

JAXA'S ENVIRONMENT CONSCIOUS AIRCRAFT TECHNOLOGY PROGRAM PLAN

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Abstract

JAXA is preparing Environmental Conscious Aircraft Technology Program Initiative commencing in 2013 which is the first year of the 3rd JAXA's Mid-Term R&D Period. This paper introduces the provisional plan of "Environment Conscious Aircraft Technology (ECAT) R&D Program". In the program, Technology Reference Aircrafts (TRA), TRA2022 and TRA2035, are defined to identify technological goals in 2022 and 2035, respectively. TRA2022 (100-150 pax passenger jet) has a target at the technological goals of 30% reduction of CO₂ emission relative to the same sized current aircrafts, 20dB reduction in airport noise relative to ICAO Chapter 4 regulation, and 70% reduction of NO_x emission relative to CAEP/6 regulation. Based on TRA's technological goals, the ECAT R&D program consists of three R&D projects and aircraft system concept research & technology evaluation.

1 Introduction

Both Airbus and Boeing predict that passenger traffic alone will grow more than 2 times (based on revenue passenger kilometer) in the next 20 years[1,2]. Reducing greenhouse gas is one of aviation's biggest challenges today along with safety and security. This paper introduces JAXA's research and development challenge of environmental conscious aircraft technologies.

2 E-CAT Program Initiative

JAXA's Environment Conscious Aircraft Technology (E-CAT) Program Initiative is composed of three research and development (R&D) projects and concept research/technology evaluation as shown in Figure 1. Element researches on environmental technologies JAXA has been conducted so far are strategically integrated into this program.

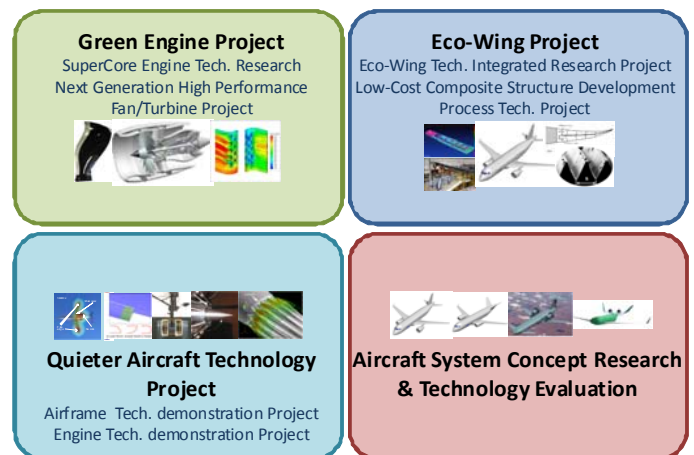


Fig.1 Framework of E-CAT Program Initiative

Green Engine Project

Technologies for the next generation high performance fan/turbine engines with drastic reduction of fuel burn CO₂ emission will be verified in this project. This includes application of composite materials to the fan blades and low pressure turbine blades and/or the case(Fig.2). Also, R&D of elemental technologies such as cooling technology for super-high pressure

turbine, high load compressor technology, and low NO_x combustor technology will be conducted.

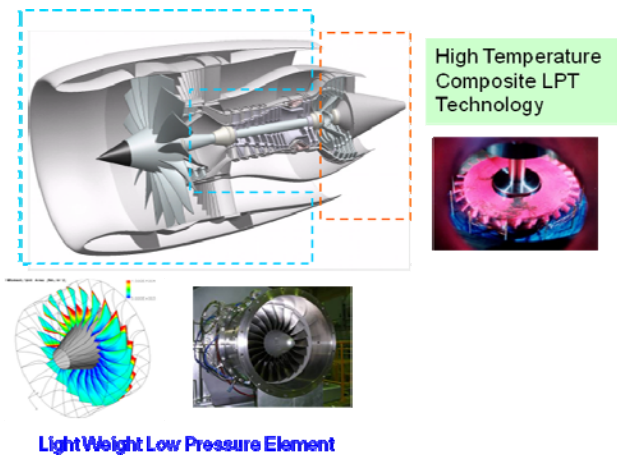


Fig.2 Next Generation High Performance Fan/Turbine Technology

Eco-Wing Project

The purpose of this project is to improve airframe fuel efficiency by increasing aerodynamic efficiency and reducing airframe weight. To increase airframe efficiency, the boundary layer control technologies and morphing technologies will be demonstrated(Fig.3). Also, research on improving type certificate process with development of highly reliable structure design technology and database of composite materials will be conducted in order to decrease airframe weigh without cost penalty.

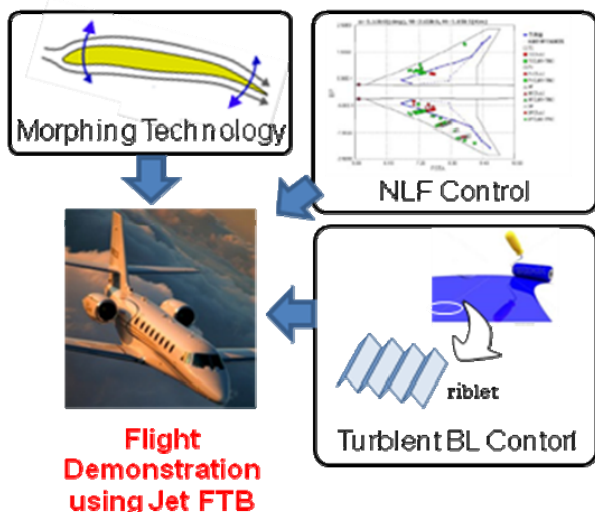


Fig.3 Flight Demonstration of Drag Reduction Technologies

Quieter Aircraft Technology Project

Noise reducing technologies for both airframe noise and engine noise will be demonstrated in this project. Noise reduction technology using devices for flaps and landing gears will be applied to JAXA's Flying Test Bed(Fig.4).

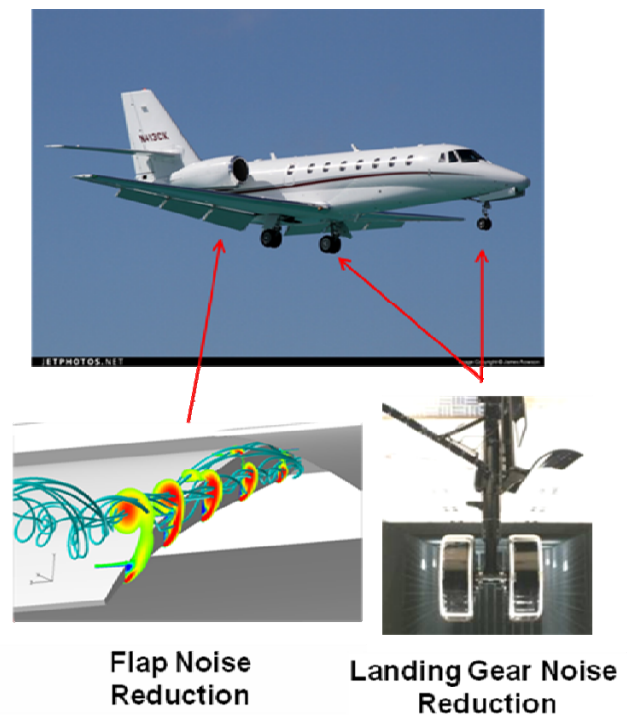


Fig.4 Flight Demonstration of Airframe Noise Reduction Technologies

Aircraft System Concept Research & Technology Evaluation

This is to clarify the position of above projects/initiative in an airplane system and to pursue creation of innovative airplane concepts. Also, fundamental technology R&D such as MDO will be conducted.

3 Technology Target

In this program, the technology targets for environmental impact mitigation are provisionally set in year 2022 and 2035 (See Table 1).

	Year 2022 100-150pax.	Year 2035 150-200pax.
Fuel burn ^A (CO ₂ Emission)	-30% ^B	-50~100% ^C
Airport Noise ^D	-20dB	-30~-75dB
NOx Emission ^E	-70%	-70~-100%

A: Relative to similar existing types of aircraft, B: Excluding Bio fuel, C: Including Bio fuel, D: Relative to ICAO Stage 4, E: Relative to CAEP/6

Table 1. Technology Target for Future Subsonic Aircraft (Provisional)

Fuel Burn (CO₂ Emission) Reduction

This target in 2022 (-30% relative to similar existing type of aircraft) is settled in consideration of competitive advantage over other aircrafts. It is required 7% improvement of lift-to-drag ratio, 15% reduction of SFC, and 20% airframe weigh reduction in order to reach this target(Fig.5).

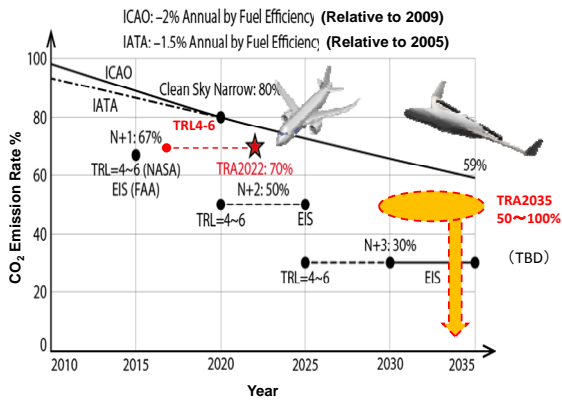


Fig. 5 Fuel Burn (CO₂ Emission) Reduction Target

Noise Reduction

Taking into account discussions in ICAO, it seems that more than 20dB cumulative below current Chapt.4 would be necessary in 2022. Technologies such as ultra high bypass engine technologies and airframe noise reduction technology are required(Fig.6).

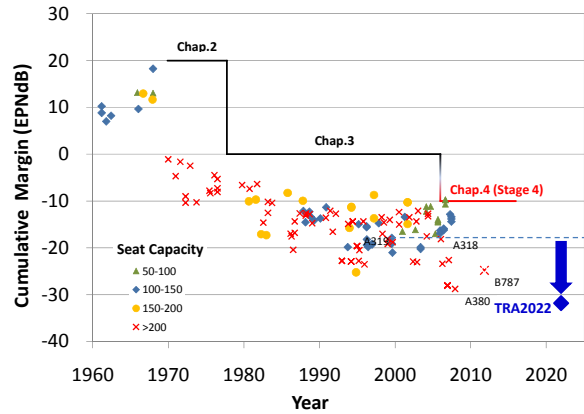


Fig. 6 Noise Reduction Target

NOx Emission Reduction

This target in 2022 (-70% relative to CAEP/6) is determined by reference to reduction target 2026 of NOx emissions by CAEP. Technological results from JAXA's "TechCLEAN Project" will be applied(Fig.7).

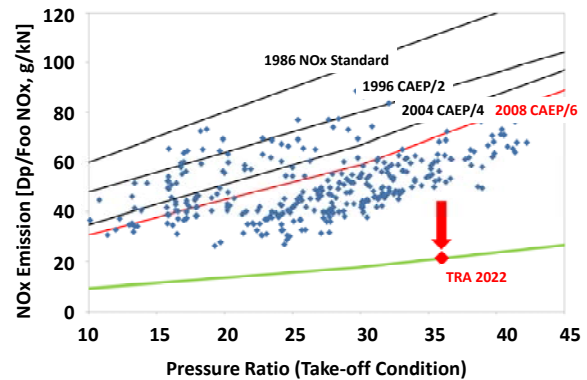


Fig. 7 NOx Emission Reduction Target

4 Technology Reference Aircraft

Technology Reference Aircraft (TRA) 2022 and TRA 2035 are defined as aircrafts to be entry in service in 2022 and 2035, respectively. They are defined with technological goals expected in 2022 and 2035. Figure 8 shows the image of TRA 2022 with technical goals of 30% reduction of CO₂ emission relative to the same sized in-production aircrafts, 20dB reduction in airport noise relative to ICAO Chapter 4 regulation, and 70% reduction of NOx emission relative to CAEP/6 regulation.

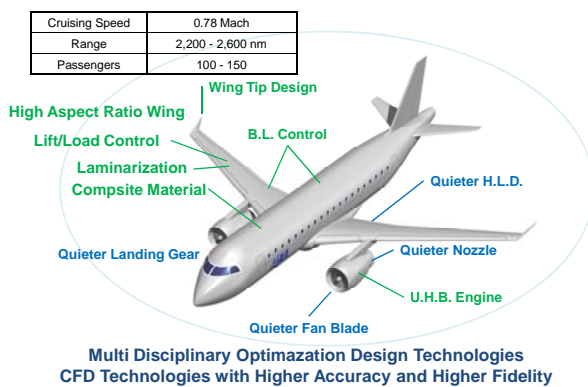


Fig. 8 Technology Reference Aircraft 2022

5 Concluding Remarks

This program is supposed to be launched in 2013 coincidentally with commencement of the 3rd JAXA's Mid-Term R&D Period 2013-2017, though all of above mentioned projects could not be launched at the same time. Detailed planning is required for all of the projects.

References

- [1] Airbus, "Global Market Forecast 2010-2029", <http://www.airbus.com/company/market/gmf2010/>
- [2] Boeing, "Current Market Outlook 2011-2030", <http://www.boeing.com/commercial/cmo/>

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