emissions. NAV CANADA will also implement Established on RNP AR (EoR) at major airports with parallel runway operations.
- NAV CANADA will explore collaborating with the Department of National Defence in identifying opportunities for Flexible Use Airspace, which will allow aircraft to fly preferred routes.
- Parties will explore alternatives to improve the efficiency of ground aircraft movement.

6. SUSTAINABLE AVIATION FUELS



The key driver of emissions in the aviation sector is the use of fossil-based fuel. While technological and operational innovations have and will continue to increase air transport efficiency and minimize overall fuel consumption, there is a limit as to how much emissions can be reduced while still using conventional jet fuel. Accordingly, to significantly lower aviation emissions it is necessary to adopt a greener primary energy source for aviation.

Unlike ground transportation, where there are viable alternatives to conventional fuels, for aviation today and for the near-term and for many applications in the medium-and long-term, the only feasible alternative to using fossil-based jet fuel is the adoption of SAF. This is consistent with the findings from ICAO's Long-Term Aspirational Goal (LTAG) for International Aviation Feasibility study which identifies SAF as the key pathway to achieving meaningful emissions reductions by 2050.

Sustainable aviation fuels are liquid hydrocarbon fuels, derived from non-petroleum sources that in addition to being low carbon, also meet pre-established and recognized sustainability criteria. SAF is produced to have identical performance and safety characteristics as conventional jet fuel using approved pathways. This make-up allows SAF to be seamlessly blended in any system that uses conventional jet fuel (current maximum blend limit is 50 percent), which is critically important since it can be used by existing aircraft engines, use existing delivery and supply chains, and be stored and distributed using existing infrastructure. This "drop-in" quality of SAF makes it the ideal candidate for decarbonizing aviation because it is a viable option for replacing fossil jet fuel that can substantially reduce the amount of GHGs that accumulate in the atmosphere.

The term feedstock is used to describe the main material used to make SAF. There are a number of potential feedstocks in Canada that could be sourced, for SAF production. Feedstocks can be plant-based (e.g., canola, camelina, carinata, corn, soy, forestry residues, agricultural residues), or come from advanced SAF pathways that utilize as feedstock carbon dioxide captured from the atmosphere or combustion exhaust

gases captured from industrial flue stack emissions, among other sources. These advanced technologies are recent and evolving pathways called power-to-liquid fuels or e-fuels because of the inherent nature of these processes that essentially transforms electricity into liquid fuels. Each type of feedstock typically uses a tailored conversion technology that fuel producers employ to convert the feedstock to SAF. Given the projected demand for SAF to decarbonize aviation, a wide variety of feedstock and conversion pathways are needed.

ICAO defines SAF as renewable or waste-derived aviation fuels that meet the CORSIA Standard's SAF Sustainability Criteria. The SAF pathways that ICAO assesses and approves require that the pathway uses an ASTM D7566 certified conversion process or a conversion process for which the Phase 2 ASTM Research Report has been reviewed and approved by Original Equipment Manufacturers (OEMs)[11]. ASTM D7566 is a specification standard for a blend of jet fuel consisting of conventional and synthetic components. The synthetic jet fuel component is currently required to be blended with conventional fossil jet fuel to achieve the requisite drop-in quality. However, work is underway to develop a standard that would allow for the use of 100 percent synthetic aviation fuel without need for blending with fossil jet fuel. As of August 2022, ASTM D7566 has seven annexes with each annex defining a specific ASTM certified conversion process for producing synthetic jet fuel and the required blend level with conventional jet fuel.

Nominally, Canada adopts the ASTM D7566 specifications for aviation fuels that contain synthetic hydrocarbons under the Canadian General Standards Board CAN/CGSB-3.23 Aviation Turbine Fuel standard. In both ASTM D7566 and CAN/CGSB-3.23, once the aviation fuel that contains synthetic hydrocarbons is manufactured, certified, and released from the D7566 specification, the aviation fuel blend will meet the requirements of ASTM D1655 and is regarded as D1655 aviation fuel thereafter. ASTM D1655 is the standard specification for conventional aviation fuel.

Synthetic jet fuel in its unblended form from any of the ASTM D7566 annexes can become SAF upon meeting certain sustainability criteria. Meeting the sustainability criteria applicable to a jurisdiction allows an ASTM D7566 or CAN/CGSB-3.23 aviation fuel to become a certified SAF product. One of the key sustainability aspects of fuels pertains to its life cycle GHG emissions. The GHG emissions associated with a given feedstock and conversion process (e.g., from inputs of hydrogen, fertilizer, and electricity) are important to measure as a key step to determining the emission reduction potential of a SAF candidate. To ensure that SAF deliver sustainability benefits over the conventional jet fuel it will be replacing, it is necessary to conduct a life cycle assessment (LCA) on the SAF candidate. LCA is an accounting method used to evaluate the environmental attributes of a product and compare it with those of its alternatives or the displaced product. The LCA of SAF accounts for GHGs along the life cycle of SAF, which includes the production of the feedstock, the conversion of the feedstock to SAF (including energy inputs such as hydrogen), transportation steps, and combustion of the SAF.

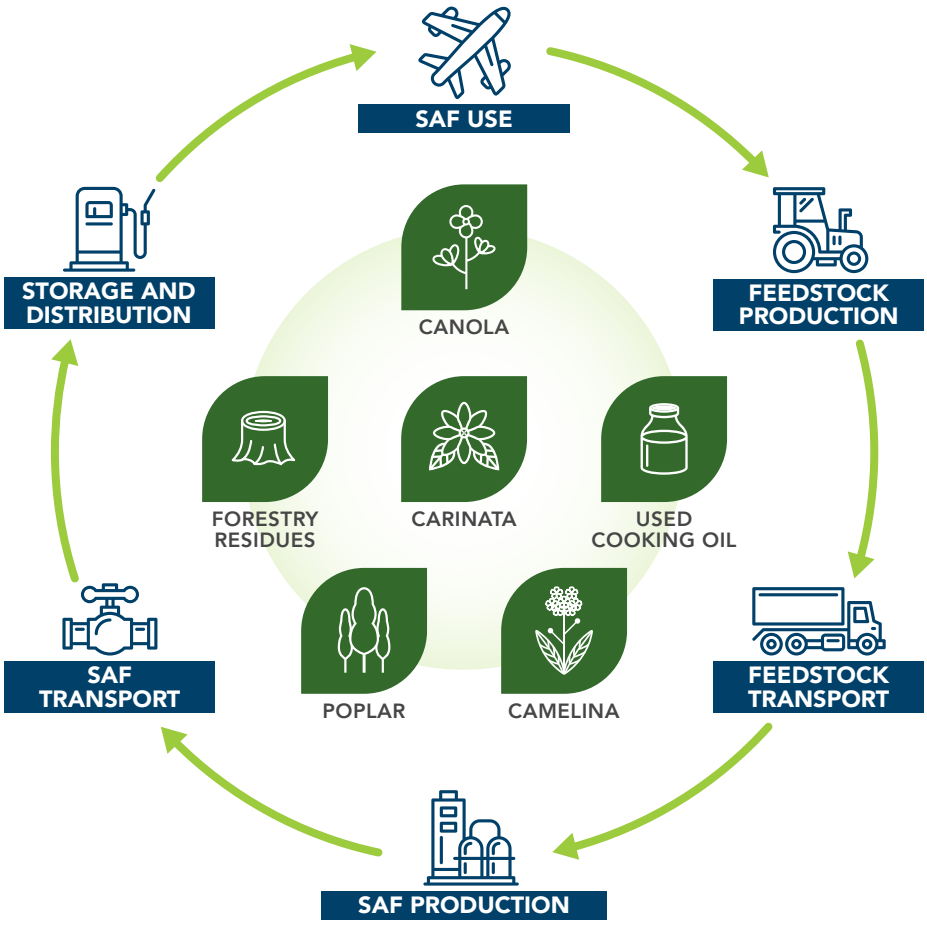
The key benefit of SAF is that it is not fossil-based and therefore, its use, compared to conventional fuel, helps limit the incremental GHG emissions from aviation.

Additionally, the sustainability of each feedstock needs to be ensured to avoid potential unintended consequences such as over-harvesting of biomass, biodiversity loss, harming long-term sustainability of food production, or other long-term environmental consequences. ICAO has established sustainability criteria for SAF to be eligible under CORSIA[12]. Canada's federal *Clean Fuel Regulations* (CFR) establish a set of land-use and biodiversity criteria for biomass-based feedstocks to prevent adverse impacts on land use and biodiversity stemming from the increased harvest and cultivation of these feedstocks. Only low carbon intensity fuels made from biomass feedstock that adhere to these criteria are eligible for credit creation under the CFR.

[11] Chapter 1. Criteria and Process for the Addition of New Default Life Cycle Emission Values in *CORSIA Supporting Document – Life Cycle Assessment Methodology*

[12] For more information on CORSIA, see Section 8.

The following diagram shows a life cycle of SAF from organic feedstock production to fuel use, highlighting a handful of feedstocks that are being produced or could be produced at a sufficient scale in Canada. The key element in the life cycle is the closed-loop circulation of carbon that comprises the SAF hydrocarbon molecules.



The ability for SAF to contribute to the sector's 2050 vision is dependent on both the production and scale-up of existing certified pathways and on new forms of SAF pathways being developed.

Currently, there is no meaningful Canadian domestic production of SAF, although there have been recent announcements of intent to produce SAF. There are however, a few SAF refiners in the U.S. and in Europe that are accelerating to produce SAF in larger volumes due to proposed and existing policies and regulations in those regions. Given SAF's importance to the aviation sector decarbonizing by 2050, accelerating SAF availability at a financially viable cost is a key area for the Government of Canada to continue to explore.

In the Canadian context, the lack of SAF production can be attributed primarily to its high cost of production (2 to 5 times more expensive than conventional jet fuel) and competition with renewable diesel (from a producer's perspective, it is cheaper and less energy-intensive to make renewable diesel, which is already in high demand from other sectors). Canada's policy and regulatory environment could be enhanced to support SAF production and use in Canada.

In this current environment, Canadian air carriers seeking to lower their GHG emissions could use SAF in flights departing from some international cities where SAF is being delivered or work with airports to import SAF to Canada from the U.S. or other countries as SAF volumes become available. Canadian air carriers could also use *book and claim*, a system being developed by industry to match demand with supply from different locations.

Over the course of the previous action plan, research and analysis was conducted to better understand the practical use, characteristics, and benefits of SAF. Previous Action Plan reporting highlights the numerous collaborative research projects led by the Green Aviation Research and Development Network, (GARDN), National Research Council Canada, ASCENT (Aviation Sustainability Center), and others.

In 2018, Canada launched a SAF competition – Sky's the Limit Challenge – awarding a $5 million prize to the company that produced (in Canada) at least 10 liters of SAF at the lowest cost, with the best GHG emissions reduction and provided the best commercialization plan.

Four companies were selected (Enerkem, FORGE Hydrocarbons, SAF+ Consortium and Carbon Engineering) to develop their project over a period of 27 months with $2.15 million in government financial support. On March 30, 2022, Enerkem was announced as the winner of the challenge following a technical evaluation and a commercialization evaluation by an international Jury (members from Canada, the U.S and France).

In early 2022, the Canadian Council for Sustainable Aviation Fuels (C-SAF) was created by over 60 airlines operating in Canada seeking to bring together key industry stakeholders and government to accelerate the commercial production and use of Canadian-made SAF. C-SAF has brought together representatives from across the value chain to develop a clean competitiveness roadmap for Canadian-made SAF (to be completed by fall 2022). This will include identifying national and regional challenges and opportunities to build a thriving Canadian SAF production industry. Findings from this exercise will support this Action Plan's implementation and help inform potential future policy development.

Winner of the Sky's the Limit Challenge: Enerkem

Enerkem, the winner of the Sky's the Limit Challenge, developed an integrated approach of two SAF pathways, gasification of municipal solid waste and fermentation of forest biomass. For more information visit the Government of Canada's website.

EXISTING POLICIES

There are several existing measures to drive emission reductions at various levels of government. At the federal level, carbon pollution pricing and *Clean Fuel Regulations* (CFR) are two important distinct cross-sectorial measures. Carbon pollution pricing aims to change behaviors and drive emissions reductions across the economy by creating market signals that incentivize the use of low-carbon technologies and fuels in Canada. The CFR targets transformative clean technologies and fuels by requiring fossil fuel suppliers to reduce the lifecycle carbon intensity of the gasoline and diesel they supply for use in Canada.

Carbon pollution pricing has been in place across Canada since 2019, through a mix of federal, provincial and territorial systems, aligned with minimum national stringency standards (federal benchmark).[13] While many of these cover emissions from intra-provincial aviation (e.g., under the fuel charge), emissions from inter-provincial flights (the majority of domestic air transportation) are not covered by carbon pricing.[14] Given the unique and complex nature of airline operations across domestic and international boundaries and carbon policy regimes, the federal government acknowledged that more work was required to establish a coherent policy for dealing with inter-provincial aviation emissions. Most recently, on August 9, 2022, the Government of Canada released *Draft Regulations Amending the Fuel Charge Regulations*, which would provide relief from the fuel charge for the portion of aviation gasoline or aviation turbo fuel that is bio-aviation fuel (i.e., SAF derived entirely from biological matter available on a renewable or recurring basis). This relief would reduce the fuel charge payable by the proportion of bio-aviation fuel blended into aviation gasoline or aviation turbo fuel, effective starting August 10, 2022.

The federal CFR sets life-cycle carbon intensity reduction requirements for gasoline and diesel used in Canada starting in 2023. The CFR takes a market-based approach, which provides regulated parties flexibility in how they meet their reduction requirements. The CFR does not have a reduction requirement for jet fuel; given the market-based approach, a reduction requirement would not specifically target uptake of SAF. However, the production or import of eligible and registered SAF and other low carbon intensity fuels will create credits, which provides some financial incentive for SAF production or import into Canada.

---

[13] The federal carbon pricing system, enabled under the *Greenhouse Gas Pollution Pricing Act* (GGPPA) includes a fuel charge on fossil fuels and a performance-based trading system for emission-intensive, trade-exposed industries. It is applied as a backstop in jurisdictions that request it or where a system is not in place that meets the federal benchmark. (See https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work.html)

[14] Emissions from intra-territorial aviation are currently not covered under the carbon pollution pricing systems in the territories, reflecting the high-reliance of the territories on air transportation.

Planned Actions

- Parties of the Action Plan to collaborate with the Canadian Council for SAF (C-SAF) and others in developing a Canadian roadmap for SAF.
- Natural Resources Canada to explore SAF as part of developing a BioEnergy Strategy to ensure Canada maximizes its bioenergy potential to reduce emissions while growing the economy.
- The Government of Canada will explore how federal measures may be leveraged to create a policy environment to enable and accelerate SAF uptake in Canada.
  - It will pursue having the *Draft Regulations Amending the Fuel Charge Regulations* made to provide relief from the federal fuel charge for bio-aviation fuel blended into aviation gasoline or aviation turbo fuel.
  - As previously indicated, it will explore a consistent national approach including the challenges and opportunities to pricing emissions from inter-provincial aviation.
- The Government of Canada will support SAF related initiatives through existing programs and will purchase SAF for its federal fleet through the upcoming Low-carbon Fuel Procurement Program.
- Transport Canada to continue collaborating with the U.S. Department of Transportation on commitments under the Joint Statement on the Nexus between Transportation and Climate Change.
  - Canada to continue supporting aviation research with U.S. partners, including the ASCENT (Aviation Sustainability Center / Centre of Excellence for Alternative Jet Fuels and Environment).
- Canadian air carriers will signal demand with offtake agreements as appropriate and financially sound.

2030 Aspirational Goal

While parties to the Action Plan coordinate and implement the various proposed actions, this plan sets an aspirational goal of 10 percent SAF use by the year 2030. This ambitious goal is intended to send a clear signal that Canada and the aviation sector recognize the need for significant volumes of sustainable low-carbon fuel to achieve its vision of net-zero by 2050 and that success depends on collective action to advance concrete initiatives to accelerate SAF adoption in Canada.

7. OUT OF SECTOR REDUCTIONS

While the previously described measures will substantially accelerate the decarbonization of the Canadian aviation sector, out-of-sector reductions will be heavily relied on to achieve net-zero GHG emissions by 2050. The Action Plan forecast suggests at minimum 12Mt of emissions would need to be offset in 2050.

This projection is not unique to Canada. For instance, ICAO's LTAG report presented three integrated scenarios representing varying degrees of ambition and feasibility for in-sector GHG reductions. By 2050, the least ambitious of the three emissions scenarios presented in-sector emissions reductions of 39 percent below the projected 2050 emissions, while the most ambitious presented emissions reductions of 87 percent below the projected 2050 emissions. A significant amount of emissions remain for two primary reasons: either fossil jet fuel cannot be completely replaced with an alternative sustainable energy source(s), or that the alternative energy source(s) itself releases GHG emissions as part of its production or lifecycle. This likely outcome is also presented in other modelling exercises undertaken by various organizations (Air Transport Action Group, the European Union's Aviation Sector, the International Council on Clean Transportation, etc.), where despite very ambitious actions being taken, in-sector GHG emissions do not reach zero by 2050.

Fortunately, a key element of the net-zero emissions concept is that emissions do not need to reach zero for each discrete human activity and sector. For a sector to be net-zero, the GHG being released into the atmosphere must be balanced by reductions or removals from actions taken elsewhere. In this case, out-of-sector GHG emissions reductions are defined as emissions reductions or removals achieved outside of the boundaries of aerospace technology, aviation operations and sustainable aviation fuels. Out-of-sector emissions reductions must be achieved as a result of actions (e.g., investments or projects) that generate high quality offset credits, from GHG emission reduction or removal projects, such as biological sequestration and technology-based projects such direct air capture and sequestration. Given that the Action Plan forecast that 12Mt of emissions in offsets will be required by 2050, this imply that substantial investments in GHG emission reduction and removal projects will be required.

A portion of emissions from international flights will be compensated using eligible offset credits as part of ICAO's CORSIA. From a domestic perspective, more work needs to be done to explore how the federal, provincial or territorial offset systems, including Canada's GHG Offset Credit system can play a role in supporting GHG emissions reductions above and beyond what will be achievable with in-sector reductions.[15]

[15] With respect to airlines providing offset options to customers, it is important to recognize that these emission reductions are attributable to the individual and not necessarily to be claimed by the air carrier.

Canada's Net-Zero Challenge

In the summer of 2022, the Government of Canada launched the Net-Zero Challenge to encourage corporations (and industry associations) to make net-zero commitments. It is a voluntary initiative where participants are required to develop and implement credible and effective plans to transition their facilities and operations to net-zero emissions by 2050. At least two interim GHG emissions reduction targets must be set between now and 2050. Progress must be reported on annually, and plans must be updated every five years. High level information about plans and progress reports will be publicly disclosed. Offset credit purchases and retirements may be used as one of the mitigation actions taken.

The Government of Canada encourages corporations operating in Canada, including within the aviation sector to participate in the Net-Zero Challenge.

Canada's GHG Offset Credit System

The Canadian GHG Offset Credit System came into effect on June 8, 2022, enabling opportunities to undertake offset projects in sectors or activities not covered by carbon pollution pricing, that are not required by law and go beyond business-as-usual activities, and for which there is a published federal offset protocol. Information published on Canada.ca (Canada's Greenhouse Gas Offset Credit System – Canada.ca) outlines the credit system and the associated federal offset protocols. The Greenhouse Gas Offset Toolkit (Greenhouse gas offsets toolkit – Canada.ca) includes additional resources.

Planned Actions

- Explore an approach to put a price on carbon emissions from inter-provincial flights.
- Explore opportunities for technologies such as direct air capture to generate sufficient supply of credits to respond to the need for out-of-sector reductions.
- The Government of Canada will encourage companies within Canada's aviation sector to voluntarily participate in the Net-Zero Challenge.

8. INTERNATIONAL COORDINATION

The Paris Agreement set a temperature goal of holding the increase in the global average temperature to well below 2 degrees Celsius above pre-industrial era levels, and to pursue efforts to hold the increase to 1.5 degrees Celsius, by undertaking rapid emission reductions and reaching global carbon neutrality in the second half of this century. To that end, it requires each country to communicate national GHG targets every five years, representing an ambitious progression over time to meet the commitments in the Paris Agreement.

Emissions from international transportation fuels are not addressed in the Agreement because it is difficult to attribute responsibility for these emissions to an individual country's national target. A consistent approach is necessary to ensure a fair playing field and avoid a patchwork of approaches. Targets and measures for the international aviation sectors are negotiated at ICAO, which is best equipped to address the sector's transboundary nature.

ICAO's work on decarbonization focuses on a basket of measures including a combination of technological and operational improvements, the incorporation of SAF, and out-of-sector carbon offsetting. The offsetting program is called CORSIA and was agreed in 2016 to address residual emissions to deliver carbon-neutral growth of international aviation from 2020.

Canada has been an active participant at the ICAO Committee on Aviation Environmental Protection (CAEP), including being its first standing chair and currently being a co-lead of Working Group 4: CORSIA. Currently, Canada is active in discussions across CAEP, with significant efforts involved in the development of a LTAG.

CARBON OFFSETTING AND REDUCTION SCHEME FOR INTERNATIONAL AVIATION (CORSIA)

CORSIA is a way to manage emissions from the international aviation industry. It's one way that the International Civil Aviation Organization's (ICAO) member countries, including Canada, are working towards carbon neutral growth for international aviation from 2020 onwards. Canada implemented the scheme in Canada through regulatory amendments to the Canadian Aviation Regulations.

From the start of the scheme, and until 2027, these offsetting rules will only apply to routes between countries that are participating voluntarily. For a route to be included, both the arrival and departure countries must be participating in the scheme. Canada has volunteered to participate early on. As of January 1, 2022, there are 107 countries that have volunteered in CORSIA.

By 2027, most countries will have to participate in CORSIA, so these offsetting requirements will apply to most international routes. Starting in 2025, and then every 3 years, operators will have to offset their emissions above the CORSIA baseline for the most recent 3-year period.

Operators can also reduce their need to offset emissions by using CORSIA eligible fuels. The development and deployment of sustainable aviation fuels is one element of the ICAO basket of measures to reduce aviation emissions.

LONG TERM ASPIRATIONAL GOAL FOR INTERNATIONAL AVIATION (LTAG)

In its 40th Session (2019), the ICAO Assembly requested the ICAO Council to continue to explore the feasibility of LTAG, through conducting detailed studies assessing the attainability and impacts of any goals proposed, including the impact on growth as well as costs in all countries, especially developing countries, for the progress of the work to be presented to the 41st Session of the ICAO Assembly, in September 2022.

INTERNATIONAL AVIATION CLIMATE AMBITION COALITION

In November 2021 at the 26th Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change, Canada along with nearly 30 other countries, signed an International Aviation Climate Ambition Coalition declaration. This includes several commitments, such as:

- Working together, both through ICAO and other complementary cooperative initiatives, to advance ambitious actions to reduce aviation CO_2 emissions at a rate consistent with efforts to limit the global average temperature increase to 1.5 degrees Celsius.
- Supporting the adoption by ICAO of an ambitious long-term aspirational goal consistent with the above-referenced temperature limit, and in view of the industry's commitments towards net-zero CO_2 emissions by 2050.
- Work with international partners to ensuring the maximum effectiveness of CORSIA.
- Promoting the development and deployment, through international and national measures, of sustainable aviation fuels that reduce lifecycle emissions and contribute to the achievement of the UN Sustainable Development Goals (SDGs), in particular avoiding competition with food production for land use and water supply.
- Promoting the development and deployment, through international and national measures, of innovative new low- and zero-carbon aircraft technologies that can reduce aviation CO_2 emissions.
- Preparing up-to-date state action plans detailing ambitious and concrete national action to reduce aviation emissions and submitting these plans to ICAO well in advance of the 41st ICAO Assembly, where such plans have not already been updated in line with ICAO Assembly Resolution A40-18, paragraph 11.

COLLABORATION WITH THE U.S.

In February 2021, Canada's Minister of Transport, the Honourable Omar Alghabra, and the United States Transportation's Secretary, the Honourable Pete Buttigieg, issued a Joint Statement which included a commitment to work collaboratively on robust aviation standards that integrate climate protection and safety. Out of this collaboration, both countries, through their aviation action plans, have set a vision for achieving net-zero emissions by 2050.

Planned Actions

- The Government of Canada will continue to work with counterparts to advance goals and measures, in line with decisions made at the ICAO Assembly and the direction from the Council.
- The Government of Canada will also continue to support CORSIA, including ensuring its maximum effectiveness through working with other ICAO member states to implement and strengthen CORSIA. It is an important measure to address aviation emissions and Canada supports efforts to expand further participation in CORSIA.
- The Government of Canada to continue working with the U.S. on developing a work plan to implement the commitments within the Joint Statement.
- The Government of Canada to continue the process of submitting updated State Action Plans to ICAO at minimum on a three-year basis.

9. MEASURES TO REDUCE NON-AIRCRAFT EMISSIONS

Parties to the Action Plan recognize the importance of reducing emissions from the entire sector, not only those from aircraft. Airports in particular, are busy transport hubs where a variety of activities generate emissions. This includes all areas in and around the airport, from terminal heating and cooling to transit systems that bring people and goods to and from the airport to equipment and infrastructure used at the gate and across the airfield. Recognizing and accounting for these emissions is important and many Canadian airports are taking the necessary steps to better understand and address these emissions. For instance, many airports have already transitioned to electrical fleets, provided access to public transit options, and provided electrical charging stations for the public to support a transition to electric vehicles.

In June 2021, Airports Council International, representing airports worldwide, established a global goal for achieving net-zero carbon emissions by 2050, recognizing that specific actions and timelines will be developed by individual airports subject to specific conditions.

The Airport Carbon Accreditation program is the global standard for carbon management in the airport industry. The program helps airports implement best practices in carbon management, with the goal of becoming carbon neutral. It provides airports with a common framework for active carbon management with measurable goalposts. It is site-specific allowing flexibility to take account of national or local legal requirements. At the time this Action Plan was drafted there were 20 Canadian airports participating in the program[16].

Within this program, there are six levels of certification:

- **Mapping** – Determine emissions sources within the operational boundary of the airport. Calculate the annual carbon emissions. Compile a carbon footprint report.
- **Reduction** – Provide evidence of effective carbon management procedures. Show quantified emissions reductions.

[16] Participation in the ACA program is voluntary and is a step that a subset of Canadian airports has chosen to take to demonstrate their commitment to reducing emissions. However, it should be noted that many airports who are not participating in this program have also made strong commitments to reduce their emissions through their own independent environment programs/initiatives.

- **Optimization** – Widen the scope of carbon footprint to include third party emissions. Engage third parties at and around the airport.
- **Neutrality** – Offset remaining emissions for all emissions over which the airport has control with high quality carbon credits.
- **Transformation** – Define a long-term carbon management strategy oriented towards absolute emissions reductions, aligned with the objectives of the Paris Agreement. Demonstrate evidence of actively driving third parties towards delivering emissions reductions.
- **Transition** – Offset the residual carbon emissions over which the airport has control, using internationally recognized offsets.

Modal connectivity: a holistic approach towards decarbonizing Canada's transportation network

The transportation of people and goods strongly relies on modal interconnectivity. While airports connect cities and countries, people and goods need access to other modes of travel to move between airports and their destinations. Improving Canada's modal connectivity is crucial both to provide Canadians with options to address their travel needs and to ensure that less emitting modes are available for a portion of their trips.

Connecting airports to intercity rail is a particularly important component of a holistic approach towards decarbonizing Canada's transportation network. This connectivity will increase options for travellers, allowing greater optimization across the transportation network. For instance, this would allow travellers to substitute a short-haul flight or a car ride for an intercity rail trip connecting them to a long-haul flight. This would decrease emissions for the total trip, as well as increase the catchment area serviced by connected airports.

This connectivity becomes even more important in the context of VIA Rail's High Frequency Rail (HFR) project. HFR will transform passenger rail service in Canada through the creation of faster, more frequent, more reliable, and more sustainable rail service among the major centres of Québec City, Trois-Rivières, Montréal, Ottawa, Peterborough and Toronto. HFR is planned to serve stations in targeted locations for airport connectivity, including at Montreal-Trudeau International Airport and at Jean-Lesage International Airport in Quebec City. Travellers will be able to make use of HFR connections at these airports to easily and reliably combine air journeys with low-emitting rail trips. HFR could be operational in the early 2030s.

Ensuring that HFR is well-connected with the aviation network, will require close collaboration between cities and provincial and federal governments. Integrating with the aviation network will be an important step in continuing to provide Canada with an optimized transportation network while reducing GHG emissions.

Planned Actions

- Transport Canada will consult with airports that have not yet mapped their GHG emissions to better understand the challenges and opportunities to provide support.
- Airport authorities to support the adoption of electric charging infrastructure for electric equipment or refueling infrastructure for low-carbon equipment.
- Major airports (airports in the National Airport System) will be requested by the Government to develop a net-zero plan and report regularly on progress, consistent with the Government's Net-Zero Challenge.
- As mentioned in Section 5 of this Action Plan, Transport Canada and Environment and Climate Change Canada will work with airports, airlines and third-party equipment owners and operators to develop an inventory of ground support equipment and infrastructure to better understand the landscape and help determine an approach for supporting the adoption of electric/low-carbon equipment and green infrastructure.
- Also mentioned in Section 5 of this Action Plan, airlines and equipment owners will transition to an electric / low-carbon ground support equipment by replacing fossil fuel-based equipment, prioritizing equipment for which technology is readily available (baggage tractors) and exploring other types of low-emitting equipment as they become commercially available/ viable (pushback tractors, belt loaders, etc.)

10. NON-CO_2 IMPACTS OF AVIATION ON CLIMATE

Human effects on the global climate are not limited to emissions of well-mixed greenhouse gases such as CO_2 and methane. Emissions nitrogen oxides (NOx), sulfur oxides (SOx), particulate matter (PM) and water vapor have direct and indirect climate effects in addition to air quality impacts. Aviation activity, including aircraft contrails, induces changes in atmospheric composition. These changes include the anthropogenic modification of clouds, which can have a significant effect on the radiative balance of the atmosphere. Non-CO_2 emissions can have magnified regional and local effects on the climate compared with their global effects.

Lee et al. (2021)[17] found that approximately 66 percent of aviation's impact on the climate up to the year 2018 was from non-CO_2 climate impacts, and clouds formed from contrails (contrail cirrus) were responsible for 57 percent of the total climate effect of aviation. Large scientific uncertainties remain around these figures, but there is consensus that, through the physical process of radiative forcing, the effect is positive and significant.

Unlike CO_2, aircraft contrails and contrail cirrus are short-lived phenomena that last on timescales measured in hours. Contrails form in cold and humid areas of the upper troposphere and lower stratosphere (7 to 13 km) that are supersaturated with respect to ice. The areas that form persistent contrails, which then transform to enduring contrail cirrus, are of particular interest. Avoiding these areas by either bypassing them vertically or laterally could create large benefits for the climate, particularly at night when the warming effect of contrails is greater.

Several scientific papers on the subject of modifying flight paths to reduce the climate impact of aviation have been published in recent years (e.g., Matthes et al., 2021[18]). In some cases, even minor flight paths corrections such as flying a few thousand feet lower or higher can eliminate contrail formation. Canada has the opportunity to make a significant contribution in this field given that we have the second largest airspace in the world and that we have extensive expertise and capabilities in the areas of atmospheric modelling and meteorology within Environment and Climate Change Canada.

Further scientific study by the international scientific community is required to better understand the non-CO_2 climate effects and reduce the uncertainties.

[17] The contribution of global aviation to anthropogenic climate forcing for 2000 to 2018 - ScienceDirect

[18] Aerospace | Free Full-Text | Mitigation of Non-CO2 Aviation's Climate Impact by Changing Cruise Altitudes (mdpi.com)

Planned Actions

- Over the next 3 years, ECCC will develop an experimental meteorological tool for the identification and prediction of contrail forming zones in the atmosphere for Canadian airspace. The tool could enable alternative flight paths that avoid persistent contrail formation when fuel burn penalties are negligible, should the experimental tool prove to be accurate and reliable. The project will be carried out in partnership with Transport Canada and with the advice of the National Research Council.
- Environment and Climate Change Canada is working to develop modelling capability for aviation's non-CO_2 emissions and their effects on air quality and climate through the global air quality prediction model (GEM-MACH global). A comprehensive model assessment of the impact of aviation emissions on atmospheric composition and deposition will be carried out.
- Canada will continue to work collaboratively with international partners on the topic of non-CO_2 climate impacts at ICAO through the Impacts and Science Group.
- All partners will support and participate in scientific research as appropriate to better understand and quantify the impact of non-CO_2 terms such as PM, water vapor and contrails, on climate change to inform future mitigation measures as appropriate.

11. GOVERNANCE AND REPORTING

An Action Plan Working Group will be formed to oversee Canada's Aviation Climate Action Plan. Its members will include representatives from government, signatory organizations, and their members. The Working Group will:

- Develop, implement, and monitor the renewed Action Plan to accelerate the reduction of emissions from the Canadian aviation sector and put the sector on a path to achieving net-zero emissions by 2050.
- Establish a forum for regular information sharing and discussion of emerging domestic and international climate policies and initiatives and impacts for Canada's air sector.

The Action Plan Working Group will conduct a series of formal reviews of the Action Plan to assess progress and make updates, as needed. The reviews will occur in 2024, 2027, and 2030. Any adjustments made to the Action Plan will be submitted to ICAO as per ICAO's request.

- In the lead-up to each review, the federal government will engage and solicit stakeholders and the public's input to support the review process.

Regular public reporting is a fundamental component of this Action Plan. Similar to the previous plan, annual reports will be developed by the Action Plan Working Group and published on Transport Canada's website. They will summarize the collective actions taken to address aviation emissions and show the year-to-year emission profile and performance of the sector. Fuel efficiency will continue to be publicly reported as part of the implementation of the new Action Plan.

As required by the *Canadian Net-Zero Emissions Accountability Act*, in 2023, 2025, and 2027, the Government of Canada will publish progress reports for the 2030 ERP. These reports will provide an update on commitments in the 2030 ERP, including the commitment to develop a whole-of-government approach on the long-term decarbonization of aviation. The development of this commitment will be informed by ongoing engagement with the Action Plan Working Group and additional engagement with Canadians on this renewed Action Plan.

12. ANNEXES

SUMMARY OF PLANNED ACTIONS

Development and Adoption of New Green Aerospace Technology – Planned Actions:

- ISED, through the SIF, will continue to support innovation in the aerospace sector to accelerate the sector's green transformation to preserve its global leadership and competitiveness.
- NRC, through LEAP, will continue to support the development of fast, market-ready, sustainable solutions while also de-risking potential high-impact technologies.
- NRC will also complete an ongoing facility renewal strategy to identify key required enhancements and realignments to NRC's existing world-class clean energy and aviation research infrastructure to better support joint technology development in the aviation sector and key supply chains.
- Transport Canada will work with the NRC to support the development of the required standards and test methodologies for certification of new low-emission aircraft technologies.
- Transport Canada will continue to support the certification and regulatory approvals of new aircraft technologies.
- Transport Canada will continue to help fund a variety of projects that help reduce air pollutants and GHG emissions in the aviation through the Clean Transportation System – Research and Development (CTS-RD) Program.
- Airlines will continue to pursue fleet renewal programs that reduce and retire older aircraft and introduce newer and more efficient aircraft.
- Airlines will also explore options to adopt advanced aircraft technologies when and where feasible, particularly for short-haul routes with smaller aircraft.
- Industry action plan members will invest in future training programs that incorporate the usage of electric aircraft.

Improved Operations – Planned Actions:

- Transport Canada and Environment and Climate Change Canada will work with airports, airlines and third-party equipment owners and operators on an approach for supporting the adoption of electric/low-carbon ground support equipment and green infrastructure, and to develop an inventory of ground support equipment and infrastructure to better understand the landscape.
- Transport Canada will work with and support NAV CANADA as they determine the optimum airspace design for the Canadian domestic airspace.
- Canadian air carriers will collaborate with Transport Canada and NAV CANADA to implement airspace redesign initiatives.
- The Government of Canada will continue to pursue adoption of international best practices, conducive to emissions reductions.
- Canadian air carriers will accelerate the implementation of industry best practices with respect to operational efficiencies from aircraft operations on the ground and in the air.
- NAV CANADA will implement Trajectory-Based Operations (TBO) to enhance system efficiencies, mitigate delays and enable aircraft to fly preferred routes, leading to the use of less fuel.
- NAV CANADA will design and implement Required Navigation Performance – Authorization Required (RNP AR) approaches, which provide opportunities to adequately equipped aircraft to fly continuous descent approach profiles and reduced track-milage, reducing fuel burn and GHG emissions. NAV CANADA will also implement Established on RNP AR (EoR) at major airports with parallel runway operations.
- NAV CANADA will explore collaborating with the Department of National Defence in identifying opportunities for Flexible Use Airspace, which will allow aircraft to fly preferred routes.
- Parties will explore alternatives to improve the efficiency of ground aircraft movement.

Sustainable Aviation Fuels – Planned Actions:

- ***Aspirational target:*** *This plan sets an aspirational goal of 10 percent SAF use by the year 2030, with a view to sending a clear signal that Canada and the aviation sector recognize the need for significant volumes of sustainable low-carbon fuel to achieve its vision of net-zero by 2050.*
- Parties of the Action Plan to collaborate with the Canadian Council for SAF (C-SAF) and others in developing a Canadian roadmap for SAF.
- Natural Resources Canada to explore SAF as part of developing a BioEnergy Strategy to ensure Canada maximizes its bioenergy potential to reduce emissions while growing the economy.
- The Government of Canada will explore how federal measures may be leveraged to create a policy environment to enable and accelerate SAF uptake in Canada.
  - It will pursue having the *Draft Regulations Amending the Fuel Charge Regulations* made to provide relief from the federal fuel charge for bio-aviation fuel blended into aviation gasoline or aviation turbo fuel.
  - As previously indicated, it will explore a consistent national approach including the challenges and opportunities to pricing emissions from inter-provincial aviation.
- The Government of Canada will support SAF related initiatives through existing programs and will purchase SAF for its federal fleet through the upcoming Low-carbon Fuel Procurement Program.
- Transport Canada to continue collaborating with the U.S. Department of Transportation on commitments under the Joint Statement on the Nexus between Transportation and Climate Change.
  - Canada to continue supporting aviation research with U.S. partners, including the ASCENT (Aviation Sustainability Center / Centre of Excellence for Alternative Jet Fuels and Environment).
- Canadian air carriers will signal demand with offtake agreements as appropriate and financially sound.

Out of Sector Reductions – Planned Actions:

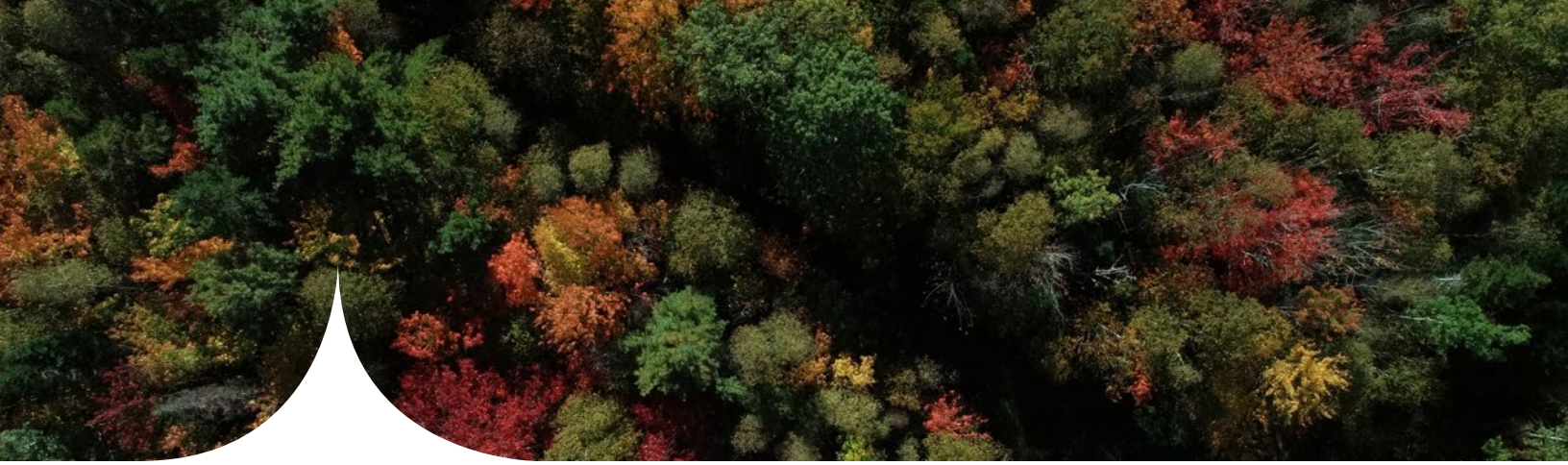
- Explore an approach to put a price on carbon emissions from inter-provincial flights.
- Explore opportunities for technologies such as direct air capture to generate sufficient supply of credits to respond to the need for out-of-sector reductions.
- The Government of Canada will encourage companies within Canada's aviation sector to voluntarily participate in the Net-Zero Challenge.

Measures to Reduce Non-aircraft Emissions – Planned Actions:

- Transport Canada will consult with airports that have not yet mapped their GHG emissions to better understand the challenges and opportunities to provide support.
- Airport authorities to support the adoption of electric charging infrastructure for electric equipment or refueling infrastructure for low-carbon equipment.
- Major airports (airports in the National Airport System) will be requested by the Government to develop a net-zero plan and report regularly on progress, consistent with the Government's Net-Zero Challenge.
- As mentioned in Section 5 of this Action Plan, Transport Canada and Environment and Climate Change Canada will work with airports, airlines and third-party equipment owners and operators to develop an inventory of ground support equipment and infrastructure to better understand the landscape and help determine an approach for supporting the adoption of electric/low-carbon equipment and green infrastructure.
- Also mentioned in Section 5 of this Action Plan, airlines and equipment owners will transition to an electric / low-carbon ground support equipment by replacing fossil fuel-based equipment, prioritizing equipment for which technology is readily available (baggage tractors) and exploring other types of low-emitting equipment as they become commercially available/ viable (pushback tractors, belt loaders, etc.)

Non-CO_2 Impacts of Aviation on Climate – Planned Actions:

- Over the next 3 years, ECCC will develop an experimental meteorological tool for the identification and prediction of contrail forming zones in the atmosphere for Canadian airspace. The tool could enable alternative flight paths that avoid persistent contrail formation when fuel burn penalties are negligible, should the experimental tool prove to be accurate and reliable. The project will be carried out in partnership with Transport Canada and with the advice of the National Research Council.
- Environment and Climate Change Canada is working to develop modelling capability for aviation's non-CO_2 emissions and their effects on air quality and climate through the global air quality prediction model (GEM-MACH global). A comprehensive model assessment of the impact of aviation emissions on atmospheric composition and deposition will be carried out.
- Canada will continue to work collaboratively with international partners on the topic of non-CO_2 climate impacts at ICAO through the Impacts and Science Group.
- All partners will support and participate in scientific research as appropriate to better understand and quantify the impact of non-CO_2 terms such as PM, water vapor and contrails, on climate change to inform future mitigation measures as appropriate.



LIST OF ABBREVIATIONS

ACIP	Airport Critical Infrastructure Program
APU	Auxiliary power units
ATAG	Air Transport Action Group
ATM	Air Traffic Management
CFR	*Clean Fuel Regulations*
CH_4	Methane
CO_2	Carbon dioxide
CO_2E	Carbon dioxide equivalent
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CTS-RD	Clean Transportation System – Research and Development Program
EPD	Environmental Product Declaration
ERP	Emissions Reduction Plan
GHG	Greenhouse gas
ICAO	International Civil Aviation Organization
IPPC	Intergovernmental Panel on Climate Change
ISED	Innovation, Science and Economic Development Canada
LCA	Life cycle assessment
LEAP	Low Emission Aviation Program
LFP	Low-carbon Fuel Procurement Program
LTAG	Long-Term Aspirational Goal
MRO	Maintenance, repair and overhaul
Mt	Megatons
N_2O	Nitrous Oxide
NDC	Nationally Determined Contribution
NRC	National Research Council
OEM	Original Equipment Manufacturers
PCF	Pan-Canadian Framework on Clean Growth and Climate Change
R&D	Research and development
RDA	Regional Development Agencies
RNP AR	Required Navigation Performance – Authorization Required
SAF	Sustainable Aviation Fuel
SCP	Strengthened Climate Plan
SIF	Strategic Innovation Fund
SME	Small and medium-sized enterprises
TBO	Trajectory-Based Operations

CANADA.CA