CANADA'S ACTION PLAN

to Reduce Greenhouse Gas Emissions from Aviation

2015 ANNUAL REPORT

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EXECUTIVE SUMMARY

This is the fourth Annual Report under Canada's Action Plan to Reduce Greenhouse Gas Emissions from Aviation (the Action Plan).

In 2015, good progress was made on the implementation of the Action Plan, including a number of noteworthy achievements related to fleet renewal, improved air traffic management (ATM), international coordination and research and development. Canadian air carriers have collected the necessary data to track fuel efficiency improvements achieved in 2015. As a result of a review undertaken in 2015, parties of the Action Plan agreed to evaluate progress against the Air Transport Action Group's target to improve fuel efficiency by 1.5 percent per year until 2020 from a 2008 baseline of 39.47 litres per 100 Revenue Tonne-Kilometres (RTK). The results show that Canadian air carriers continue to improve their annual fuel efficiency. The combined fuel consumption rate in 2015 was 35.46 litres per 100 RTK. The fuel consumption rate for international activity was 32.79 litres per 100 RTK, and for domestic activity was 42.17 litres per 100 RTK. Compared with 2014, Canadian air carriers improved fuel efficiency by 0.8 percent, which represents a 1.52 percent average annual improvement, from a 2008 baseline or a cumulative improvement of 10.1 percent from 2008 to 2015.

Section 5.0 of the Action Plan identifies measures that are expected to have the greatest impact on greenhouse gas emissions: fleet renewals and upgrades; more efficient air operations; and improved capabilities in ATM. This Annual Report highlights the advances made on all three fronts in 2015, including Canadian air carriers replacing older aircraft with more efficient aircraft and Canada making greater use of improved air traffic management technologies, including performance-based navigation and advanced surveillance technologies.

Section 6.0 of the Action Plan highlights progress on a second set of measures that the Canadian aviation industry expects to produce beneficial environmental results in the future. These measures include: aviation environmental research and development; alternative fuels; airport ground operations and infrastructure use; regulatory measures; and international coordination.

Finally, this Annual Report provides a preview of some important 2016 milestones, including: the installation of preconditioned air and ground power units at the 6 new boarding gates at the Montreal-Pierre Elliott Trudeau International Airport; the finalizing of two new emissions standards at ICAO; the WestJet and Clean Energy Technology Centre initiative to accelerate the development of sustainable aviation biofuel in Western Canada; Air Canada's participation in Canada's Biojet Supply Chain Initiative to introduce 400,000 litres of sustainable aviation biofuel into a shared fuel system at the Montreal- Pierre Elliott Trudeau International Airport; highlights of fleet renewal plans; and, the international agreement that was reached at the 39th ICAO Assembly on a global market-based measure for international aviation.

BACKGROUND

On June 4, 2012, the Government of Canada and the Canadian aviation industry released *Canada's Action Plan to Reduce Greenhouse Gas Emissions from Aviation* (the Action Plan) and submitted it to the International Civil Aviation Organization (ICAO). Developed by a joint industry-government Working Group on Aviation Emissions, the Action Plan:

- Builds on the success of previous collaborations between the Government of Canada and Canada's aviation stakeholders. This includes the world's first voluntary agreement to reduce greenhouse gas emissions from aviation, which was signed in 2005 between Transport Canada and the Air Transport Association of Canada on behalf of its member carriers.

- Commits to annual reporting to summarize and track progress towards meeting the fuel efficiency goal and other Action Plan activities. This is the fourth Annual Report published under the Action Plan.

- Describes ongoing and planned activities to address greenhouse gas emissions from Canada's domestic and international aviation activities. These measures could contribute to reductions in Canada's domestic emissions and ICAO's global aspirational goals.

The Working Group on Aviation Emissions committed to review the Action Plan and its associated activities in 2015 in accordance with section 7.3. This review was undertaken in alignment with the ICAO's guidance that States review and, if necessary, update their Action Plans every three years. As a result of the review, the parties of the Action Plan agreed to evaluate progress against the Air Transport Action Group[1] (ATAG)'s target to improve fuel efficiency by 1.5 percent per year until 2020 from a 2008 baseline of 39.47 litres of fuel per 100 Revenue Tonne-Kilometres (RTK). Canada will also continue to pursue and report against the 2012 aspirational goal to improve fuel efficiency of Canada's air carriers by 2 percent per year until 2020, from a 2005 baseline of 40.43 litres of fuel per 100 RTK.

The Action Plan identifies measures that are expected to have the greatest impact in reducing greenhouse gas emissions:

- Fleet Renewals and Upgrades;

- More Efficient Air Operations;

- Improved Capabilities in Air Traffic Management;

- Aviation Environmental Research and Development;

- Alternative Fuels;

- Airport Ground Operations and Infrastructure Use;

- Regulatory Measures; and,

- International Coordination.

1 The Air Transport Action Group is an independent coalition that represents all sectors of the air transport industry, working to promote aviation's sustainable growth.

Highlights for 2015

Canada has made good progress on the implementation of the Action Plan. Working Group members took advantage of opportunities to advance collaboratively a number of Action Plan measures. Several milestones were reached in 2015, including the following noteworthy achievements:

Fleet Renewals and Upgrades

Canadian airlines continued to upgrade their overall fleet operating efficiencies by replacing older generation aircraft with new and more efficient aircraft and engine types. These fleet changes have a positive impact on operating efficiency for both all-passenger and all-cargo type operations.

Air Traffic Management

The Minister of Transport endorsed the Canadian Performance-Based Navigation (PBN) State Plan and presented it to the International Civil Aviation Organization (ICAO) in December 2015. The State Plan will assist the Canadian aviation community in both the transition to PBN and in planning future transition and investment strategies. Aircraft and aerodrome owners and operators can use this plan to forecast future equipage and additional navigation capability investments.

International Coordination

Canada has continued its active engagement at ICAO, including on work to develop a market-based measure, technical standards for carbon dioxide (CO_2) and non-volatile particulate matter (nvPM) and on work related to alternative fuels.

Research and Development

A number of advances were made with respect to aviation environmental research and development. These include: four Green Aviation Research & Development Network (GARDN) projects focusing on bio-derived jet fuel applications for Canada; the completion of a Transport Canada-funded two-year research project on a biofuel supply chain in Canada; the National Research Council of Canada's critical safety and emissions tests on aviation alternative fuels; and research under the Aviation Sustainability Center (ASCENT) National Jet Fuel Combustion Program to support the accelerated approval of new alternative jet fuels.

Airport Carbon Accreditation:

The Airport Carbon Accreditation (ACA) recognizes airport efforts to manage and reduce their CO_2 emissions through independent assessment and verification. ACA is an independent program administered by an international consultancy (WSP | Parsons Brinckerhoff) appointed by Airports Council International (ACI) to enforce the accreditation criteria for airports annually. There are 4 levels of certification: I) mapping – footprint measurement; II) reduction – carbon management towards a reduced carbon footprint; III) optimization – third party engagement in carbon footprint reduction; and, IV) neutrality – carbon neutrality for direct emissions by offsetting. The Airport Carbon and Emission Reporting Tool (ACERT), developed by Transport Canada in partnership with the Canadian Airports Council, can be used to develop GHG emission inventories that are required to become part of the ACA program. Canada continues to work with ACI World to improve the ACERT with the recent release of version 3.0 of the tool.

Prior to the global launch of the ACA, a number of Canadians airports were proactively establishing GHG reductions goals and policies through their Environmental Management Systems (EMS), which are certified to the ISO 14001 standard. For example, the Toronto Pearson International Airport created its GHG policy of reducing emissions by 20 percent by 2020 under its EMS in 2009. These early efforts have facilitated ACI accreditation for some Canadian airports.

Canadian airports that have achieved accreditation include: Toronto Pearson International Airport, Montreal-Pierre Elliott Trudeau International Airport, Greater Moncton International Airport, Victoria Airport, and Winnipeg Airport.

The Greater Moncton International Airport, Victoria Airport and Winnipeg Airport have all achieved Level I ACA.

Toronto Pearson International Airport and Montreal-Pierre Elliott Trudeau International Airport have achieved Level II ACA. Toronto Pearson International Airport has a 20-2020 Program which targets a reduction of 20 percent by 2020 from a 2006 baseline, with further reductions to be achieved in 2033 and 2050. Montreal Elliott Trudeau International Airport has achieved ISO 14001 certification and has developed specific objectives relating to GHG emissions reduction (e.g. a 5 percent reduction in GHG emissions by 2020 from a 2013 baseline).

Participation in the ACA program is voluntary and is a step that a subset of Canadian airports have chosen to take to demonstrate their commitment to reducing emissions. However, it should be noted that a number of airports who are not participating in this program have also made strong commitments to reducing emissions through their environment programs.

Results for 2015

The Air Transport Association of Canada (ATAC) and the National Airlines Council of Canada (NACC) have collected the data required to report on the fuel efficiency improvements achieved in 2015.[2] Although progress towards the Action Plan's target is measured in terms of litres of fuel used per Revenue Tonne-Kilometre (RTK), the air operator associations have provided additional data (see Appendix A: Glossary of Key Terms and Acronyms for definitions) to calculate the industry's main activity measures. Other key aviation activity measurements include:

- Revenue Passenger-Kilometres (RPK);
- Passenger Revenue Tonne-Kilometres (Passenger RTK);
- Cargo Revenue Tonne-Kilometres (Cargo RTK); and,
- Total Revenue Tonne-Kilometres (Total RTK).

Table 1 illustrates the combined results for ATAC and NACC air carriers for calendar years 2005 to 2015. It shows trends in fuel consumption and its conversion to greenhouse gas emissions, expressed in carbon dioxide equivalent (CO_2e); as well as ratios of litres of fuel and grams of CO_2e per RPK and total RTK.

Table 1 also shows the following results from the reporting carriers in 2015 (in slightly rounded figures):

- The combined fuel consumption rate was 35.45 litres per 100 RTK, which is an average annual improvement between 2008 and 2015 of 1.52 percent.
- Revenue service was 19.80 billion RTK (17.57 billion passenger RTK and 2.24 billion cargo RTK)

2 It should be noted that the number of air carriers that provide data under the Action Plan could change from year to year. As a result, the statistics presented in this report may not be entirely comparable with those in other years.

TABLE 1 Annual Results of Domestic and International Operations, 2005-2015

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Fuel use (million litres)	4,887	5,186	5,543	5,575	5,098	5,659	6,089	6,256	6,314	6,579	7,023
Greenhouse gas emissions (megatonnes of CO_2e)	12.619	13.390	14.312	14.396	13.164	14.611	15.721	16.153	16.303	16.987	18.132
Traffic (billions)											
Revenue passenger-kilometres (RPK)	105.22	112.98	124.15	125.55	117.62	128.77	141.27	148.74	150.92	161.62	175.66
Passenger revenue-tonne-kilometres (pass. RTK) *	10.52	11.30	12.42	12.55	11.76	12.88	14.13	14.87	15.09	16.16	17.57
Cargo revenue-tonne-kilometres (cargo RTK)	1.57	1.53	1.82	1.57	1.38	2.01	1.98	1.96	2.05	2.25	2.24
Total revenue-tonne-kilometres (RTK)	12.09	12.83	14.23	14.13	13.14	14.88	16.11	16.83	17.14	18.41	19.80
Fuel consumption rates											
Litres/RPK	0.0464	0.0459	0.0446	0.0444	0.0433	0.0439	0.0431	0.0421	0.0418	0.0407	0.0400
Litres/Total RTK	0.4043	0.4043	0.3895	0.3947	0.3879	0.3802	0.3780	0.3716	0.3683	0.3574	0.3546
Emission rates:											
CO_2e grams/RPK	119.93	118.52	115.28	114.66	111.92	113.47	111.28	108.59	108.03	105.11	103.22
CO_2e grams/Total RTK	1,044	1,044	1,006	1,019	1,002	982	976	960	951	923	916

* Note that Passenger RTK are calculated by multiplying RPK by 100 kg (or 0.1 tonnes), which is the industry's conventional assumption of the average weight per passenger, including baggage.

** The CO_2 emission factor and global warming potentials for CH4 and N2O were updated in 2013. These changes are documented in Environment Canada's National Inventory Report 1990-2014. All GHG emissions included in this report have been calculated based on these updated factors and potentials.

See Appendix D: Additional Figures Illustrating Key Trends for Figures 5, 6, 7, 8, 9, 11, 14 and 15 that illustrate trends presented in Table 1.

Canadian air carriers report aviation activity data for both domestic and international activities. International activities include flight segments that begin or end outside of Canada, whereas domestic activity includes flight segments within Canada.

Table 2 provides data on international versus domestic aviation activity for 2015.

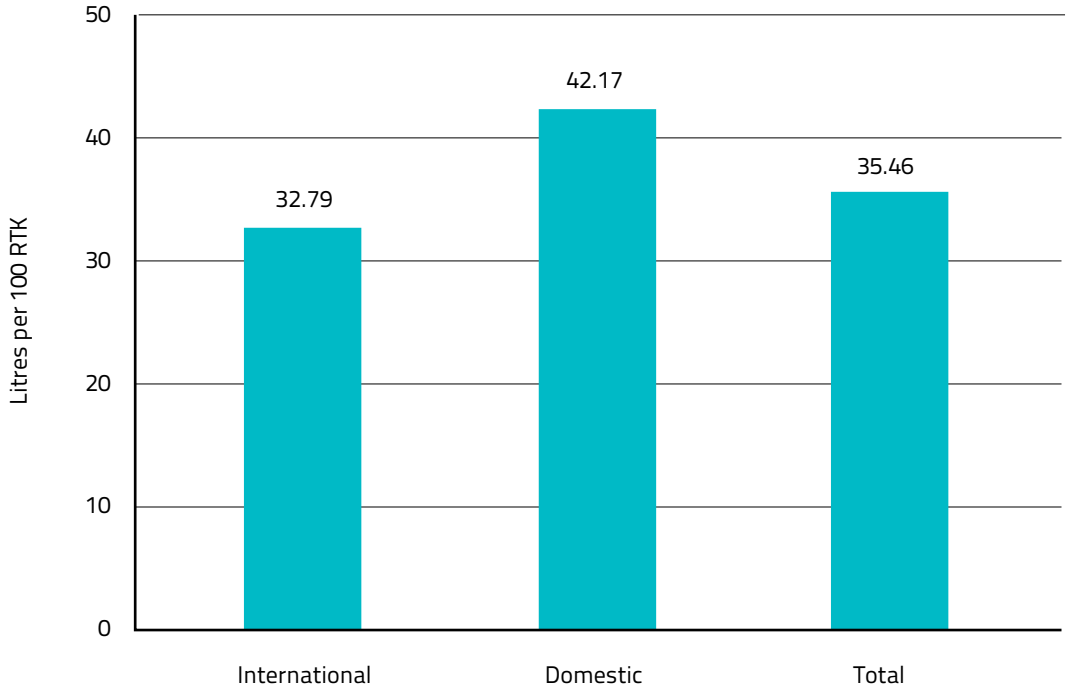
- Separately, the fuel consumption rate for international activity was 32.79 litres per 100 RTK, and 42.17 litres per 100 RTK for domestic activity. (Also illustrated in Figure 1).
- Total fuel consumed amounted to 7.02 billion litres (66.1 percent for international activity and 33.9 percent for domestic activity).
- Total greenhouse gas emissions amounted to an estimated 18.13 megatonnes (Mt) (11.98 Mt for international activity and 6.15 Mt for domestic).

TABLE 2 International vs. Domestic Aviation Activity, 2015

	International	Domestic	Total
Fuel use (million litres)	4,640	2,383	7,023
Greenhouse gas emissions (mega-tonnes CO_2e)	11.98	6.15	18.13
Traffic (billions)			
Revenue passenger-kilometres (RPK)	124.6	51.1	175.7
Passenger revenue-tonne-kilometres (pass. RTK)	12.5	5.1	17.6
Cargo revenue-tonne-kilometres (cargo RTK)	1.7	0.5	2.2
Total revenue-tonne-kilometres (RTK)	14.2	5.7	19.8
Fuel consumption rates			
Litres/Total RTK	0.3279	0.4217	0.3546
Emission rates:			
CO_2e grams/Total RTK	847	1,089	916

See Appendix D: Additional Figures Illustrating Key Trends for Figures 4, 9, 12 and 13 that illustrate trends presented in Table 2.

FIGURE 1 Fuel Consumption Rates – International and Domestic, 2015



Following the 2015 review of Canada's Action Plan, Canada will benchmark progress (measured by ratio of fuel consumption to total traffic – litres/total RTK) against ATAG's target of 1.5 percent annual improvement in fuel efficiency to 2020 against a 2008 baseline.

Table 3 shows progress in improving fuel efficiency, illustrating the change in the measures and rates between 2014 and 2015, and between 2008 and 2015. Fuel efficiency in 2015 improved by 0.8 percent over 2014, and the cumulative improvement between 2008 and 2015 was 10.1 percent, or an annual average of 1.52 percent.

TABLE 3 Absolute and Proportional Changes Over Time, 2008-2015

	Change 2014-2015		Change 2008-2015		
	Absolute	Proportional	Absolute	Proportional	Annual rate
Fuel use (million litres)	444	6.7%	1,447	26.0%	3.4%
Greenhouse gas emissions (megatonnes of CO_2e)	1.15	6.7%	3.7	26.0%	3.4%
Traffic (billions)					
Revenue passenger-kilometres (RPK)	14.0	8.7%	50.1	39.9%	4.9%
Passenger revenue-tonne-kilometres (pass. RTK)	1.4	8.7%	5.0	39.9%	4.9%
Cargo revenue-tonne-kilometres (cargo RTK)	0.0	-0.5%	0.7	42.3%	5.2%
Total revenue-tonne-kilometres (RTK)	1.4	7.6%	5.7	40.2%	4.9%
Fuel consumption rates					
Litres/RPK	-0.001	-1.8%	-0.0044	-10.0%	-1.49%
Litres/Total RTK	-0.003	-0.8%	-0.0400	-10.1%	-1.52%
Emission rates					
CO_2e grams/RPK	-1.9	-1.8%	-11.4	-10.0%	-1.49%
CO_2e grams/Total RTK	-7.1	-0.8%	-103.4	-10.1%	-1.52%

Canadian PBN State Plan

The Canadian Performance Based Navigation (PBN) State Plan was prepared by the Canadian Performance-based Aviation Action Team (CPAAT) in 2015 and includes vision for performance-based communication, navigation, surveillance and Air Traffic Management.

Through this plan, Canada has committed to supporting the ICAO PBN Initiative and the need for harmonized operations globally and within North America. Global harmonization of navigation specifications will improve the safety of enroute, terminal and approach operations; improve operational efficiency by reducing track miles flown; reduce infrastructure costs; increase airspace capacity; and, reduce the environmental impact through reduced emissions and potential to reduce exposure to noise.

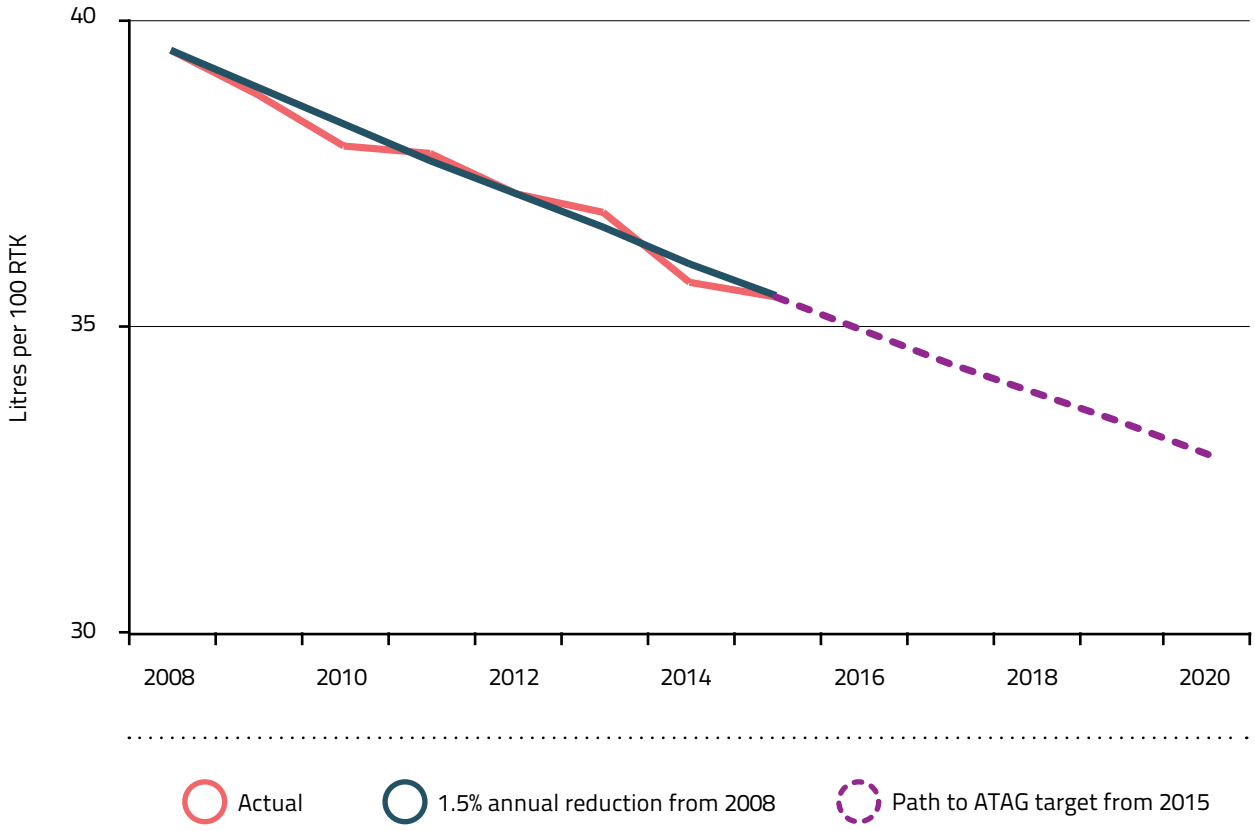
CPAAT will facilitate Performance-based Operations in Canada with the aim is to meet the short, medium and long-term goals as defined in NAV CANADA's PBN Operations Plan; Air Navigation System Plan (ANS Plan); and Operations Business Plan.

The figures presented in Tables 1, 2 and 3 allow for the following summary of trends:

- In 2015, reported RPK rose by 8.7 percent (partially attributed to additional carriers reporting). Between 2008 and 2015, RPK grew by 39.9 percent.
- While changes in NACC and ATAC carrier reporting make it difficult to compare reported trends in cargo, the figures suggest there was an increase in total RTK of 7.6 percent from 2014 to 2015, and an increase of 40.2 percent between 2008 and 2015.
- A total of 7.02 billion litres of fuel was used in 2015, 6.7 percent greater than in 2014.
- While fuel efficiency improved, greenhouse gas emissions from 2014 to 2015 also increased by 6.7 percent, to 18.13 Mt of CO_2e due to increased traffic.
- Greenhouse gas emissions per RTK improved by the same proportions as the fuel consumption rates (in litres per RTK) in 2015 compared to 2014 and 2008 (0.8 percent and 10.1 percent, respectively).

Figure 2 plots the target trajectory from 2008 to 2020 of reductions of 1.5 percent annual improvement in fuel efficiency and the progress made between 2008 and 2015. It adds an indicative trajectory that would be required to meet the 2020 ATAG target, given the actual 2015 results. Canadian carriers expect to achieve greater emissions reduction as they take delivery of new, more efficient aircraft closer to 2020.

FIGURE 2 Progress towards ATAG Target, 2008 – 2020



2015 Review of Canada's Action Plan

In line with ICAO guidance, Canada's Action Plan committed to a review pursuant to section 7.3 (Review) of the Action Plan and its associated activities which states that "the Working Group will conduct a review of the Action Plan in three years to assess progress towards environmental goals and commitments, and update the Action Plan". This review was completed in 2015 and was included as an appendix to the 2014 Annual Report.

The review found that Canada has made good progress towards implementing the Action Plan. It also identified a number of challenges in reaching the 2 percent set out in 2012 goal including:

- early action by the industry having resulted in significant gains leading to fewer opportunities for efficiency improvements;
- Committee on Aviation Environmental Protection (CAEP) research on the aviation sector's mitigation potential indicating that, under the most ambitious scenarios, annual average efficiency improvements of 1.4 percent to 2050 could be achievable;
- estimating efficiency gains from any one measure in isolation from other measures could be difficult and misleading, with experience having demonstrated that it is not possible to accurately apportion fuel efficiency gains to any one measure, as they are interconnected initiatives working together.

Despite these challenges, Canada's continuing commitment is to strive towards the 2 percent goal as an aspirational target, as it inspires future work and innovation in the aviation sector. At the same time, Canada also recognizes the Air Transport Action Group (ATAG) target of 1.5 percent to 2020 set in 2009 as an ambitious industry-accepted goal. Beginning with the 2015 Annual Report, Canada's progress will be benchmarked against both the 2 percent aspirational goal and the 1.5 percent target set by ATAG.

FIGURE 3 Impact of Fuel Consumption Improvements since 2008 on Greenhouse Gas Emissions

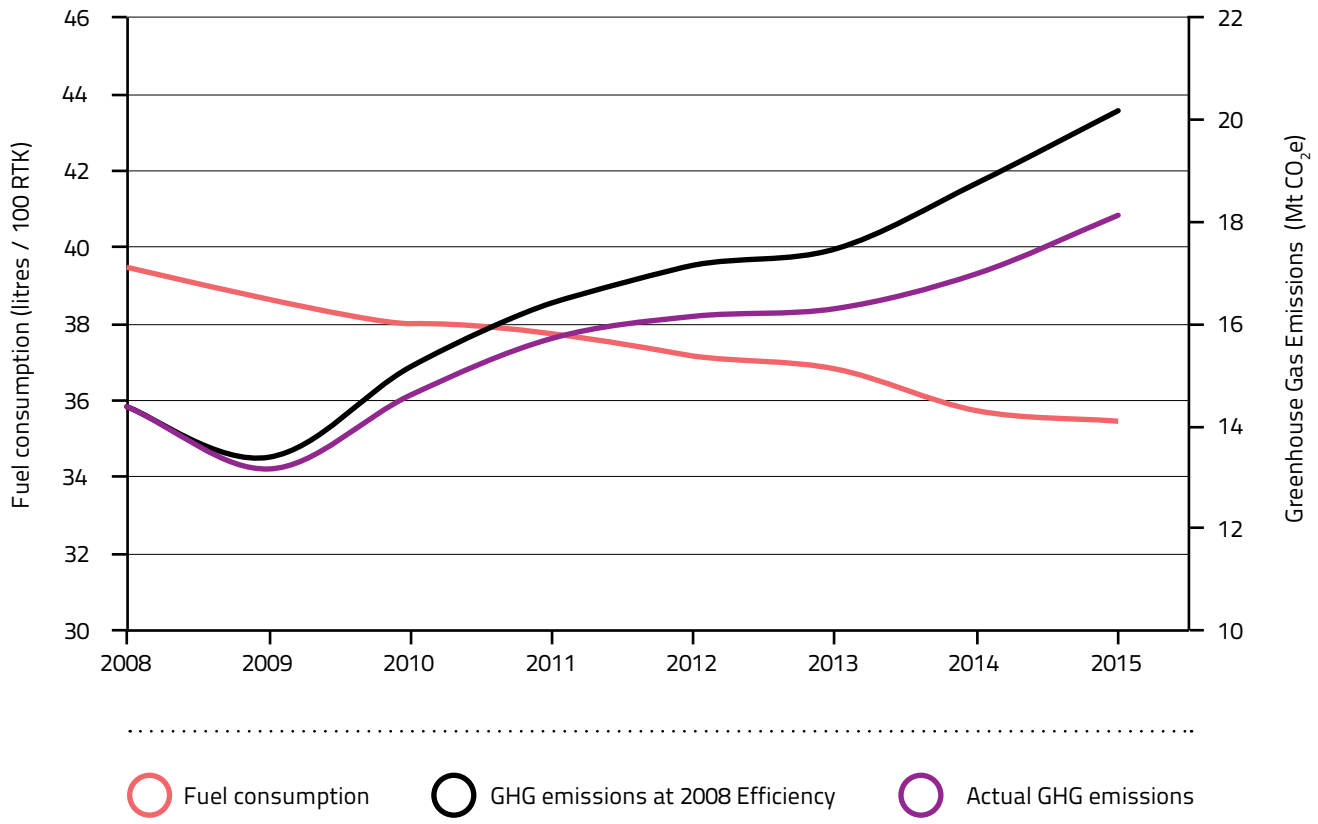


Figure 3 provides an illustration of the importance of fuel consumption improvements to reducing greenhouse gas emissions. Between 2008 and 2015, if fuel consumption had remained at 2008 levels of 39.47 litres of fuel per 100 RTK, total greenhouse gas emissions in 2015 would have reached 20.18 Mt at the 2008 rate. Actual 2015 emissions were 10.1 percent lower, at 18.13 Mt with fuel consumption improvements.

Measuring progress towards Canada's 2 percent aspirational goal

Table 4 provides the combined ATAC and NACC results for measuring progress towards the Action Plan's annual improvement in fuel efficiency goals between 2005 and 2015.

TABLE 4 Absolute and Proportional Changes Over Time, 2005-2015

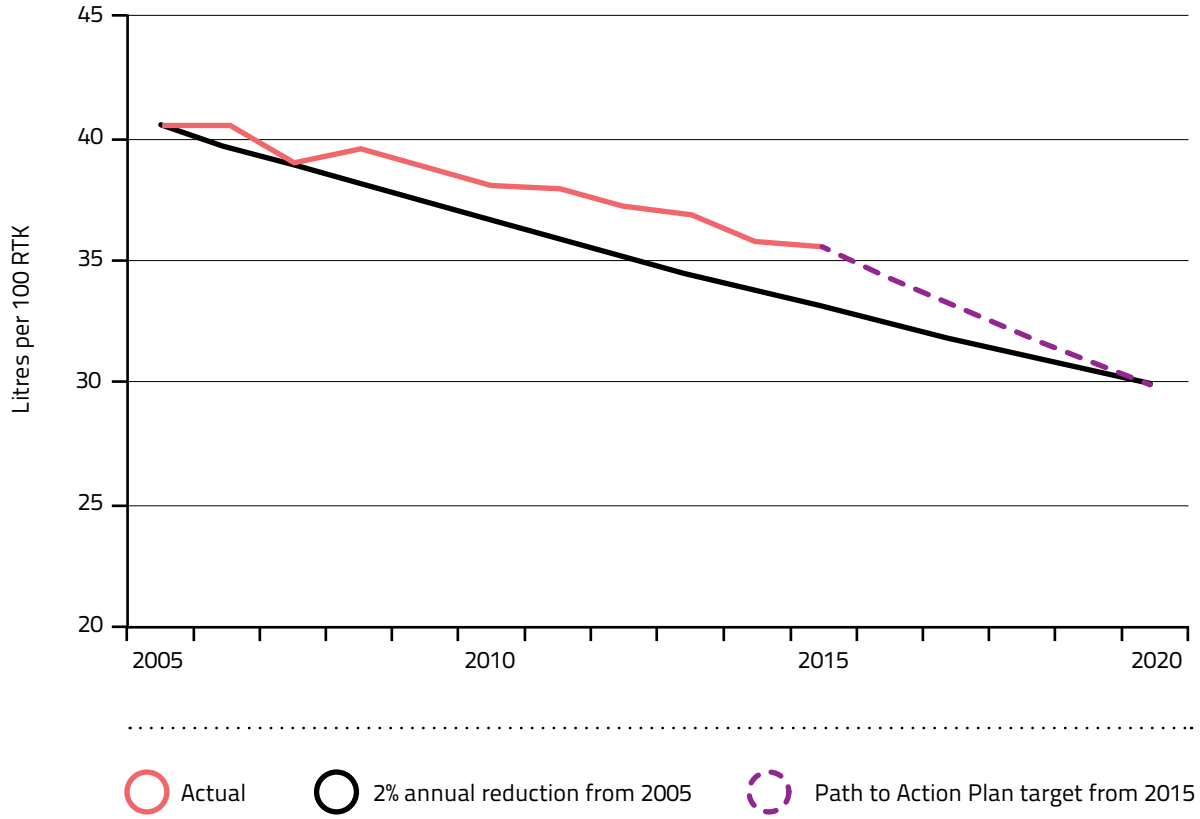
	Change 2005-2015		
	Absolute	**Proportional**	**Annual rate**
Fuel use (million litres)	2,135	43.7%	3.7%
Greenhouse gas emissions (megatonnes of CO_2e)	5.51	43.7%	3.7%
Traffic (billions)			
Revenue passenger-kilometres (RPK)	70.4	66.9%	5.3%
Passenger revenue-tonne-kilometres (pass. RTK)	7.0	66.9%	5.3%
Cargo revenue-tonne-kilometres (cargo RTK)	0.7	42.7%	3.6%
Total revenue-tonne-kilometres (RTK)	7.7	63.8%	5.1%
Fuel consumption rates			
Litres/RPK	-0.006	-13.9%	-1.5%
Litres/Total RTK	-0.050	-12.3%	-1.3%
Emission rates			
CO_2e grams/RPK	-16.7	-13.9%	-1.5%
CO_2e grams/Total RTK	-128.2	-12.3%	-1.3%

The figures presented in Table 4 allow for the following summary of trends between 2005 and 2015:

- Fuel consumption and greenhouse gas emissions rose by 43.7 percent, an average of 3.7 percent per year;
- RPK grew by 69.9 percent;
- Total reported RTK increased by 63.8 percent; and,
- The cumulative improvement in fuel efficiency (litres/RTK) was 12.3 percent, or an annual average of 1.3 percent.

Figure 4 shows the goal trajectory of the 2 percent aspirational goal and the fuel efficiency improvements made between 2005 and 2015. It also shows an indicative trajectory that would be required to meet the 2020 aspirational goal, given the actual 2015 results.

FIGURE 4 Aspirational Goal Trajectory, 2005-2015



Reporting on Section 5.0 Measures

Section 5.0 of *Canada's Action Plan to Reduce Greenhouse Gas Emissions from Aviation* identifies measures that represent the greatest opportunities to reduce greenhouse gas emissions and help improve average annual fuel efficiency. The following table summarizes the results achieved and the status of each measure. Completed measures can be found in Appendix E.

Summary Table of Section 5.0 Measures

Measure	Results	Status
5.1 Fleet Renewals and Upgrades		
Canadian air carriers expect to achieve annual fuel efficiency improvements on domestic and international flights to 2020 through further fleet changes.	During 2015, NACC member airlines made the following changes to their aircraft fleets: ▪ WestJet introduced 12 Boeing 737-800 NG aircraft and 2 B767-300 aircraft and removed 5 Boeing 737-700 NG aircraft from service. ▪ Air Canada introduced 2 Boeing 787-8 aircraft and 4 Boeing 787-9 aircraft into service and removed 1 A320 from service. Air Canada also removed 8 Embraer 190 aircraft from service. ▪ Air Transat introduced an additional Boeing 737-800 into service. Air Transat also seasonally operated an additional 10 Boeing 737-800 and 2 737-700 aircraft. ▪ Jazz removed 5 CRJ-200s and 6 DH8-100s from service and introduced 6 Q400s into service. ▪ Encore introduced 9 Bombardier Q400 into service. ▪ Rouge introduced 6 Boeing 767-300 aircraft into service. Rouge also added 4 A321 aircraft into service. Four of the Boeing 767-300 aircraft and the 4 A321 aircraft were transferred from Air Canada.	IN PROGRESS

COMPLETE IN PROGRESS BEHIND SCHEDULE

Measure	Results	Status
	ATAC all-passenger air carriers continue to add highly efficient aircraft such as B737-800 and Bombardier Q400/ATR 42-500 and -700 aircraft to their fleets while replacing older less efficient fleet types such as B737-200 and HS-748. Operators of B737-200 aircraft have replaced most of these classic versions with B737-300/400/500 series aircraft with their more efficient CFM56 engines. ATAC all-cargo air carriers continue their transformation, at a more advanced pace, to much more efficient cargo operations as they upgrade from narrow body B727 to larger, more fuel efficient aircraft with high bypass ratio engines such as B757, B767 and DC-10-30 aircraft.	
Business aviation operators will be encouraged to take advantage of opportunities to reduce emissions through fleet renewal.	The CBAA continued to build on its greenhouse gas reduction outreach efforts through "CBAA Matters!", launched in 2013. This online forum increases awareness CBAA members and provides a space for feedback on activities of interest to Canadian business aviation operators, including Canada's Action Plan. The CBAA will continue to encourage its members to take advantage of opportunities to reduce greenhouse gas emissions through fleet renewal.	
5.2 More Efficient Air Operations		
Canadian air carriers expect to achieve average annual fuel efficiency improvements for domestic and international flights to 2020 through improved operations.	All ATAC and NACC carrier members continued to re-emphasize the use of fuel saving operating procedures. Carriers continue to look for additional opportunities to reduce fuel burn. 5 of the 6 Boeing 767-300 transferred to Rouge from Air Canada were retrofitted with blended winglets which will provide significant fuel savings..	
Business aviation operators will be encouraged to adopt operational improvement to reduce emissions.	The CBAA continued to encourage its members to take advantage of opportunities to reduce greenhouse gas emissions through operational improvements. CBAA Matters! will continue to give these issues greater visibility to operators.	

COMPLETE IN PROGRESS BEHIND SCHEDULE

Measure	Results	Status
Canadian operators will continue to take advantage of the opportunities identified in ICAO guidance on minimizing fuel use and reducing emissions.	The input for the updated manual was built upon NACC and ATAC carriers' policies and procedures. NACC, ATAC and CBAA promoted the ICAO manual to its members when it came online in 2014.	
5.3 Improved Capabilities in Air Traffic Management		
NAV CANADA, in partnership with Transport Canada, Canadian air carriers, global Air Navigation Service Providers (ANSPs) and other industry participants remains committed to taking advantage of opportunities to improve ATM through further implementation of Performance Based Navigation (PBN), such as RNP AR and RNAV, new ATM technologies and procedures, as well as surveillance technologies, such as ADS-B and multilateration. The Canadian Performance-based Aviation Action Team (CPAAT) will lead the implementation of Canada's PBN Implementation Plan and will provide opportunities for ongoing consultation and involvement throughout implementation. More specifically NAV CANADA will:	The CARAC PBN Working Group identified short- and medium-term solutions in its Final Report in 2014. Discussions within Transport Canada are underway on proceeding with these solutions. In 2014, the Working Group transitioned to the Canadian Performance-based Aviation Action Team (CPAAT), a standing working group that will address: ▪ long-term solutions identified by the Working Group; and ▪ NAV CANADA's Concept of Operations for the implementation of PBN in Canada.	
Implement RNP AR procedures at numerous airports beginning in 2015, continue to expand the use of Area Navigation and implement broader access to ADS-B surveillance; all of which will improve flight path efficiencies, reduce fuel consumption and reduce GHG emissions.	Public RNP-AR approaches allow aircraft to land using satellite-based navigation (i.e. with on-board equipment) in place of ground-based navigation systems, the benefits of which include reduced flying time and GHGs. Transport Canada, NAV CANADA and other key stakeholders (including customers, airport authorities, noise consultation, procedure design and operational Air Traffic Control) are working through a collaborative process to make the necessary regulatory and procedural changes to fully take advantage of these approaches, including for parallel runway operations where aircraft could use either the on-board navigation equipment or the existing ground-based systems.	

COMPLETE IN PROGRESS BEHIND SCHEDULE

Measure	Results	Status
	During 2015, several different projects were initiated in preparation for publication in 2016. These included Kelowna, Calgary International, Ottawa International and Halifax International, all of which remain on target. In October 2015, the Vancouver International Airport (YVR) became the first Canadian airport to make RNP AR available to equipped aircraft arriving on YVR's North Runway. Work is underway at Transport Canada and NAV CANADA on additional approvals and separation standards, which are required to allow the use of this procedure in a close parallel runway environment (i.e. at YVR and other similar airports). The RNP AR Parallel Approaches procedures are under internal review at ICAO safety panel.	
Enable international navigation improvements through work at ICAO and through initiatives such as Aireon LLC's plan to provide global surveillance capabilities through the deployment of space-based ADS-B, anticipated for 2018.	Reduced Lateral Separation (RLat) trials were introduced in the North Atlantic Region in late 2015. RLat enables more aircraft to safely benefit from the most efficient flight paths available. RNP 4 is one of the underlying requirements for participation in the RLat trial. As of 2015, all Air Canada's wide-body fleets (A330, B767, B777, B787) were qualified for RNP 4 prior to the start of the North Atlantic trial.	IN PROGRESS
Report annually on achievable fuel savings and emission reductions from joint efforts with domestic and international carriers operating in Canadian airspace and industry partners through the annual Collaborative Initiatives for Emissions Reduction (CIFER) Report.	NAV CANADA's CIFER reports are available on the NAV CANADA website.	IN PROGRESS

COMPLETE IN PROGRESS BEHIND SCHEDULE

Measure	Results	Status
In addition, Transport Canada will continue to issue or update advisory circulars to provide guidance or approve new procedures or specifications, such as those related to RNP and ADS-B. Transport Canada is working to amend the Foreign Air Operator Certification to allow foreign operators to gain approvals for RNP AR. This would enable an increase in the number of aircraft eligible to perform RNP AR runway approaches. While ADS-B is not being mandated in the near term, consideration could be given to airspace or route mandates for a geographic area or operational time period should equipage rates be insufficient to enable full system surveillance benefits.	Transport Canada has drafted an advisory circular to inform the aviation industry that air operators and private operators may now obtain a Canadian Special Authorization for Required Navigation Performance 2 (RNP 2) - Continental. This Special Authorization will enable Canadian air operators or private operators to operate within airspace designated as RNP 2 (Continental). It will also form the basis upon which a foreign National Aviation Authority (NAA) may authorize, within their jurisdiction, a Canadian air operator or private operator to operate in RNP 2 (Continental) airspace. Transport Canada submitted the PBN State Plan in December 2015, which outlines the actions that will be undertaken to develop and implement policy to ensure smooth transition to ADS-B and monitor future changes in the technology in Canada. Transport Canada and NAV CANADA recognize that air carriers would like to take advantage of new air traffic management procedures as early as possible and are working together to expedite this process, while also maintaining the highest standard for safety.	IN PROGRESS

COMPLETE IN PROGRESS BEHIND SCHEDULE

Reporting on Section 6.0 Measures

The *Canada's Action Plan to Reduce Greenhouse Gas Emissions from Aviation* contains other measures essential to achieving the long-term aspirational goals. Completed measures can be found in Appendix E

Summary Table of Section 6.0 Measures

Measure	Results	Status
6.1 Aviation Environmental Research and Development		
The Government of Canada and the Canadian aviation industry will continue to support research and development initiatives to minimize or reduce aviation environmental impacts. Research will continue through a number of key organizations and programs, including: ▪ Green Aviation Research & Development Network ▪ FAA Aviation Sustainability Centre ▪ National Research Council of Canada ▪ US Transportation Research Board's Airport Cooperative Research Program Research findings and key indicators such as technology readiness levels will be shared with interested parties.		
Green Aviation Research & Development Network (GARDN)	Established in 2009 and renewed in 2014, GARDN has supported more than 30 projects representing over $65 M of Canadian aviation environmental research (jointly funded by the Federal Government and participating aerospace companies - at minimum of 50%) that embrace 3 research thrusts, CLEAN, QUIET and SUSTAINABLE air transportation system. Over half of the projects deal specifically with emissions reductions, with 4 (2 under GARDN I and 2 more under GARDN II) projects focusing on bio-derived jet fuel applications for Canada.	IN PROGRESS

COMPLETE IN PROGRESS BEHIND SCHEDULE

Measure	Results	Status
FAA Aviation Sustainability Centre (ASCENT)	ASCENT, a $40 million dollar COE launched in 2014 by the US FAA, focuses on alternative aviation jet fuels as well as aircraft noise and other environmental issues. Transport Canada continues to sponsor ASCENT and maintain an active role on the Advisory Board reviewing research projects and progress with particular focus on the following: ▪ ASCENT 1 - Alternative Jet Fuel Supply Chain Analysis ▪ ASCENT 2A & B - Ambient Conditions Corrections for Non-Volatile PM Emissions Measurements & Examination of Engine to Engine PM Emissions Variability Using an ARP Reference Sampling and Measurement System ▪ ASCENT 13 - Microphysical Modeling & Analysis of Aviation Exhaust Observations ▪ ASCENT 14 - CO_2 Standard ▪ ASCENT 16 - Investigation of Aviation Emissions Air Quality Impacts; ▪ ASCENT 18 - Health Impacts Quantification for Aviation Air Quality Tools; and ▪ ASCENT 24B - PM Emissions Database Compilation, Analysis and Predictive Assessment.	IN PROGRESS

COMPLETE IN PROGRESS BEHIND SCHEDULE

Measure	Results	Status
National Research Council of Canada (NRC)	With financial support from the Government of Canada's Clean Transportation Initiatives, the NRC has: ▪ Made significant contributions to the development and documentation of a sampling and measurement methodology for the certification requirement for the new ICAO nvPM mass standard for aircraft engines. ▪ Continued to work with Transport Canada, Environment and Climate Change Canada and the US FAA to develop capabilities to conduct the required testing to transition to unleaded aviation gasoline. ▪ Conducted a number of critical safety and emissions tests on aviation alternative fuels. The NRC, with financial support from the Department of National Defence, is also conducting research under the ASCENT National Jet Fuel Combustion Program (NJFCP). The prime goal of NJFCP is to accelerate the approval of new alternative jet fuels.	IN PROGRESS
US Transportation Research Board's Airport Cooperative Research Program (ACRP)	Transport Canada and the CAC continue to support and participate in ACRP and to share relevant information with Canadian airports.	
6.2 Alternative Fuels		
The Government of Canada and the Canadian aviation industry will continue to work collaboratively to advance efforts related to alternative aviation fuel production and use in Canada and will take advantage of opportunities to collaborate with key trading partners.	Transport Canada maintains a dialogue with the US FAA to exchange information on biofuels development. In December 2015, an initiative was launched by the Boeing Company, the University of British Columbia, and SkyNRG, with support from the Canadian aviation industry and other stakeholders, to convert forest waste into sustainable aviation biofuel. A 2015 Boeing-sponsored study by the University of British Columbia found that aviation biofuel made from forest waste could meet 10 percent – about 46 million gallons, or 175 million liters – of British Columbia's annual jet fuel demand. This project also received funding from GARDN.	IN PROGRESS

COMPLETE IN PROGRESS BEHIND SCHEDULE

Measure	Results	Status
	A consortium that includes Boeing, Air Canada, WestJet, Bombardier, research institutions and industry partners will assess whether forest waste could also be harnessed to produce sustainable aviation biofuel using thermochemical processing.	
The Government of Canada and the Canadian aviation industry will continue to support research, development and demonstration of alternative fuels for aviation through initiatives such as the ICAO Committee on Aviation and Environmental Protection (CAEP) Alternative Fuels Task Force, Sustainable Development Technology Canada; BioFuelNet, ASCENT and the Commercial Aviation Alternative Fuels Initiative (CAAFI).	In 2015, Canada's BioFuelNet initiated work under a new Aviation Task Force (ATF) within the network. Transport Canada and members of the Canadian aviation industry participate in the Task Force. The ATF provides information on the latest developments of Canadian biojet activities for all stakeholders and identifies the main barriers to the commercial development of bio-derived jet fuel in Canada. In addition to a number of interesting research projects, the task force has initiated Canada's Biojet Supply Chain Initiative, a pilot project in an airport setting, to demonstrate the operational feasibility of using biojet blended with the airport's general fuel supply. The resulting generation of hands-on experience and validation of elements of the Canadian supply chain for biojet will assist in catalyzing the development of the biojet sector. During 2015, the ATF organized three workshops in which they identified the ATF vision, priorities, issues and approaches, and established research priorities for 2017-2022. Since 2010, Sustainable Development Technology Canada (SDTC) has provided over $12 million to two ongoing alternative aviation fuel projects that are in the demonstration phase: ▪ $3.3 million to Agrisoma Biosciences Inc. for a Brassica carinata-based biofuel project; and ▪ $9.6 million to MARA Renewables Corporation for an algae-based biofuel project. In 2015, there were no new alternative jet fuel projects funded under the SDTC.	IN PROGRESS

COMPLETE IN PROGRESS BEHIND SCHEDULE

Measure	Results	Status
	Transport Canada has actively supported the US FAA in the establishment of the new ASCENT Center of Excellence and collaborated with NASA on alternative aviation fuel research. Transport Canada and the Canadian aviation industry engaged with the US "CAAFI". Transport Canada also participates in the ICAO Alternative Fuels Task Force, which is developing information on how to assess the "sustainability" of aviation biofuels. In 2015, the two-year research project into the feasibility, cost, and environmental impact of a biojet fuel supply chain in Canada was completed. This project received $200,000 of funding from Transport Canada. Government of Canada and Canadian aviation industry officials continue discussions on potential next steps.	
6.3 Airport Ground Operations and Infrastructure Use		
The Canadian aviation industry will collaborate to reduce emissions at the gate and on the ground from taxi operations, auxiliary power units and ground support equipment.	In 2015, the Airport Ground Operations Subgroup continued to share information on current emission reduction initiatives and maintained a list of potential projects the group could undertake over the coming years. A number of emission reduction initiatives are advancing at Canadian airports. Examples include: ▪ Upgrades to five gates at Vancouver International Airport with pre-conditioned air units and introduction of a new ground handling license program that includes requirements to convert equipment to electrical. The goal is to have 50 percent of the ground handling fleet running on electrical power by 2020; ▪ Continued deployment of BoomAir at Montreal-Trudeau International Airport; ▪ Jazz Aviation and Air Canada continued tracking of GSE with GPS at the Toronto Pearson International Airport, the Montréal-Trudeau International Airport, the Halifax Stanfield International Airport, the Calgary International Airport and the Vancouver International Airport.	

COMPLETE IN PROGRESS BEHIND SCHEDULE

Measure	Results	Status
	Multilateration systems make it possible to see all airport ground movement. Initially adopted for safety reasons, these systems can promote efficiencies and reduce emissions. Such systems were introduced in Montreal in 2012, in Toronto in 2013, Calgary in 2014, and will be operational in Vancouver in 2018. The ability to monitor taxi times helps manage and reduce aircraft operating times and emissions. A cost-sharing agreement between NAV CANADA and the Toronto Airport uses a program called EXCDS to produce taxi times. Toronto, Montreal and Calgary Airports have the capability to use EXCDS to develop average baselines for taxi times. The Greater Toronto Airports Authority Air Traffic Management Working Group is extending the Airline/NAV CANADA working partnership on GHG reduction activities to aircraft movements from gate-to-gate. This will improve performance and reduce emissions by: balancing and improving runway use, and arrival and departure flows (holding and taxi times). In 2015, the Visual Departure Separation, which allows for the reduction of the minimum separation standard of 3 miles, was accepted by the Community Environment & Noise Advisory Committee and is now being implemented.	
Partners will work together to improve the quantification of greenhouse gas emissions associated with ground operations.	A study on Pre-conditioned Air and Ground Power Unit usage at Canadian airports was undertaken in 2015, which looked at the current state of utilization and opportunities for increasing this use and tracking associated GHG reductions. In addition, two studies were initiated in 2015: one on the feasibility of alternative energy conversion of Ground Support Equipment (GSE) at Canadian airports and one on alternative systems to reduce aircraft Auxiliary Power Unit emissions. Both will be completed in 2016.	IN PROGRESS

COMPLETE IN PROGRESS BEHIND SCHEDULE

Measure	Results	Status
Canadian airports will refine and improve emissions inventories and will explore further opportunities for emissions reduction strategies.	Currently there are 5 Canadian airports participating in the Airport Carbon Accreditation Program under ACI.	
6.4 Regulatory Measures		
Transport Canada will continue to participate at CAEP on the finalizations of the new CO_2 emissions standard for airplanes, targeted for 2016.	The new international CO_2 standard certification requirement was drafted and analysis completed in 2015, with Canada's participation on the working groups. The CO_2 standard is on track to be finalized in 2016 with the selection of the regulatory levels and approval of the certification requirement at ICAO.	
Transport Canada will continue to help develop a new non-volatile particulate matter (nvPM) standard for aircraft engines, through CAEP, with Phase 1 targeted for 2016, and Phase 2 targeted for 2019.	Canada made a significant contribution to the drafting of the certification requirement in 2015. The completion of the new international mass standard is on-track for 2016. A new mass and number nvPM standard is scheduled for completion by 2019.	
Once completed and adopted by ICAO, Transport Canada will adopt both standards domestically under the *Aeronautics Act*.	Work on this will begin in 2016.	
6.5 International Coordination		
Transport Canada will continue to actively participate, through ICAO, on the development and implementation of global approaches and standards to address climate change, including system efficiencies and market-based measures, and the development of alternative fuels for aviation. Transport Canada will continue to engage the Canadian aviation industry as part of the international dialogue.	Canada is participating in the Environmental Advisory Group of the ICAO Council, tasked with developing the design of a global market-based measure to address greenhouse gas emissions from international civil aviation for consideration at the 39th ICAO assembly in 2016.	

COMPLETE IN PROGRESS BEHIND SCHEDULE

Measure	Results	Status
	Canada continues to actively participate in ICAO's CAEP to develop the new CO_2 standard for aeroplanes and the new particulate matter mass and number standard for aircraft engines. Canada is also a member of CAEP's Global Market-based measure technical Task Force that is assessing two specific technical elements of market-based measures for aviation and providing quantitative analysis supporting the work of the Environmental Advisory Group. Canada is also participating in the CAEP Alternative Fuels Task Force. Canada is actively participating in ICAO's CAEP Working Group 2 – Operations and is leading the Group's work to update the Airport Planning Manual, Part 2. The update will include adding eco-friendly airport planning information as well as best practices in land-use planning and management. Once completed, the manual will provide ICAO Member States with guidance and recommendations on airport planning. The update is scheduled for completion in 2016. Transport Canada also provided support to a number of other tasks including the Circular on Community Engagement for Aviation Environmental Management and the Aviation System Block Upgrades (ASBU).	
NAV CANADA will continue to support the air navigation interests of Canadian aviation stakeholders internationally through representation in ICAO groups and panels.	Transport Canada and NAV CANADA are supporting efforts under ICAO's Global Air Navigation Plan and ASBU, as well as NAV CANADA's PBN Operations Plan, through planned upgrades through to 2017 on: ▪ Communications; ▪ Navigation; ▪ Surveillance; and ▪ Air Traffic Management. These upgrades maximize the benefits for operators of aircraft that are best equipped to take advantage of the PBN procedures, while recognizing the needs for airspace access to operators not eligible for these procedures.	IN PROGRESS

COMPLETE IN PROGRESS BEHIND SCHEDULE

Measure	Results	Status
As a member of the International Coordinating Council of Aerospace Industries Associations (ICCAIA), the Aerospace Industries Association of Canada (AIAC) will continue to lead Canadian aerospace manufacturers in working with international partners to develop and produce aircraft and engines that meet or exceed ICAO requirements for fuel efficiency and emissions.	AIAC member companies continue to provide subject matter experts to advise ICAO's CAEP; and AIAC provides the link to the international community through its membership in ICCAIA. The AIAC also plays a key leadership role by chairing and facilitating the work of GARDN, which includes international coordination. Since it was formed, GARDN has signed agreements with ATAG, the Advisory Council for Aeronautics Research in Europe, and Canadian Composites Manufacturing R&D Inc. AIAC is also the Canadian representative for the Civil Aviation sector in the context of the Canada-China Science and Technology Agreement.	IN PROGRESS

COMPLETE IN PROGRESS BEHIND SCHEDULE

CONCLUSIONS

Summary of Results

Aviation activity and associated fuel use data for 2015 provided by members of ATAC and NACC, demonstrate continued progress towards the aspirational goal and fuel efficiency target.

Since 2010, the demand for aviation services has continued to grow. Combined revenue passenger and cargo operations increased by 7.6 percent in 2015, compared with 2014. Canadian air carriers used 7.02 billion litres of fuel, a 6.7 percent increase compared with 2014. Consequently, total greenhouse gas emissions also increased by 6.7 percent to 18.13 Mt in 2015, compared with 2014.

In 2015, the overall rate of fuel consumption (i.e., litres per RTK) declined by 0.8 percent, compared with 2014. The combined domestic and international fuel consumption rate reported for 2015 was 35.46 litres per 100 RTK (combining both passenger and cargo traffic). This translates to an average annual fuel efficiency improvement of 1.52 percent per year between 2008 and 2015, and a cumulative improvement of 10.1 percent.

2016 Look Ahead

While Canada made progress in many areas in 2015, important milestones have also been advanced in 2016. These milestones will be addressed in more detail in the 2016 Annual Report, which is scheduled to be released by December 31, 2017. The 2016 Annual Report will include information about:

- Preconditioned air and ground power units as well as BoomAir installations at the 6 new boarding gates at the Montreal- Pierre Elliott Trudeau International Airport in the extension of the international jetty. All gates equipped with boarding bridges will have BoomAir.

- ICAO's two new emissions standards in 2016: the CO_2 standard for airplanes and the non-volatile particulate matter mass standard for aircraft engines.

- WestJet and Clean Energy Technology Centre's initiative to accelerate the development of sustainable aviation biofuel in Western Canada.

- Air Canada's participation in Canada's Biojet Supply Chain Initiative, a three-year project with 14 stakeholder organizations to introduce 400,000 litres of sustainable aviation biofuel into a shared fuel system at the Montreal-Pierre Elliott Trudeau International Airport.

- Updates on NACC carrier fleet renewal plans:

  – Air Canada's firm purchase agreement with Bombardier Inc. for 45 CS300 aircraft and options for an additional 30 CS300 aircraft. Deliveries are scheduled to begin in late 2019 and extend to 2022. At list price, the firm order for 45 CS300 aircraft is valued at approximately $US 3.8 billion. This amount would increase to $US 6.3 billion should Air Canada exercise all 30 option aircraft.

  – Jazz Aviation LP's agreement to acquire five Bombardier CRJ900 regional jets and acquire purchase rights for five additional aircraft. The new aircraft are expected to enter service in early 2017.

- Updates on ATAC carrier fleet renewal plans:

  – Porter Airlines' intent to purchase three new Q400s.

- Updates on the 39th ICAO Assembly, including on the historic agreement on a global market-based measure, the first that will apply across an entire international sector. Through this measure, airlines will address annual increases in total CO_2 emissions from international civil aviation above 2020 levels.

Appendix A: Glossary of Key Terms and Acronyms

Key Aviation Activity Measurements

Revenue Passenger-Kilometres (RPK): is a measure of traffic showing revenue-paying passengers carried, multiplied by distance flown.

Passenger Revenue Tonne-Kilometres (Passenger RTK): is the total tonnes of revenue-paying passengers carried, estimated by converting RPK into weight using the industry's convention of 100 kg (220 lbs) per passenger, multiplied by distance flown.

Cargo Revenue Tonne-Kilometres (Cargo RTK): is the total tonnes of revenue-generating cargo (freight and mail) multiplied by distance flown (reflects actual cargo carried).

Total Revenue Tonne-Kilometres (Total RTK): is the total tonnes of passengers, freight, and mail carried (revenue load) multiplied by distance flown.

Acronyms

ACRP: Airport Cooperative Research Program

ADS-B: Automatic Dependent Surveillance-Broadcast

AIAC: Aerospace Industries Association of Canada

ANSP: Air Navigation Service Providers

APU: Auxiliary power unit

ASBU: Aviation System Block Upgrades

ASCENT: Aviation Sustainability Center

ATAC: Air Transport Association of Canada

ATAG: Air Transport Action Group

ATM: Air Traffic Management

CAAFI: U.S. Commercial Aviation Alternative Fuels Initiative

CAC: Canadian Airports Council

CAEP: Committee on Aviation and Environmental Protection

CARAC: Canadian Aviation Regulation Advisory Council

CBAA: Canadian Business Aviation Association

CO_2: Carbon dioxide

CO_2e: Carbon dioxide equivalent

COE: Center of Excellence

CPAAT: Canadian Performance Based Aviation Action Team

FAA: Federal Aviation Administration

GARDN: Green Aviation Research & Development Network

GSE: Ground support equipment

GTAA: Greater Toronto Airports Authority

ICAO: International Civil Aviation Organization

ICCAIA : International Coordinating Council of Aerospace Industries Associations

Mt: Megatonnes

NACC: National Airlines Association of Canada

NRC: National Research Council

nvPM: Non-volatile particulate matter

PARTNER: Partnership for AiR Transportation Noise and Emissions Reduction

PBN: Performance-based navigation

RNAV: Area Navigation

RNP: Required Navigation Performance

RNP AR: RNP Authorization Required

RPK: Revenue Passenger-Kilometres

RTK: Revenue Tonne-Kilometres

SDTC: Sustainable Development Technology Canada

WTM: Windsor-Toronto-Montreal

Appendix B: Calculations and Caveats

The following factors and formulas were applied in preparation of the aggregated report from ATAC and NACC. Note that industry statistics are still maintained in imperial units, including miles and tons, which are converted to International System (SI) units (kilometres and tonnes) for the present report. The emissions factors for all calendar years are the latest factors used by Environment Canada in Canada's National Greenhouse Gas Inventory since 2009.

Aviation Jet Fuel emission factors:
2560 grams CO_2 per litre
2582 grams CO_2e per litre

Conversion miles to kilometres:
1 m = 1.609344 km

Conversion tons to tonnes:
1 ton = 0.907185 tonnes

Formulae for CO_2-equivalents:
CO_2e (grams)/RPK = (Fuel Used x 2582) / (RPM x 1.609344)

CO_2e (grams)/Cargo RTK = (Fuel Used x 2582) / (Cargo RTM x 1.609344 x 0.907185)

CO_2e (grams)/Total RTK = (Fuel Used x 2582) / {(RPM x 1.609344 x 0.907185) + (Cargo RTM x 1.609344 x 0.907185)}

Reports by ATAC and NACC members have been revised from time to time, notably activity statistics. The consolidated statistics presented in this report include all the latest figures reported by ATAC and NACC carriers, including all such revisions. It should be noted that the statistics are not entirely comparable between years.

The reported annual emission statistics do not account for 100 percent of Canadian aviation operations, and therefore will not be directly comparable to Environment Canada's annual National Greenhouse Gas Emissions Inventory. *Canada's Action Plan to Reduce Greenhouse Gas Emissions from Aviation*, and therefore this report, did not cover private aviation, military and other government operations, or foreign carriers' operations in Canada.

There has been some variability in reporting from year to year, particularly from including more carriers. Coverage in 2015 was slightly improved compared to 2014. Adding carriers does not substantially affect the industry-wide ratios and longer-term trends computed for fuel use and emissions per unit of traffic.

Appendix C: List of Signatories and Air Operator Member Companies Reporting

The members of the Working Group on Aviation Emissions, which developed the Action Plan, are:

- Aerospace Industries Association of Canada;
- Air Transport Association of Canada;
- Canadian Airports Council;
- Canadian Business Aviation Association;
- National Airlines Council of Canada;
- NAV CANADA; and
- Transport Canada.

All four members of NACC contributed 2015 data for this annual report, including:

- Air Canada;[3]
- Air Transat;
- Jazz Aviation LP; and
- WestJet.[4]

The ATAC member carriers who contributed 2015 data for this annual report were:

- Air Georgian;
- Air North;
- Bearskin;
- Canadian North;
- Cargojet;
- EVAS Air;
- First Air;
- Flair;
- Harbour Air;
- KF Aerospace;
- Morningstar;
- Nolinor;
- North Cariboo Air;
- Provincial Air Lines
- Porter Airlines;
- Sunwing;
- Transwest & North Shore Helicopters.

3 Air Canada reporting includes data from Rouge

4 WestJet reporting includes data from Encore

Appendix D: Additional Figures Illustrating Key Trends

FIGURE 5 Fuel Use — International and Domestic, 2015

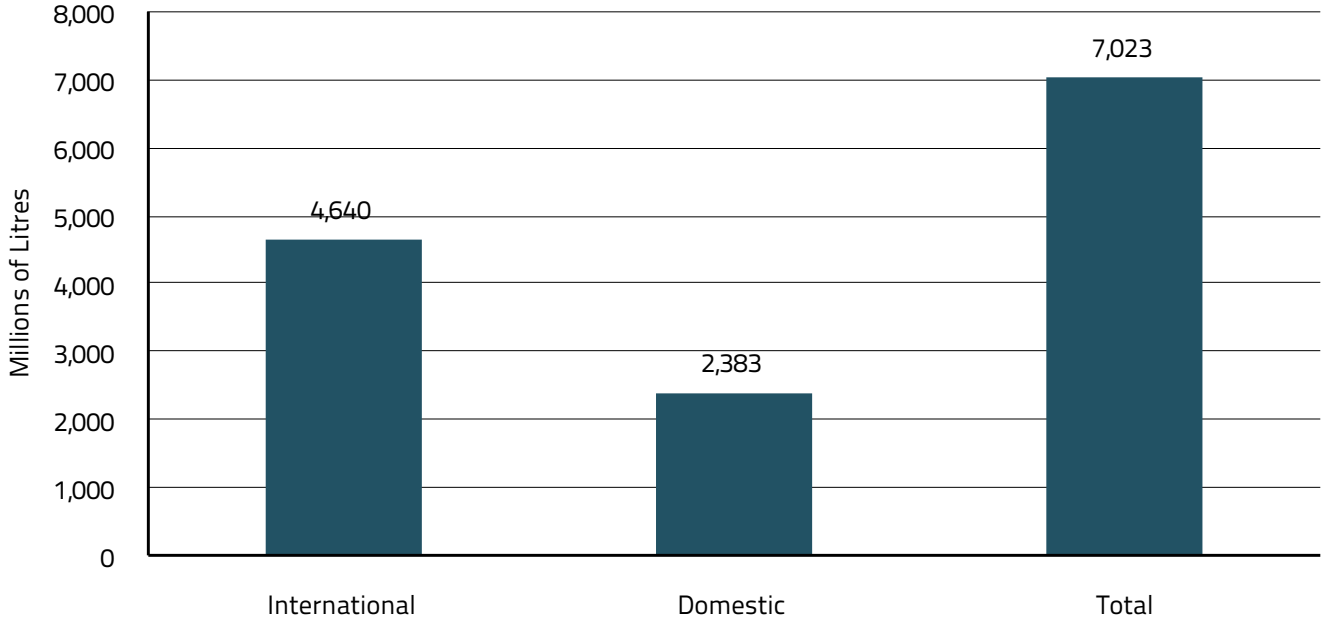


FIGURE 6 Fuel Use, 2005-2015

FIGURE 7 Revenue Passenger Kilometres, 2005-2015

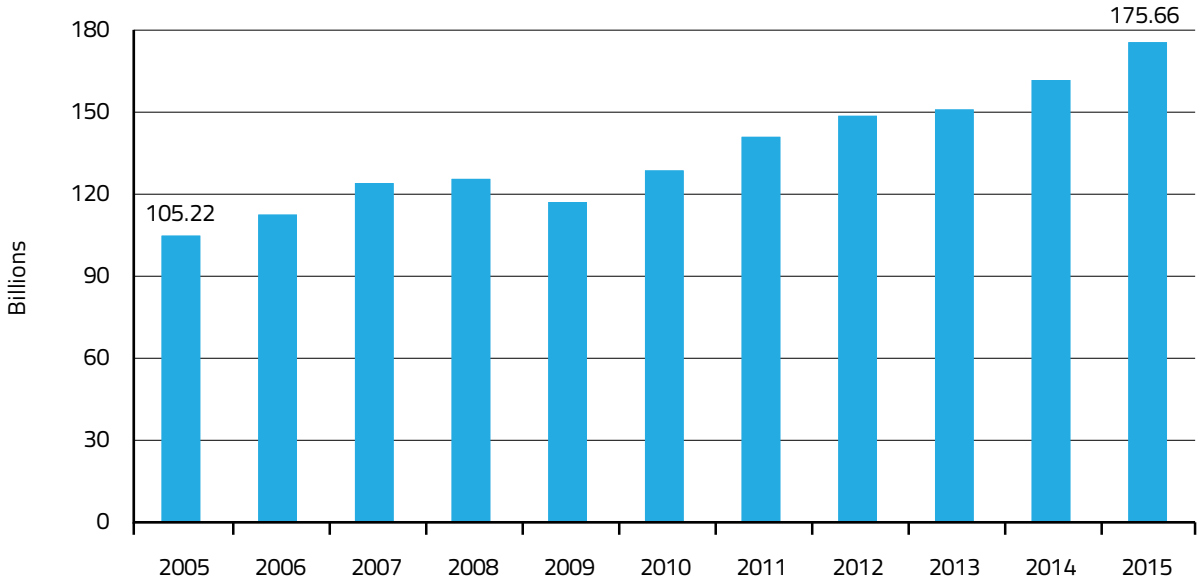


FIGURE 8 Cargo Revenue Tonne-Kilometres, 2005-2015

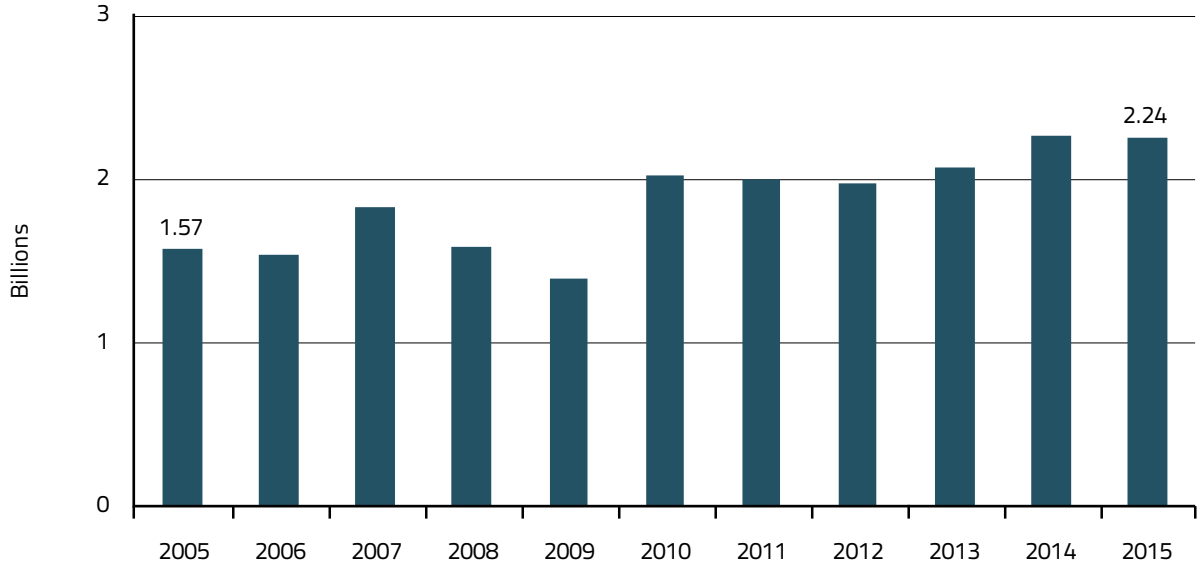


FIGURE 9 Total Passenger and Cargo Tonne-Kilometres, 2005 -2015

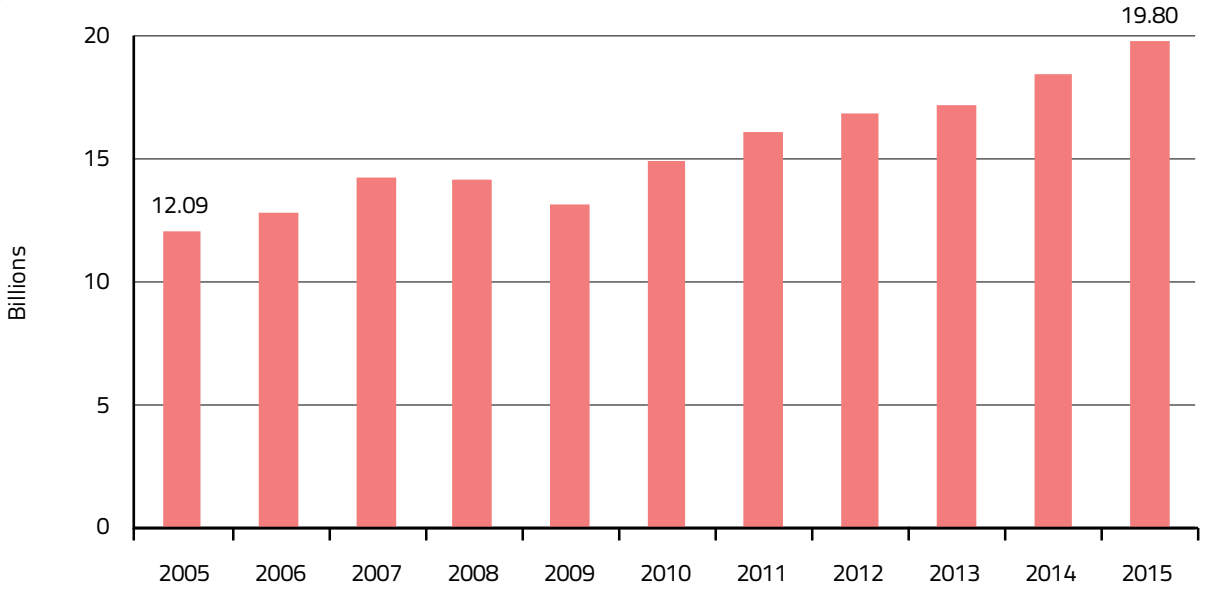


FIGURE 10 Total Passenger and Cargo Tonne-Kilometres — International and Domestic, 2015

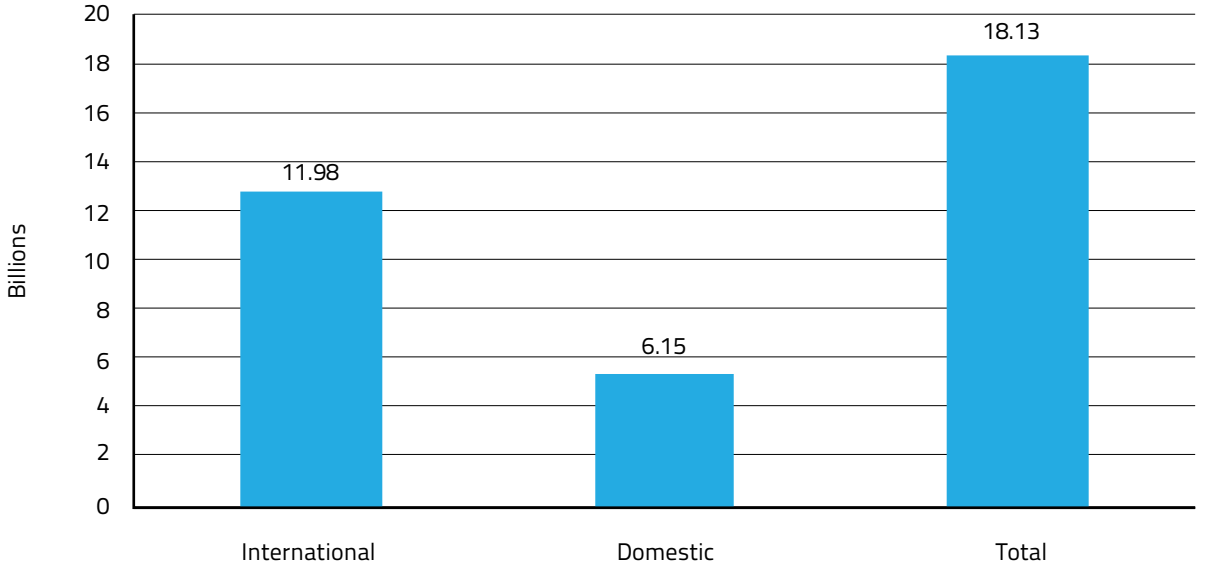


FIGURE 11 Fuel Consumption Rate — Passengers, 2005-2015

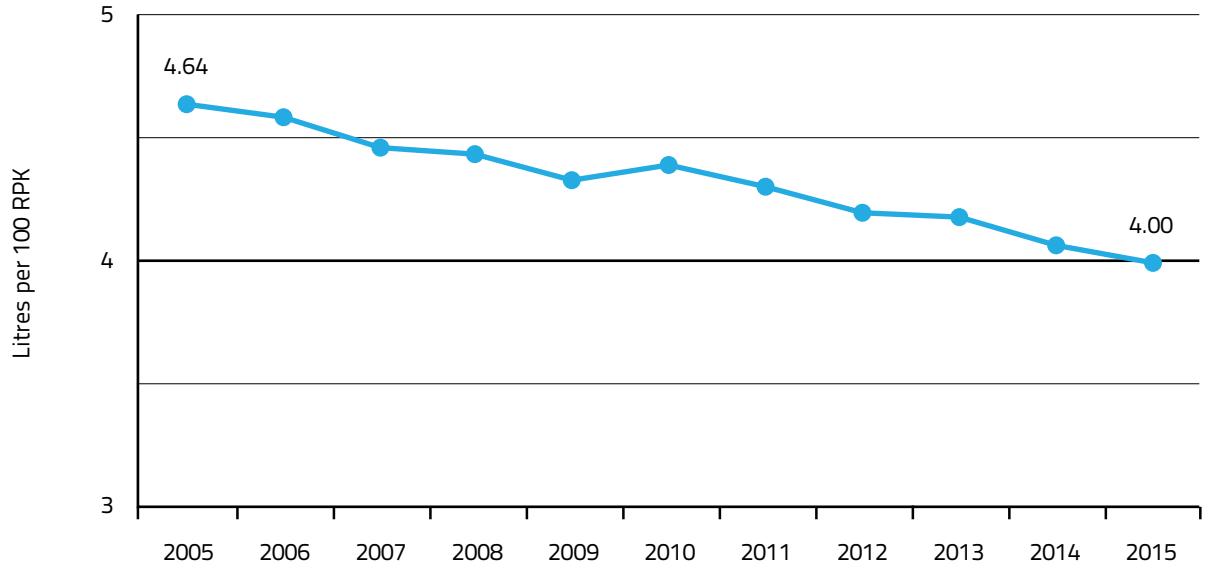


FIGURE 12 Fuel Consumption Rate — Combined Passengers and Cargo, 2005-2015

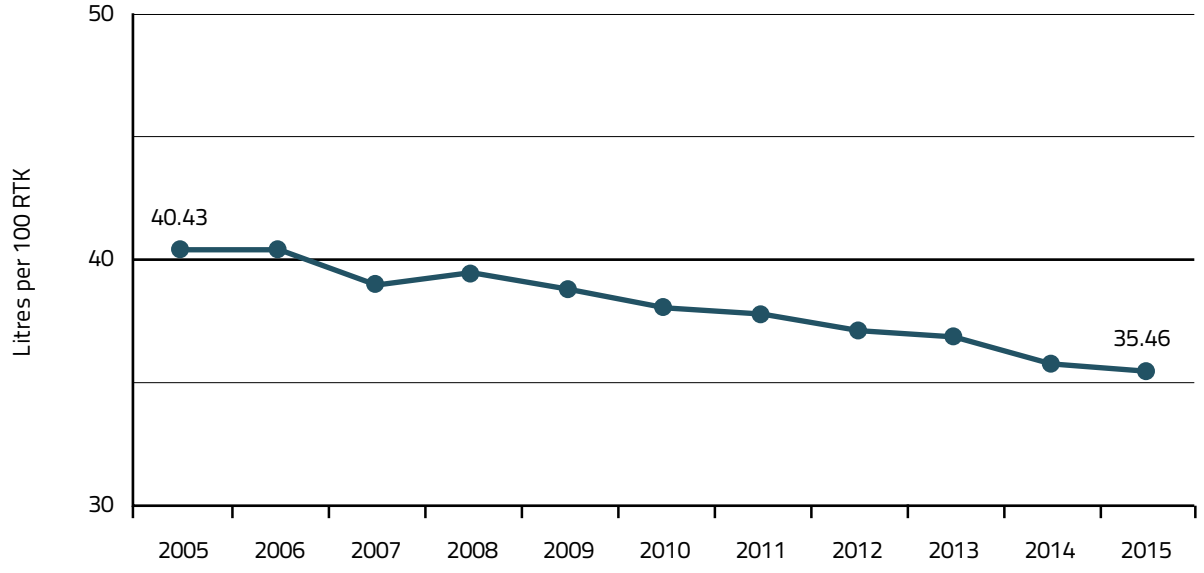


FIGURE 13 Greenhouse Gas Emissions — International and Domestic, 2015

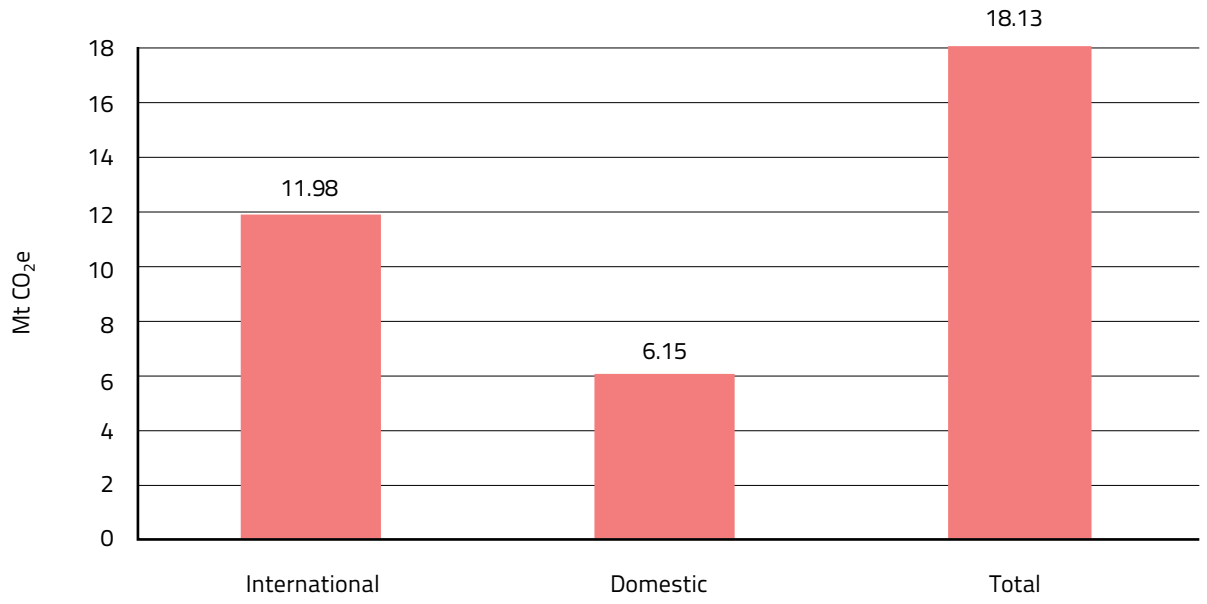


FIGURE 14 Greenhouse Gas Emission Rates — International and Domestic, 2015

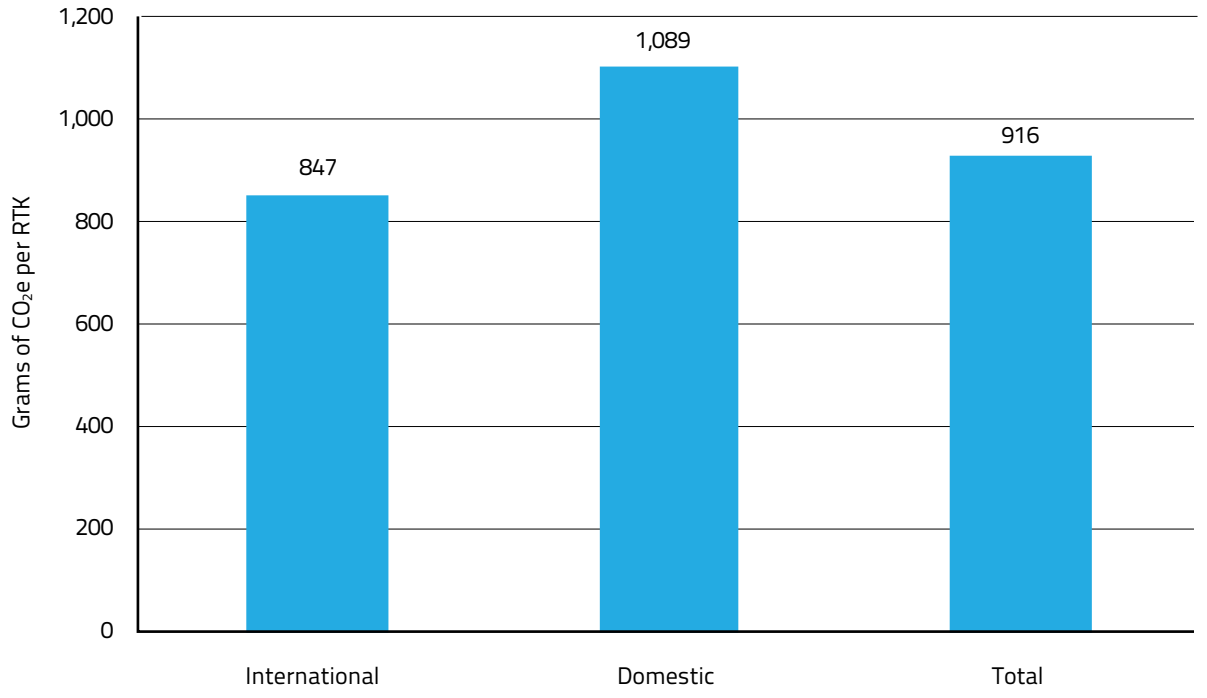


FIGURE 15 Greenhouse Gas Emission Rate — Passengers, 2005-2015

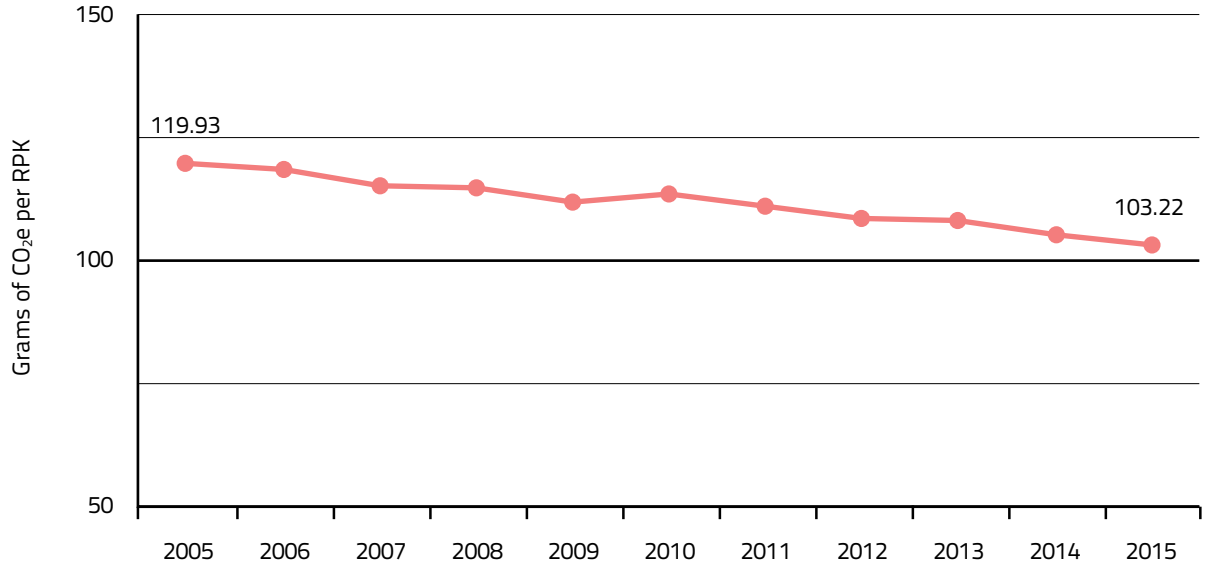
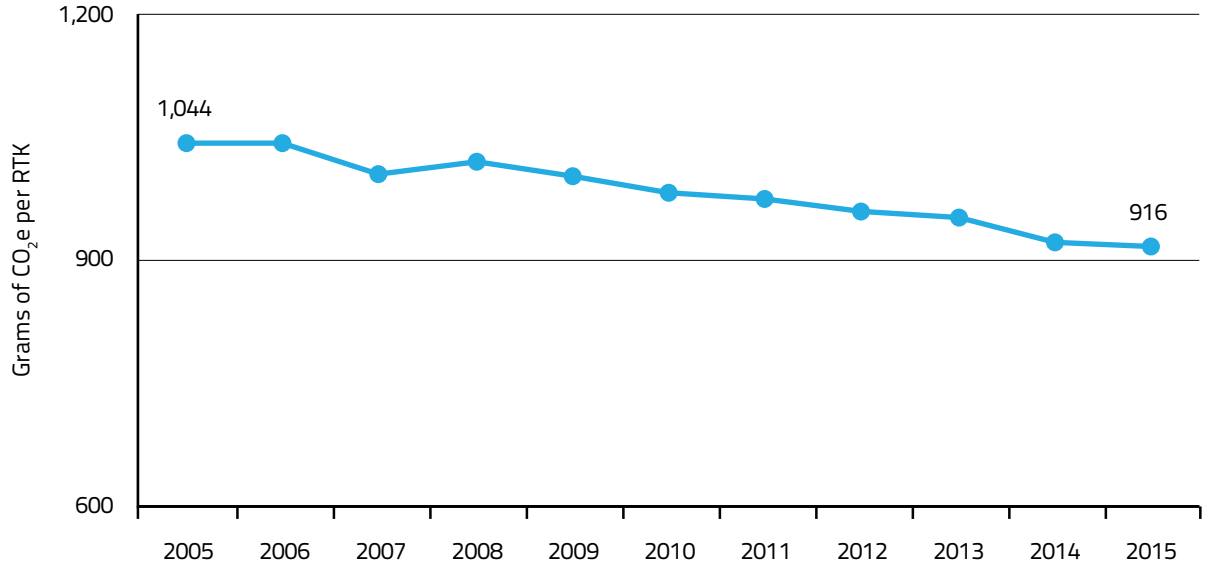


FIGURE 16 Greenhouse Gas Emission Rate — Combined Passenger and Cargo, 2005-2015



Appendix E: Completed Action Plan Measures

Measure	Results
5.2 More Efficient Air Operations	
Transport Canada will continue to work through ICAO to help provide guidance, and encourage technological and operational improvements, including updating ICAO Circular 303.	Transport Canada participated in updating ICAO Circular 303 into a new ICAO manual: Doc 10013 Operation Opportunities to Minimize Fuel Use and Reduce Emissions. Work on this document was completed in 2012 and became available for sale online in 2014.
5.3 Improved Capabilities in Air Traffic Management	
Approval by Transport Canada for use of the United States (US) Federal Aviation Administration (FAA) Order 8260.54A and 8260.52 instrument procedure.	Transport Canada approved the US FAA Orders 8260.54A in December 2011. Transport Canada approved the use of the US FAA Order 8260.58 (which consolidates 8260.54A and 8260.52) in October, 2013.
Approval of guidance by Transport Canada for Operations Specifications in support of the use of the US FAA Order 8260.52 criteria.	Final publication of the Advisory Circular for use of procedures based on the US FAA Order 8260.52 was completed on March 31, 2013. Additional Advisory Circulars for new PBN navigation specification were also published: Required Navigation Performance Authorization Required Approach in March, 2013; Radius-to-fix legs in September, 2013 and Required Navigation Performance 1 (RNP 1) in October, 2013. NACC carriers continued to work on Canadian Required Navigation Approach Authorization Required (RNP AR) approval in 2014.
6.1 Aviation Environmental Research and Development	
Canada will continue its support of the Partnership for AiR Transportation Noise and Emissions Reduction (PARTNER) to advance research in such areas as emissions; operations; alternative fuels; tools; system-level and policy assessment; and noise.	The PARTNER Center of Excellence (COE) held its final advisory board meeting in the fall of 2013. In September 2013, the US FAA announced a new 10-year, $40 million COE called the Aviation Sustainability Center (ASCENT).