Air Resistance (Aircraft)

(1) Purpose

To suppress CO_2 emissions from aircraft, reducing fuel consumption is of the utmost importance. From the standpoint of flight operations, this might be achieved by switching to new aircraft models and improving operation methods. From the viewpoint of engineering, this might be achieved by improving engine fuel efficiency, reducing airframe weight, improving the lift-to-drag ratio, and using alternatives to fossil fuels. This section discusses technology that will contribute reductions in CO_2 emissions by reducing air resistance and thereby improving the lift-to-drag ratio.

(2) Social and technological requirements for technical issues

[1] By 2015, the European Union (EU) is scheduled to introduce a new tax on aircraft CO_2 emissions. This will require marked reductions in CO_2 emissions by that time. One aircraft operating company, easyJet Co. Ltd., intends to reduce the CO_2 emissions from its aircraft 50% by 2015, while aircraft manufacturer Boeing Co. has announced the Performance Improvement Package (PIP) for Boeing 777 model aircraft, which is intended to reduce CO_2 emissions by upgrading existing airframes. Furthermore, there are growing needs for technologies that will lead to CO_2 emission reductions from newly built airframes.

(3) Potential mechanisms for realizing advanced key parameters

As measures of reducing air resistance and improving lift-to-drag ratios, the following points can be considered:

First, takeoff and landing characteristics will be improved in order to improve fuel efficiency and reduce environmental loading. **[2]** To achieve this improvement, we intend to establish a technology that simultaneously optimizes airframe cruising configuration and high-lift devices for use during takeoff and landing. This optimization will be realized using morphing technology (technology for freely changing an airframe shape).

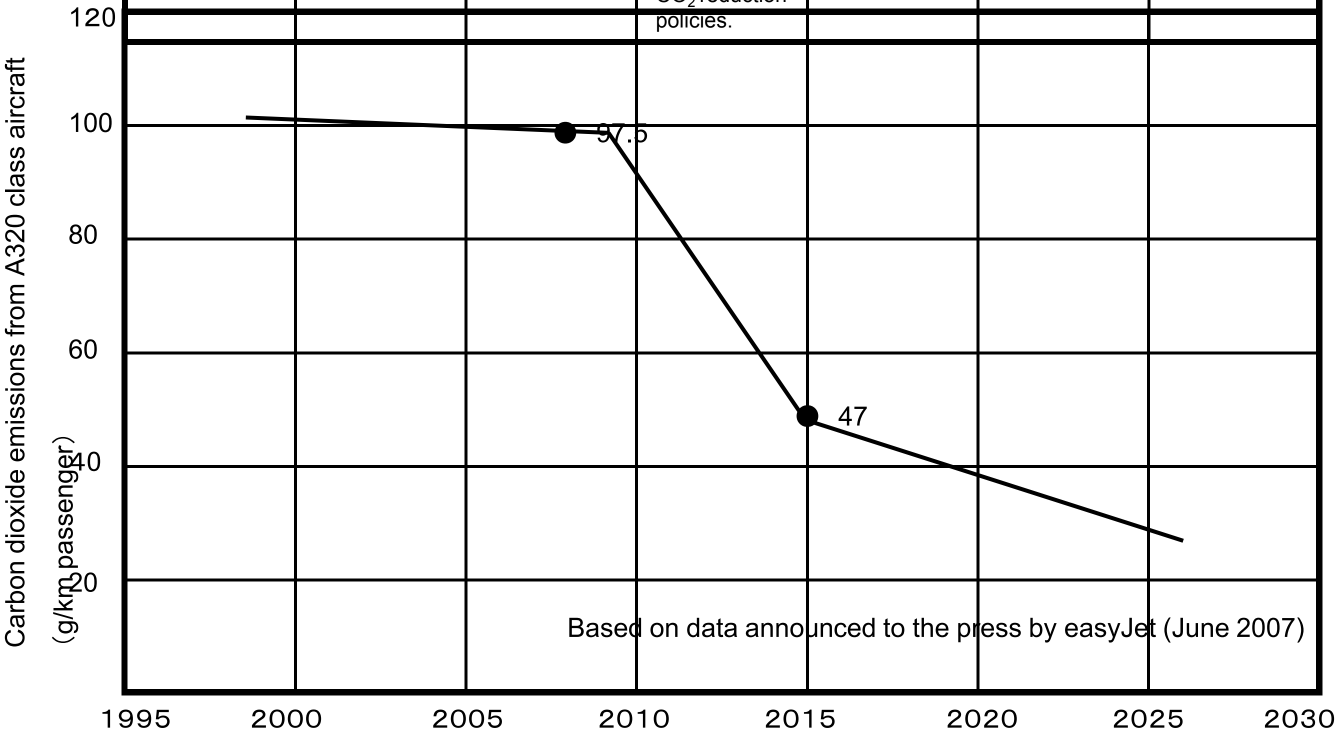
Next, friction resistance will be reduced to improve cruising characteristics and fuel efficiency. To achieve this, we will establish a natural laminar flow wing design technology and develop a technology capable of converting a wing boundary layer into a laminar flow by means of boundary layer control.

Additionally, the induced resistance and interference resistance will be reduced to improve the cruising characteristics, thereby increasing fuel efficiency and reducing CO_2 emissions. To accomplish this, we will establish a technology capable of reducing induced resistance through use of optimum wing end devices and flap scheduling, as well as a technology aimed at reducing aerodynamic interference between fuselage and wings.

(4) Future society outlook

Based primarily on technologies that are already close to practical use, we intend to reduce CO_2 emissions by 50% by 2015. This will be accomplished by promoting technological developments aimed at reducing air resistance and improving the lift-to-drag ratio. Furthermore, we envision further air resistance reductions by the 2030s that will utilize morphing and other breakthrough technologies that have yet to be established.

Social and technological requirements	ICAO gas emission standards applied only to NOx, HC, CO, and Soots. (1981)	ICAO initiated discussions on techniques to reduce CO_2 emissions. (2004)	ICAO discussed techniques to reduce CO_2 emissions.	50% reduction of energy consumption. Introduction of a CO_2 emission right acquisition system for aircraft in and outside EU (2012). ICAO will establish CO_2 reduction policies.			Zero CO_2 emissions by 2050.



Technological breakthroughs		First flight of Honda Jet. (2003)	Successful flight experiment of JAXA small supersonic aircraft. (2005)	Implementation of natural laminar flow wing technology.	Implementation of boundary layer control wing technology.		Implementation of morphing technology.
Social and market changes	Number of jets in service: 10,606 (1997)	CO_2 emissions from private aircraft: 572,000,000 tons (2000)	Number of jets in service: 15,929 (2007) Super-large passenger aircraft (A380) introduced into service RNAV introduced to domestic routes in Japan	CO_2 emissions from private aircraft: 605,000,000 to 776,000,000 tons (2010) Boeing 787 enters service. First flight of environment-friendly small passenger plane MRJ.	Number of jets in service: About 25,200 (2017)	Ultrasonic small passenger plane	Number of jets in service: About 36,600 (2028) CO_2 emissions from private aircraft: 1,228,000,000 to 1,488,000,000 tons (2025)

			Baseline	Climate plan		
			2007	2015	2030	2050
[Name of the technology/solution] Air Resistance (Aircraft)	Savings	Consumption if old technologies are sustained (BAU)	100	100	100	100
		Consumption after implementing new technology and measures		90	80	70
		Net saving		10	20	30
	Cost (Investment, operation & maintenance, fuel)			120	120	110
	Cost Per PJ saved			–	–	–
	GHG reduction potential	Emission if old technologies are sustained and with current trends (BAU)	100	100	100	100
		Emission after implementing new technology and measures		90	80	70
		Total Reduction		10	20	30
	Cost of GHG reduction			120	120	110

Using a value of 100 for the year 2007.