ANA: Highlights of 2000 Fiscal Year

1. General

(1) Paid-in Capital: ¥86,079 million (as of March 31,2001)
(2) Number of Employees: 13,946 (as of March 31,2001)
(3) Operating Revenues: ¥966 billion
(4) Operating Size: Domestic: 36 cities、85 routs、544 flights/day on average
International : 26 cities 、38 routs 、324 flights/week (March,2001)

2. Operating Status

(1) Number of Flights: 215,090 (Domestic: 195,389、International: 19,701)
(2) Passengers carried: 43.7 million
(3) Revenue Passenger Kilometers, RPK: 58,819 million
(4) Available Seat Kilometers, ASK: 86,836 million
(5) Overall Load Factor: 67.7%

3. Establishment of New Routes and relating matters

(1) **Domestic**: Construction permission of Chubu International airport (April 2000)
Extension of Airport operating hour (Asahikawa, Obihiro, Kushiro, Memanbetsu, Wakkanai, Akita, Komatsu, Oita, Miyazaki, Okinoerabu) (July)
Code sharing with Asiana Airlines started (December)
Nighttime Operation at Haneda airport began (February 2001)
Extension of runway at Yamaguchi-Ube Airport (March)

(2) **International**: Narita-Chicago, B777ER ETOPS operation started (May 2000)
New fleet introduction of B777-300ER decided (July)
Code sharing with Asiana Airlines, Kansai-Seoul, started (December)
Code sharing with Thai Airways, Narita-Bangkok, started (December)
AJX (Air Japan) operation started (January 2001)
International Charter Flight from Haneda Airport started (February)
Code sharing with Air Canada, Nagoya-Vancouver, started (February)
Code sharing with Vietnam Airlines, Narita-Ho Chi Minn, started (March)
Inchon Airport, Korea, opened (March)

4. Main Movement relating to Environmental Issues

(1) **Domestic**: Revised Energy Conservation Law(April 2000)
Free Air Tickets to volunteer activities for Mt. Usu eruption (April)
New left-turn procedure from Haneda A-runway started (July)

「ANA-group Environmental Liaison Conference」 was held (September)

「Environmental Sub-committee」 by Scheduled Air Transport Service Association of Japan(Japanese 12 scheduled airlines) was established (January 2001)

「PRTR calculation manual for Airline Industry」 was published by Scheduled Air Transport Service Association of Japan(February)

PRTR workshop for Airline Industry by Tokyo Environmental Protection Office was held (March)

「ANA Environmental Management Practical Training」was held (March)

(3) **International**: STAR Alliance Environmental Advisory Meeting was held (May/December 2000)

IATA ENTAF (Environmental Task Force Meeting) was held (November /March 2001)

ICAO CAEP/5(5^{th} Committee on Aviation Environmental Protection) was held (February)

5. ANA FLEET（as of March 31, 2001）

Aircraft Type	Fleet	Engine Type	Average Age (Year)	ICAO Noise Standard
B747SR	11	CF6-45A2/-50E2	20.3	Chapter 3(*)
B747-200B	3	CF6-50E2	13.8	Chapter 3(*)
B747-400	23	CF6-80C2B1F	7.3	Chapter 3(*)
B767-200 B767-300(**)	11 42	CF6-80A CF6-80C2B2/B6/B6F	15.4 9.5	Chapter 3(*) Chapter 3(*)
A320 A321	25 7	CFM56-5A1 V2530-A5	8.0 2.0	Chapter 3(*) Chapter 3(*)
B777-200 B777-300	16 5	PW4074/4077 PW4090	3.4 2.5	Chapter 3(*) Chapter 3(*)
Total	143	—	9.0	—

(*):Chapter 3 is the most stringent noise standard at this moment.

(**)Including AJX(Air Japan) aircraft

NOTE: ANA Group（NCA、ANK）Fleet

(1) NCA（Nippon Cargo Airlines）Fleet（as of March 31,2001）

Aircraft Type	Fleet	Engine Type	Average Age (Year)	ICAO Noise Standard
B747-F	10	CF6-50E2	14.8	Chapter 3(*)

(2) ANK（Air Nippon Co., Ltd.）Fleet（as of March 31,2001）

Aircraft Type	Fleet	Engine Type	Average Age (Year)	ICAO Noise Standard
B737-400	1	CFM56-3C1	11.1	Chapter 3(*)
B737-500	18	CFM56-3C1	4.5	Chapter 3(*)
YS-11	6	DART Mk542-10	31.6	－

Chapter 1 Introduction

1-1 Main Movement in fiscal 2000

(1) General

After the 3rd Conference of Parties to the United Nations Framework Convention on Climate Change (Kyoto Conference) in December 1997, the government has drawn up the "Outline concerning the Promotion of the Measures to cope with Global Warming" in 1998. And it has enforced the laws such as "Law for Recycling of Specified Kinds of Home Appliances", "Law for Promotion of Effective Utilization of Resources", "Law on Promoting Green Purchasing", "Law for Promotion of Effective Use of Resources", "Law for Promotion of Recycle Use of Recyclable Food Resources" and "Containers and Packaging Recycling Law" in fiscal 2000. Thus, the effort to create the infrastructure for the recycling style society has been being made.

We have been tackling on the issues relating to the environment as follows in 2000 fiscal year. While reorganizing the "Environmental Management System", we drew up the "ANA Environmental Concept" in 1998, and established the Environmental Course of Action (Action Plan for the 21st century) in May 1999. In fiscal 2000 each department inside ANA started making their own action plan according to the Environmental Course of Action. Also, we held the 6th “ANA Group Environmental Liaison Conference” in September 2000 to exchange information of each group company as well as to confirm the cooperation system on the conservation activity for global environment by the group company as a whole. Third in-house training related to the environment, “Environmental Management Practical Training” was executed in March 2001.

Cooperation and information-sharing At the time of becoming a member airline of the Star Alliance in fiscal 2000, ANA has adopted ‘Star Alliance Environmental Commitment Statement’ that commits to reduce the impact on the environment and maintain a healthy balance between progress and environmental sustainability with other member airlines through regular meetings of environmental commissioners encourage us to promote our environmental activities. ANA hosted the 6th Meeting in Tokyo in May 2000.

With respect to Environmental Management System Standard, ISO 14001, our Narita Maintenance Center that is main maintenance base for international flights aims to acquire the UKAS certification in 2002.

As Japanese airline industry, Scheduled Air Transport Service Association of Japan represents Japanese 12 scheduled airlines established ‘Environmental Sub-Committee’ to discuss and decide its policy for the common environmental issues.

As the global organization, ICAO(International Civil Aviation Organization) and IATA(International Air Transport Association) proact for the global environmental issues caused by aviation to reduce their impact to the environment. ANA has been participating in their activities.

(2) Aircraft Noise

In Japan the amendment of Civil Aeronautics Law in June 1994 is requiring Chapter 2 aircraft to be phased out by April 1, 2002 in line with ICAO (International Civil Aviation Organization) regulation (Annex 16). All aircraft operated by ANA meet the most stringent noise regulation in accordance with ICAO Annex 16, Chapter 3 after the retirement of the last B737-200 in August 1992 and L1011 in May 1994. As ANA group the last ANK B737-200 Chapter 2 aircraft retired in November 2000. All aircraft of the entire ANA group was replaced by Chapter 3 aircraft accordingly.

ICAO CAEP (Committee on Air Environmental Protection) has been examining the reinforcement of the present Chapter 3 aircraft standard further. ICAO CAEP/5 (January 2001) recommended the Council 'The introduction of New Chapter 4 standard', 'Re-certification standards to New Chapter 4' and 'Balanced approach to aircraft noise management' but did not support general phase-out of Chapter 3 aircraft in the non-exempt regions as the result of the cost/benefit analysis. 'Local operating restriction at airports based upon aircraft noise characteristics' was suspended. New Chapter 4 standard is going to be adopted at ICAO Assembly/33(September 2001) and be effective in 2002.

In the European airport with an original noise restriction, there is a movement to reinforce the noise regulation value. Therefore, a big impact is forecasted for the airline companies that operate airplane with near maximum take-off weight for long air route. ANA operates the quietest B747-400.

At New Tokyo International Airport the noise suppression facility (for south wind) for the ground run-up of the aircraft engine was built by a joint investment of ANA, JAL, and NAA(Narita Airport Authority) in April 1999. After the modification of facility to resist the crosswind and to improve the performance, Full-dress operation started from April 2001. It is expected that it is more efficient than the existing facility for the north wind, is possible to correspond to all types of airplanes, is possible to operate for 24 hours, and contributes to the noise reduction to the region greatly.

(3) Air Pollution

The situation of the air pollution in Japan is highly influenced by the automobile and so on. Especially it is the urgent business to improve the pollution by NOx and SPM (Suspended Particle Matter). As for NOx, the legislation of automobile NOx emission came into force in December 1993. From the city of Tokyo in August 1996 "Guidance Outline of Automobile NOx Emission Gross Weight Control" was issued to call on the business who uses trucks and so on above a certain scale for

the voluntarily supervision of NOx emission control. Similar outlines are also issued in Osaka and Kanagawa prefecture.

The automobile emission control plan has been made and executed also in our company aiming at desired value in the outline that is "to reduce 10% by 2000 fiscal year based on the amount in 1997 fiscal year". It was achieved successfully.

To reinforce the emission standard of NOx from the aircraft, ICAO adopted new regulation in March 1999, which is about 16% (at engine pressure ratio 30) reduction from the present regulation value. The regulation will be applied to the new engine types first certified after December 31, 2003. The engines currently being produced are not applicable.

(4) Waste and Recycling

The establishment and the amendment of The Law concerning Material Recycling (October 1991), Waste Disposal and Public Cleansing Law(July, 1992), Tokyo City Ordinance(June 1992 and December 1996)and so on successively request the reduction of the waste. We are recycling our papers, empty cans and bottles at almost offices in our company.

"Law concerning Pollutant Release and Transfer Register" (PRTR Law) was finalized in November 1999. By PRTR system, the transferred amount of the wastes containing the objective chemical materials to the processing traders also becomes the object of the understanding in addition to the emission amount of chemical materials.

(5) Global Warming

In September 1996 Japanese airline industry has committed to achieve the target “By 2010, CO_2 emission per transport unit(ASK: Available Seat Kilometer)will be reduced by 10% from the 1990 level”, according to the voluntary action plan(the goal quantity of the reduction of the CO2 emission and the concrete measure for the reduction, and so on)produced by The Federation of Economic Organizations.

In February 1998 as the Ministry of Transport requested Japanese airline industry the voluntary action plan to reduce CO2 emission, The Scheduled Airlines Association of Japan represents Japanese 12 scheduled airlines has committed to achieve the same target and measures to cope with global warming as the one submitted to The Federation of Economic Organizations.

UNFCCC COP/3 held in Kyoto in December 1997 has adopted「Kyoto Protocol」that define reduction target of emissions of Green House Gas by developed countries not controlled by the Montreal Protocol. In May 1999 IPCC published a special report,「Aviation and the Global Atmosphere」, that was based on the request of the ICAO. It assesses what is known about the effects of aviation on the earth's climate and on atmospheric ozone in the past and in the future. It also includes scientific, technological, social and economic issues associated with adverse effects of aviation. The outline of IPCC special report is described in

Chapter 5. ICAO keeps working to establish market-based measures to reduce CO_2 emission from aviation international bunker fuel that is not included in the national inventory of the Kyoto Protocol.

At resumed meeting of UNFCCC COP/6（July 2001）many draft operating rules of 「Kyoto Protocol」were adopted. It is expected to be made a final rule at COP/7 （October 2001）, thereafter ratification process by member states.

(6) Protection of Ozone Layer

The production of freon and trichloroethane was prohibited in January 1, 1996 and halon was in January 1, 1994 in compliance with “Montreal Protocol”. It plans to make a total abolition of CFC alternatives in principle in 2020. In Europe there is also a movement that advances the date of CFC alternatives abolition.

As for the use of freon and trichloroethane etc. in ANA, they were abolished at the end of fiscal 1993 based on the abolition plan in 1990. Refrigerant used for the air chillers (freezer) installed in the aircraft have completely replaced by CFCs substitute (HFC134a) in 1999 fiscal year.

1.2 Air Transport and Global Environmental Issues

The environmental issues are classified as follows in figure 1-1. The issues to be especially related to the air transport in figure 1-1 are the following items.

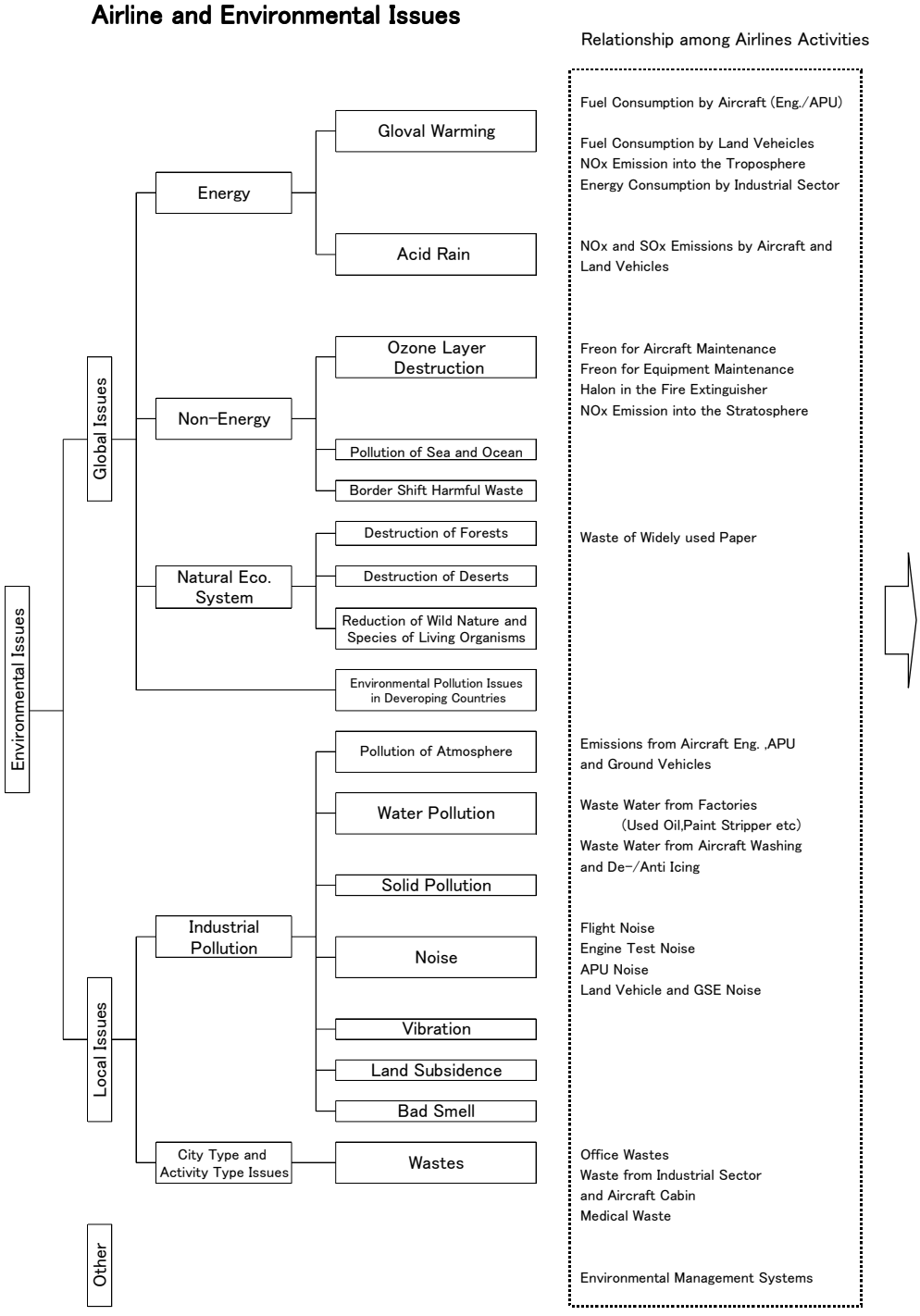


Figure 1-1 Classification of the environmental issues and their relation with Airline Business

Law and Reguration , Economical Merit	ANA's Present and Theme
United Nations Agreement of Climate Change「Kyoto Protocol」	Emission Amount of CO2 from Aircrafts 7850 Thousand-ton
「Law Concerning the Promotion of the Measures to Cope with Global Warming」	(2140 thousand ton-carbon)
Vountary Plan by Airline Industry in Japan :	(Fuel Consumption 3190 Thousand-kl)
by 2010, CO2 Emission per Tranportunit(ASK:Available Seat Kilometer)	Actual in 2000 24.9gram-carbon (target in 2010 24.4gram-c)
will be Reduce 10% from 1990 Level	Reducing APU Use
* 「Environmental Tax(Carbon Tax)」?	Class 2 Designated Energy Management Factry
* 「Law Conserning the Rational Use of Energy」 Amended	(Over 6Mega-KWh/Year)
「Air Polution Control Law」	(Inf. Ctr., Training Ctr., Aircraft Maint. Ctr., TYO Apo Office)
「The Law for Total Emission Reguration of Nitrogen Oxides from Automobiles」	
* Metropolitan's Ordinance : Nox from Automobiles	ANA Group : Low Emission Vehicles : 78/2200 Cars→to Increase
「Vienna Agreement」・「Montreal Protocol」	Fluorocarbon Complete Abolished from Maintenance(1994)
「Ozone Layer Protection Law」	Remove/In-operative Fluorocarbon Used Aircraft Components
Halon,Fluorocarbon was Suspended、CFC Alternatives will Suspend by 2020	Replaced by CFC's Substitude
「Fire Law」	Collect HFC、Harmlessness when Scrap CFC and HFC
	Fuel Dump due to Unexpected Landing
	(8 Cases、454kl)
undamental Law for the Promotion of the Formation of Recicleing Style Societ	Use Recycled Paper
「Law on Promoting Green Purchasing」	Enforce Classified Collection of Papers and Recycle
「Convention on Int'l Trade in Endangered Species of Wild Fauna and Flora : Washington Convention」	Inform about Inport Prohibit Animals and Plants
ICAO Aircraft Emission Standard、「Civil Aeronautics Law」	ANA's Aircrafts Complied with ICAO Emission Standard
「Air Polution Control Law」	Reducing Emission(NOx、SPM) from Airport Vehicles
	Thoroughness of Eng. Stop when Vehicles Stay
* 「Water Pollution Control Law」	Low VOC Paints 、Examination Non-chlorine Paint Remover
* 「Sewerage Water Law」	Completed Waste Water Facilities、Study to Inc. of Water Reuse
「Natural Environment Consevation Law」	Changed Low Pollution De-/Anti-Icing Fluid(Propylene Glycol) from Ethylene Grycol
ICAO Aircraft Noise Standard、「Civil Aeronautics Law」	All ANA's Aircrafts Complied with ICAO Chapter 3
「Airport Regulations」、Curfew etc	Counterplan with Meet New Chapter 4
「Environmental Standard for Aircraft Noise」	Obey and Study Noise Abatement Operational Prosedure
* 「Industrial Safety and Health Law」	Reduce T/R Operation at Night、Reduce ENG Test Run
	Noise Suppression Facility for Test-run(NRT,HND,OSA,KIX)
	Change to Low Noise GSE
「Waste Disposal and Public Cleaning Law」	Classification Collection ・ Recycle
* 「Pollutant Release and Transfer Resister Law」・「Material Safety Data Sheet」	Management by PRTR/MSDS
* 「Industrial Safety and Health Law」	Manage by Manifest Sheet
「Fundamental Law for the Promotion of the Formation of Recicleing Style Society	Eco-Airport Planing(JCAB)
「Law for the Protection of Utilization of Recycled Resources」 etc	
	ISO14001 (Narita Maint. Center)
Public Information、Propaganda Value	ANA Environmental Report/Home Page、Environmental Account

* with Some Penalty
Recentry Executed or Tightened Law and Reguration

__ ANA's Theme

Figure 1-1 Classification of the environmental issues and their relation with Airline Business

(1) **Noise issue**: Although it is different from the global environmental issue, it is a issue to which a considerable improvement effort has been made as a issue not avoided in the airline industry up to the present.

(2) **Air pollution issue** : The influence of the aircraft on the atmospheric environment is assumed about 1 to 3% but the influence of the emission produced at the higher altitude has not been well understood yet. Every effort was focussed on the improvement of engine performance up to now.
The acid rain problem is thought to be caused rather by the automobile emission than by the aircraft engine.

(3) **Industrial Wastes Issue**: The issue of industrial wastes is not directly related to the air transport. However, the increase of industrial wastes by the business activity has been a social issue, which is necessary for us to concern as a matter of course as the business.

(4) **Global Warming Issue**: For the aircraft that uses fossil fuel, it is the highest concern of the issue. Also, the influence of NOx emission in the troposphere is recently argued.

(5) **Depletion of Ozone Layer Issue**: This issue is relating to the use of freon and halon for the aircraft maintenance work or aircraft equipment, and moreover there is an argument that NOx in the higher altitude destroys stratospheric ozone.

ANA takes these 5 items of (1) to (5) as the environmental issues, which concerns airline business in this report.

1.3 ANA Environmental Concept

ANA settled on "ANA Environmental Policy" in May 1998, which shows "ANA's Attitude toward the Environment" as a company.

ANA Environmental Policy

『ANA's Attitude toward the Environment』

Basic Policy

We will pursue:

- protection of the environment
- effective utilization of limited natural resources
- awareness of the public good

Course of Action

1. We will evaluate the impact of our commercial activities on the environment, and persevere in our efforts to protect the environment.

2. We will observe environmental laws and regulations, and furthermore, think and act independently to protect the environment.

3. We will make our best endeavor to minimize the environmental impact arising from operations of the airline industry.

4. We will make every effort to save energy and resources, to recycle articles, and to reduce waste.

5. We will contribute to the communities in which we live and work, through participation in social activities on environmental protection.

6. We will educate employees so that each may pay much more attention to environmental protection.

Global Environment Committee

This ANA Environmental Policy is declared inside and outside company.

1.4 ANA Environmental Action Plan

Our company drew up "Environmental Action Plan " (Action Plan for the 21st century) in May 1999, to which "Environmental Concept" had been embodied.

In fiscal 2000 Emission target and Aircraft Noise target were achieved successfully. Additional effort will be kept on other targets.

Environmental Action Plan

(Action Plan toward the 21st Century)

EMS

- To establish an EMS in accordance with ISO14001 standards.
  1. ANA or subsidiary companies to be accredited to ISO14001 standards by the end of 2002.

Global Warming

- To improve the level of CO_2 emissions caused by aircraft fuel consumption, per unit of output* in fiscal year 2010 by 10% compared to the level of fiscal year 1990. (*output measured in terms of ASK, Available Seat Kilometers)
  1. To promote a shift toward the introduction of new aircraft with improved rates of fuel consumption.
  2. To introduce new navigation systems (FANS).
  3. To continue to conserve fuel in operations, for example, by selecting optimum cruise speeds and altitudes, through APU limitation, and so on.

- To reduce energy consumption, especially electrical power, at facilities.
  Target:1% reduction per year, as compared with the previous year.

Emission

- To reduce the NOx pollutant caused by ground vehicles by 10% by fiscal year 2000, based 1997 levels.

Ozone Layer Protection

- To abolish the use in ANA subsidiary companies of materials prohibited the Montreal Protocol by 2002 fiscal year.

Aircraft Noise

- To phase out chapter 2 aircraft in ANA subsidiary companies by fiscal year 2002.

Waste

- To reduce waste.
- To reduce the amount of paper used for photo copying.

Global Environment Committee

1.5 Star Alliance Environmental Commitment Statement

At the time of becoming a member airline of the Star Alliance in fiscal 2000, ANA has adopted 'Star Alliance Environmental Commitment Statement' that commits to reduce the impact on the environment and maintain a healthy balance between progress and environmental sustainability.

Basic part of Commitment Statement is consistent with ANA Environmental Policy.

STAR ALLIANCE

Environmental Commitment Statement

Star Alliance, the first global airline alliance was established to deliver worldwide service to our customers We believe this global alliance creates important opportunities for cooperation and information-sharing as each of our companies seeks to integrate environmental considerations into all aspects of our business.

We recognise that each of our carriers operates in diverse regions of the world and faces many unique and local challenges, however, we share some important core principles The following principles challenge us to reduce our impact on the environment and maintain a healthy balance between progress and environmental sustainability.

- We are committed to promoting awareness and protection of the environment through an appropriate management system
- We will conduct our business in compliance with all applicable environmental regulations and expect every employee to take responsibility for meeting these standards when performing his or her duties
- We will work and communicate with customers, governments, local communities, unions, employees, and suppliers to identify and resolve environmental issues.
- We will prevent pollution at the source by reducing waste, recycling or disposing of items, and purchasing products that are reusable or that contain recycled materials
- We will strive to develop and use technology that is environmentally sound and we will promote enhanced environmental standards in our purchasing of new aircraft, equipment, and facilities
- We will seek new methods to balance the constant need for development with a commitment to protecting the environment, by continuous improvement

Air Canada

Scandinavian Airlines System

Air New Zealand

Thai Airways International

All Nippon Airways

United Airlines

Ansett Australia

VARIG Brazilian Airlines

Deutsche Lufthansa

3 May 1999

1.6 Process of Our Actions to Environmental Measure and Organizational system

(1) Process

① In November 1973 ANA established "Airport Department" as generalization/ adjustment department related to the environmental problems.

② In February 1974 ANA established “Environment Preservation Committee” as an advisory body of the president. The first committee was held in July of the same year, in which 4 professional Sub-committees were inaugurated that are “Aircraft Noise Issue Sub-committee”, “Ground Noise and Air Pollution Issue Sub-committee”, “Factory Waste Water Issue Sub-committee”, and “General Evaluation Sub-committee”.

③ In July 1990 ANA established "Environmental Affairs" to actively grapple the problems including the global environmental problems by stepping forward from the conventional way of dealing with the occurrence source. ANA integrated a part of the sub-committees by the function and reorganized them to make “Aircraft Noise Issue Sub-committee”, “Ground Noise and Pollution Issue Sub-committee”, and “Resource Preservation Sub-committee”.

④ In April 1993 ANA changed the title of “Resource Preservation Sub-committee” to “Global Environmental Measure Sub-committee”.

⑤ In June 1999 ANA changed the title of “Environment Preservation Committee” to “Global Environment Committee”, and 3 sub-committees of “Aircraft Noise Issue Sub-committee”, “Ground Noise and Pollution Issue Sub-committee” and “Global Environmental Measure Sub-committee” to “Flight Operation Environmental Issue Sub-committee”, “Ground Operation Environmental Issue Sub-committee” and “Global Environmental Issue Sub-committee” respectively.

(2) Organizational System

Figure 1-2 shows the location of "Global Environment Committee" and "Environmental Affairs" section in the organization.

Fig.1-3 shows Global Environment Committee and Sub-Committee.

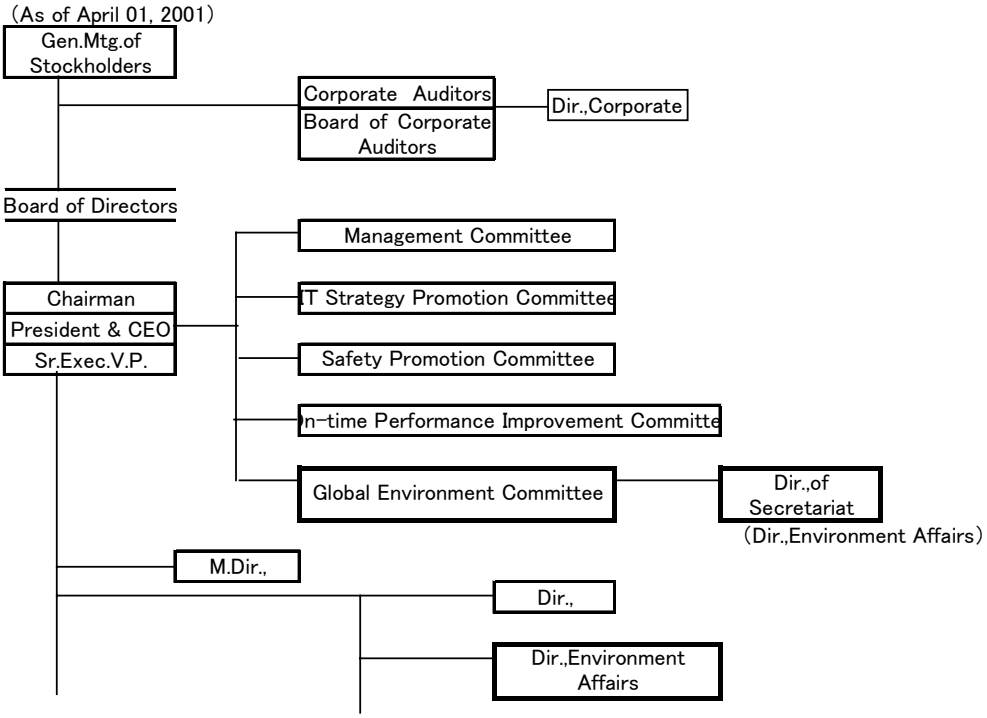


Fig.1-2 ANA Company Organization (Environment)

Global Environment Committee

- Global Environmental Issue Sub-Committee
- Flight Operation Environmental Issue Sub-Committee
- Ground Operation Environmental Issue Sub-Committee

Fig.1-3 Global Environment Committee and Sub-Committee

1.7 Situation of Our Cooperation to Outside Organizations

The situation of our participation and cooperation to the outside organizations related to the environment is as in table 1-2.

Fiscal Year	Organization	Content
1991	Environmental Information Center	The business of this group is to spread and to offer an information of science and technology that affects the environmental conservation. The economic world backed up to establish the group. ANA cooperated when the group was established.
	Global Environmental Forum	This group is developing a scientific research of the global environmental issues, exchanging information, spreading the result of the research, supporting the environmental conservation activity, and developing international cooperation. ANA registers as a member and has received the service of information etc. concerning the environment.
	Japan Flower Promotion Center (JFPC)	This group (The Ministry of Agriculture, Forestry and Fisheries jurisdiction) succeeds to the idea of "International Flower EXPO", and aims at the spread of flowers and the promotion of national greening. ANA agrees to this idea and cooperates with this group.
1992	Japan International Forestry Promotion and Cooperation Center	ANA cooperates in this group (the Ministry of International Trade and Industry and the Ministry of Agriculture, Forestry and Fisheries jurisdiction) which promotes the national tree-planting campaign.
	IATA ETAF(Environmental Task Force)	ANA has participated in a regular conference since the 5th conference (May 1992) as an observer and has acquired the opinion and exchanged information. The first IATA international seminar about " Environmental impact by Air Transport" planned by ETAF was held at ANA hotel in Washington DC in March 1993. ANA also supported the seminar.
1993	International Noise Control Conference	ANA cooperated in the 23rd Inter Noise 1994 Yokohama held in Japan in 1994.
	Council on Life-Innovation	ANA participates in "Asian investigation committee concerning development and the environment" sponsored by Council on Life-Innovation.
1994	Global Environment Tokyo Conference	ANA agrees to and supports the purport of the global environment Tokyo conference held in October 1994.
1995	Oze Conservation Group	ANA agrees to and supports businesses to protect "Oze" and to conserve "Nikko Cedar Avenue".
	Nikko Cedar Avenue Conservation Fund	
1996	Green Purchasing Network	Member registration (February 1997) to the network where promotes prior purchase of commodity with few impacts to the environment.
1997	FCCC (Framework Convention on Climate Change)Conference	ANA donated contribution money to "COP 3(3rd Conference of the Parties)" held in December in Kyoto.

1999	Japan National Trust	ANA agrees to and supports conservation activities of cultural property and nature.
2000	Star Alliance Environmental Advisory Meeting(Tokyo)	ANA hosts the meeting in Tokyo (8 member airlines).
	Green Port 2000(Narita)	ANA supports International Airport Environment Conference held by ACI (Airport Council International), NAA(Narita Airport Authority)and IATA(International Air Transport Association)

Table 1-2 Situation of the cooperation to the outside organizations

Chapter 2　Noise

2.1 Airport Noise

Followings are airport noise issues.

(1) Aircraft noise (aircraft engine sound at landing and takeoff)

(2) Ground noise

① Engine ground running noise

② APU (Auxiliary Power Unit) running noise

③ GPU (Ground Power Unit) running noise

④ Others (ground support equipment operating noise, maintenance facility operating noise and so on)

To reduce the influence of noise, the condition of the airport establishment becomes a big factor. As an airline company, ANA will continue to consider minimizing noise disturbance.

2.2 Aircraft Noise

(1) Introduction of Quieter Chapter 3 Aircraft

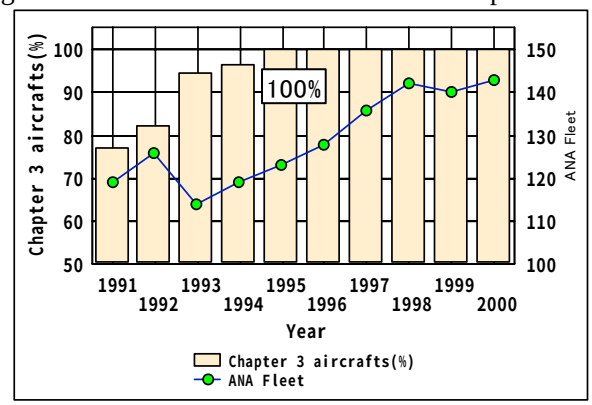
Aircraft are certified against ICAO（Annex 16）standards. In the present standard, it is divided into two; Chapter 2 aircraft(aircraft which suits to the standard before the noise standard was reinforced）and Chapter 3 aircraft（aircraft which suits to the most severe standard at present after the noise standard reinforcement）.

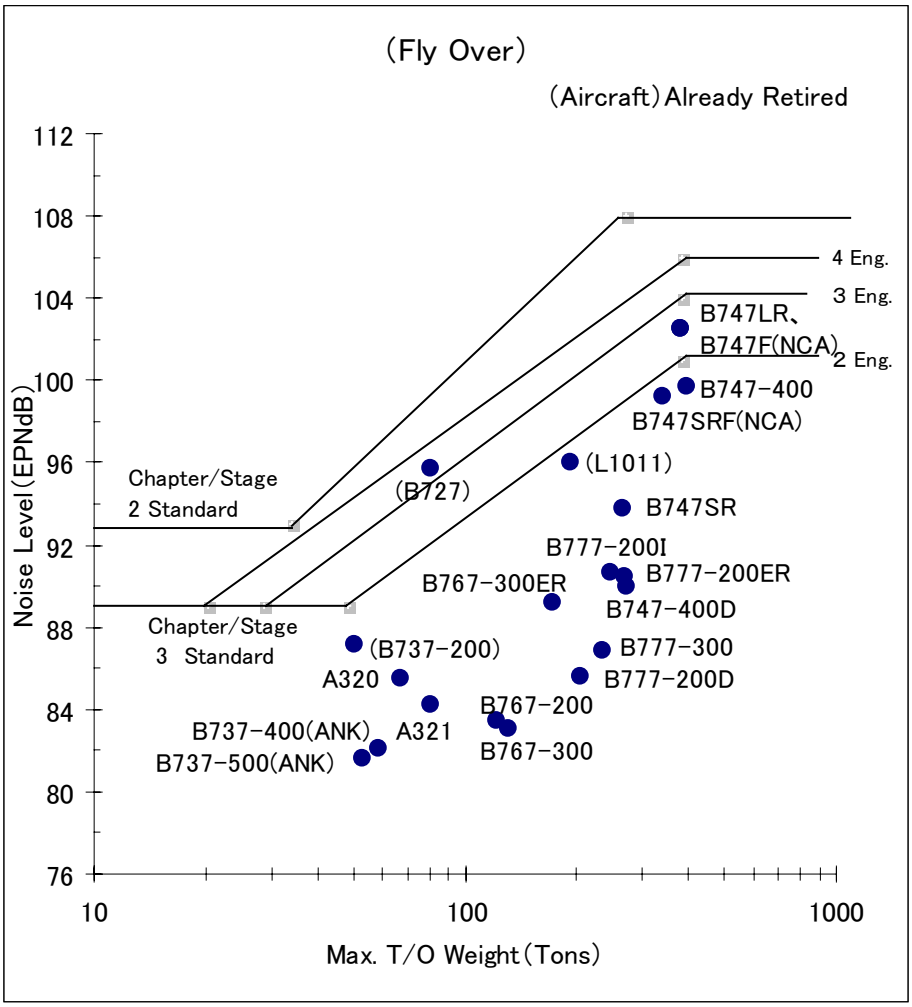
All ANA's aircraft have fully complied with Chapter 3 requirement in 1994 (see Figure 2-1, Figure 2-2). Moreover, ANA has been continuing to introduce newer, quieter Chapter 3 aircraft like B777-300 and A321. In Japan, Certification to the quieter Chapter 3 standard will become a mandatory requirement by April 1, 2002. In ANA group ANK had retired the last Chapter 2, B737-200, aircraft in November 2000. All ANA group's aircraft have fully complied with Chapter 3 requirement accordingly (see Figure 2-1, Figure 2-2).

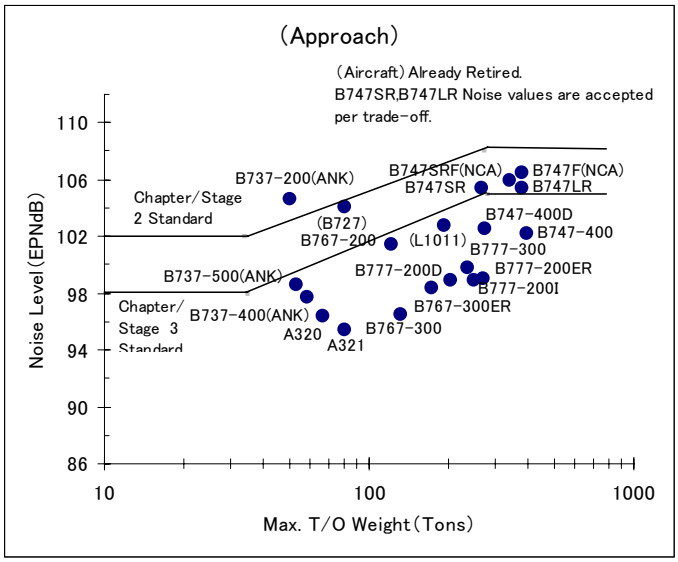
ICAO is going to a new requirement for the noise standard reinforcement, and a new standard(Chapter 4)is scheduled to be adopted in September 2001.

New standard(Chapter 4)is going to be applicable for new type certificated aircraft after 01 January 2006. At this stage 90% of ANA's fleet is going to be complied with new Chapter 4 requirement.

Fig.2-1　ANA fleet that conform to Chapter 3 standards







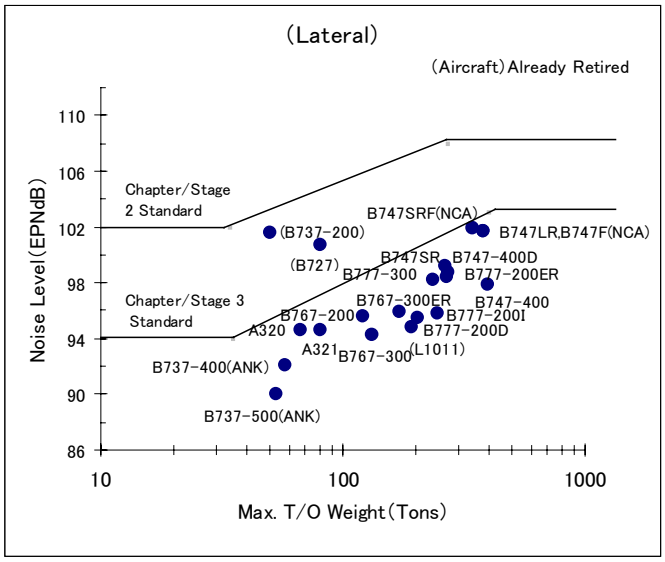


Fig.2-2 ANA Fleet Noise Level and ICAO Standards

(2) Change in Noise Contour

The area influenced by the same noise level has been reduced with the introduction of new quieter aircraft. (Refer to Figure 2-3).

ANA participate in "Aircraft Noise Issue Sub-committee" and its working group that are formed by the government and the people combination, and continue the review work to improve the accuracy of the noise-forecast program.

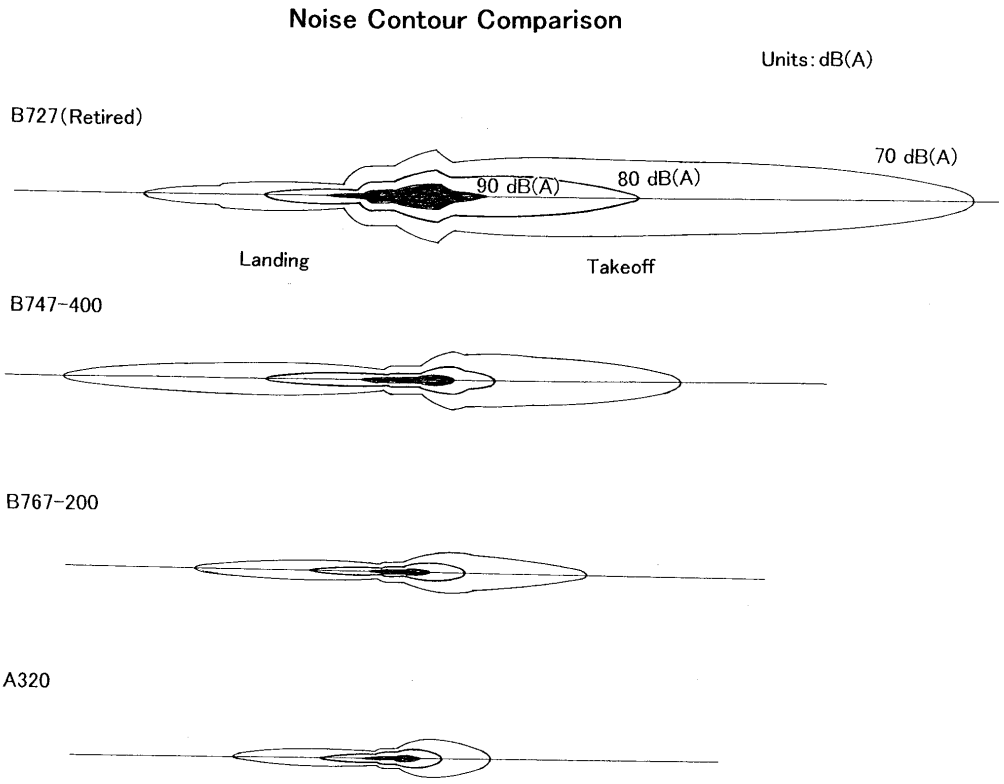


Fig.2-3 (1) Noise Contour comparison

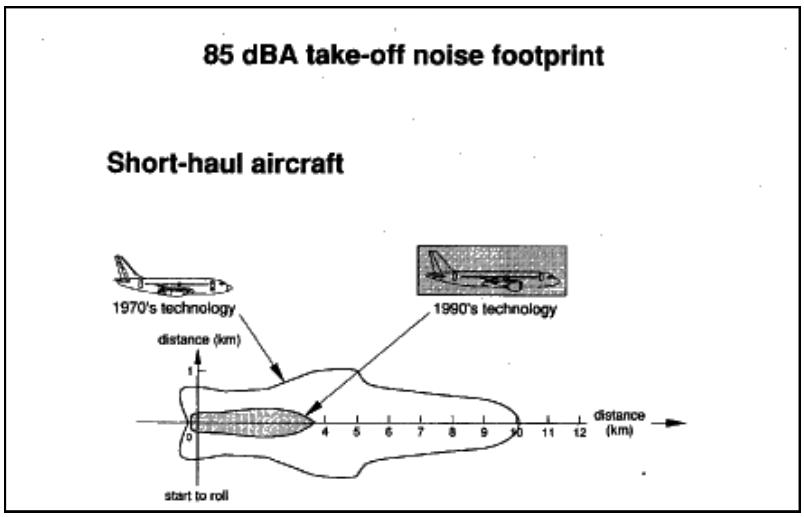


Fig.2-3(2) Noise Contour comparison (Sources: Airbus Industries)

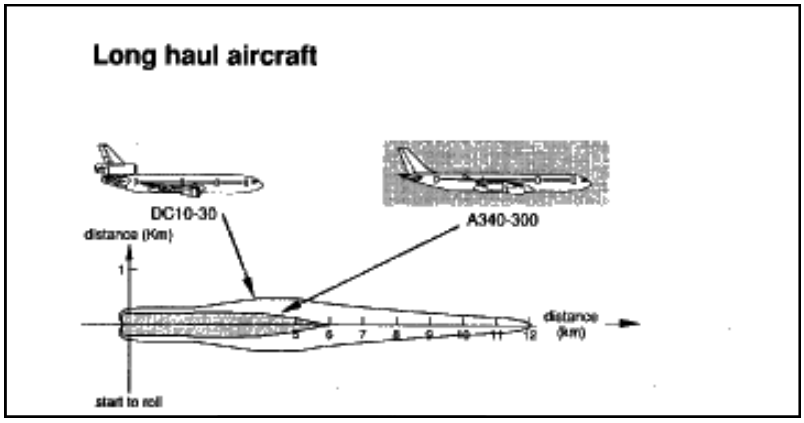


Fig.2-3(2) Noise Contour comparison（Sources: Airbus Industries）

(3) Reinforcement of Chapter 3 Noise Standard

ICAO has been examining to reinforce the aircraft noise standard based on the following facts; restriction for the introduction of hush-kited chapter 3 aircraft in EU, movement of adopting the noise regulation and noise charges in EU airports, and present noise standards not being improved since 1977.

ICAO CAEP/5（January 2001）recommended the Council 'The introduction of New Chapter 4 standard' and 'Balanced approach to aircraft noise management' but did not support general phase-out of Chapter 3 aircraft in the non-exempt regions as the result of the cost/benefit analysis. 'Local operating restriction at airports based upon aircraft noise characteristics' was suspended.

New Chapter 4 standard, a cumulative stringency of –10dB over current Chapter 3 levels and the sum of the improvements at any two measurement points shall be at least 2dB with no trade-offs（The applicability date is 01 January 2006）, is going to be adopted at ICAO Assembly/33(September 2001) and be effective in 2002.

(4) Introduction of Noise Abatement Operational Procedure

Based on the examination of "Promotion Committee of Noise Abatement Operational Procedure", which was established by the united efforts of the government and the people in 1975, ANA introduced Noise Abatement Operational Procedure and have been improving it up to the present.

Also, FMS (Flight Management System) operation in a terminal area to fly effectively avoiding densely built-up area has been started at Haneda Airport in March 1999 and the operation was expanded. It is expected to be expanded in other effective airports.

(5) Kansai International Airport

The investigation flight has been implemented for the evaluation on the "ground route" which was introduced in December 1998. Kansai International Airport Authority has issued their 'Environmental Management Plan' in June 2001.

New B-runway is scheduled in use in 2007.

(6) Osaka International Airport

Noise area was judged to have been decreased remarkably by the improvement of the landing noise, the introduction of quieter jet aircraft, a functional share with Kansai International Airport and so on. Consequently, the Ministry of Transport brought up the reviewed proposal of Osaka International Airport Noise Area. The noise-measured district was scaled down based on the Aircraft Noise Regulation law in April 2000.

(7) Tokyo International Airport (Haneda)

The noise problem in Haneda Airport area was improved extensively by the use of the new C-runway beginning in March 1997. As a result, Tokyo International Airport became to be operated for 24 hours. And new B runway was started to be used in March 2000. From February 2001 international charter flight operation during nighttime has been permitted and ANA has started its operation.

(8) New Tokyo International Airport (Narita)

Interim parallel runway, 2,180m, has been constructing and scheduled to be completed at the end of November 2001.

2.3 Ground Noise

(1) Osaka International Airport

Sound isolating walls for the engine run-up were set up in 1971, which are still in use, also have been making a best effort to shorten the run-up time and the high power operation time as well as the APU operation time. A new engine test-run facility with large-scale soundproof walls will be constructed to contribute to the ground noise reduction. It will complete in spring 2002.

(2) New Tokyo International Airport (Narita)

① With the beginning of the operation of terminal 2, ANA consider an influence over the area near taxiway, and voluntarily refrain from operating APU at the time of ramp in and ramp out. As for our operation of APU, APU OFF operation has been our standard since 1992 from the viewpoint of ramp noise reduction according to a request from NAA as well as from the viewpoint of the fuel cut down (the reduction of CO2 emission). When the repair of terminal 1 was completed, NAA notified all the airlines "to implement APU OFF operation as much as possible from April 1, 1998" with a document from the viewpoint of the global warming prevention.

② The hanger type noise suppression facility(engine ground running noise) for the south wind was constructed by a joint investment of ANA, JAL, and NAA in April 1999, which is a part of the countermeasures on the aircraft noise. It is expected to be more efficient than the existing facilities for the north wind, to be possible to correspond to all kinds of airplanes, to be possible to operate for 24

hours, and to contribute to the region environmentally. The modification of facility to resist the crosswind and to improve the performance was carried out in 2000. Full-dress operation started from April 2001.

(3) Tokyo International Airport (Haneda)

① New run-up area was established in offshore area of Haneda and was started to operate in January 1994. The noise problem to the area was considerably eased by the operation of 7 spots in total.

② ANA built the new engine test cell in October 1995, which is considered to restrain low frequency noise, and also built an APU run-up facility aside in April 1998.

(4) Countermeasure on Noise of Maintenance Facilities and Vehicles

ANA is carrying forward the renewal of our vehicles to low noise type and 70% of the AC power supply car ANA possess are low noise type. Also, ANA introduced 1 low-noise type de/anti-icing vehicle with blower by 2001.

Chapter 3 Emissions

3.1 Air Pollution Issue

The pollutants are carbon monoxide (CO), hydrocarbon (HC), nitrogen oxides (NOx), sulfur oxides (SOx), dust, small particles and so on. Especially NOx from diesels, Suspended Particle Matter (SPM/DPM) and secondary pollutant of photochemical oxidant are recently considered as big issues.

3.2 Aircraft and Air pollution

It is supposed that the aircraft engine emissions hardly influences local air pollution because emissions becomes extremely rarefied due to the air diffusion effect in the atmosphere over 1,000 meter altitude. According to the data of International Air Transport Association (IATA), the aircraft emissions contributes 1 to 3% of all the air pollution, that is quite small percentage compared to other emission sources such as automobiles and factories. The scientific findings report at this moment by United Nations IPCC (Intergovernmental Panel on Climate Change) was issued in May 1999. (Refer to Chapter 5)

The study and development of the aircraft emission reduction technique is remarkably improved in the past 30 years and emission quantity of HC, CO and smoke have been substantially decreased. Figure 3-1 shows the change in every 10 years from 1960 to 1990 about the emission quantity per engine thrust with the Landing Taking Off(LTO)Cycle set by(ICAO). HC and CO has been reduced substantially within 30 years. However, NOx shows not to be decreased. To have made a combustion chamber with a high temperature and a high pressure to improve the efficiency of engine combustion makes the reduction of NOx emission difficult.

Also, trying to suppress NOx emission results in the increase of the fuel consumption. It is our concern to balance both. Following methods have been researched to reduce NOx, and a part of them has been made practicable: multi-staged combustion chamber, pre-mixed rarefaction combustion method, concentration/rapid cooing/rarefaction combustion method, pre-mixed catalyst combustion method. Incidentally, the fuel used decides the sulfur oxides (SOx) emission. However, the influence on the air pollution(especially the acid rain problem) can be said very small because the aircraft_fuel (kerosene type) which is used at present contains equal or less than 0.01 % of sulfur (the standard is equal or less than 0.3 %).

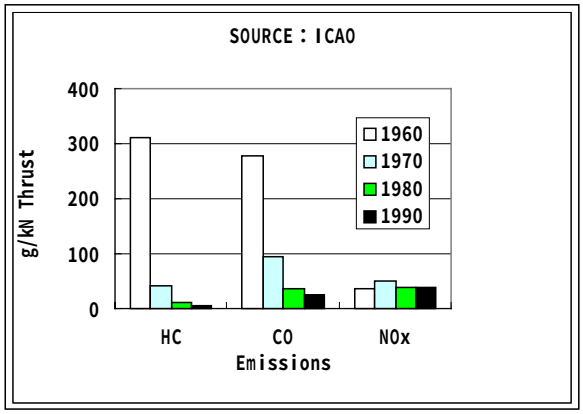


Fig.3-1 Progress of Engine Emissions

3.3 Aircraft Engine Emission Control

ICAO regulates HC, CO, NOx and smoke with Emissions certification system and Fuel emissions certification system according to the ANNEX 16, Part 2 "Aircraft Engine Emission" that became effective on February 18, 1982. After the revision some times, in March 1999, ICAO agreed on the new regulation value plan, which cut down NOx standard by about 16 %(at engine pressure ratio 30) from the present regulation value, to apply to the new type engines shipped first after December 2003(not applicable to engines being produced at present).

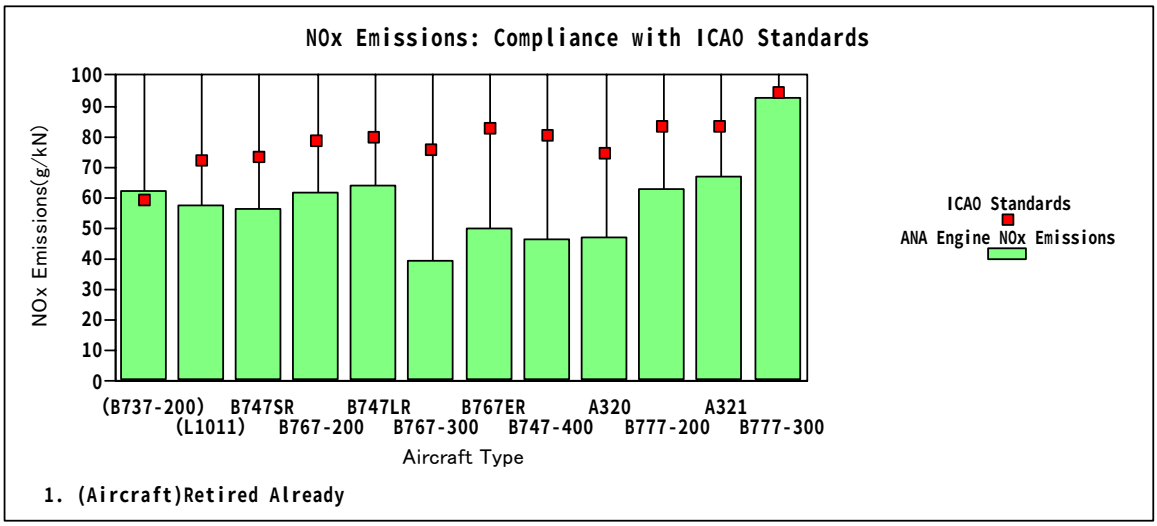
In Japan, a part of Civil Aeronautics Law was amended in April 1996, that the aircraft engine emission was added to the inspection standard of Airworthiness Certificate, and was enforced in October 1997.

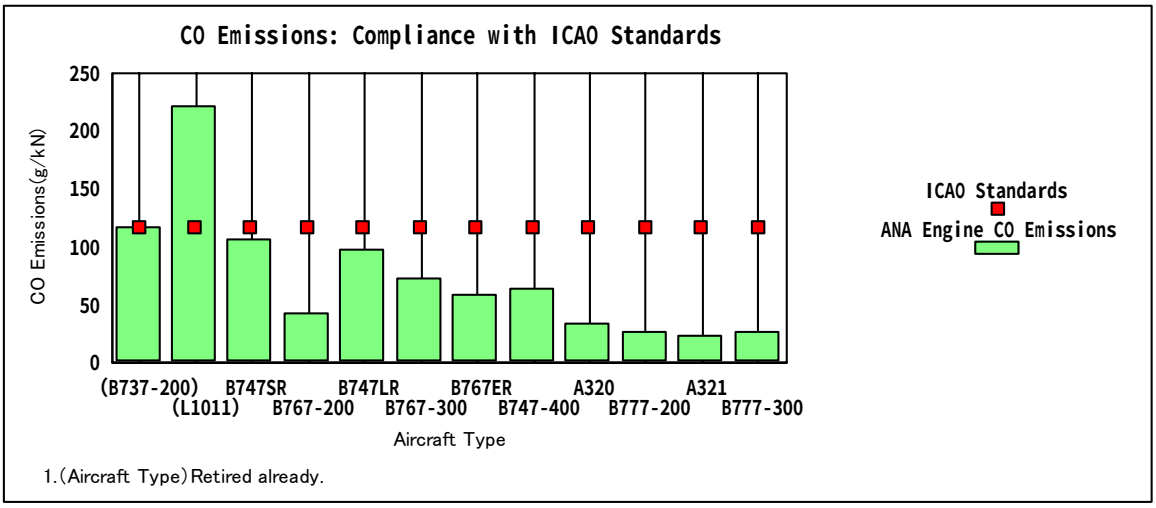
3.4 Present Situation of ANA and its attitude

(1) Aircraft and related matters

The most effective way to reduce the harmful aircraft emission is to introduce an improved new engine. As a result of our having actively introduced the latest aircraft, the improvement of the emission is remarkable in this 20 years. Figure 3-2 shows the contrast of the emission quantity of aircraft engines ANA possess with the ICAO standard value. The engines being used at present in our company, excluding a few engines produced in a small scale, meet the emission standard of ICAO.

In order to restrain the emission in the operation, we practice following matters besides introducing the latest engines: decreasing the operational time of engines as much as possible, reducing the use of Auxiliary Power Unit (APU) by utilizing the ground facilities, shortening time of ground engine run-up by improving the maintenance work procedure, executing a practical flight training with a simulator, and cutting time of ground run-up training.





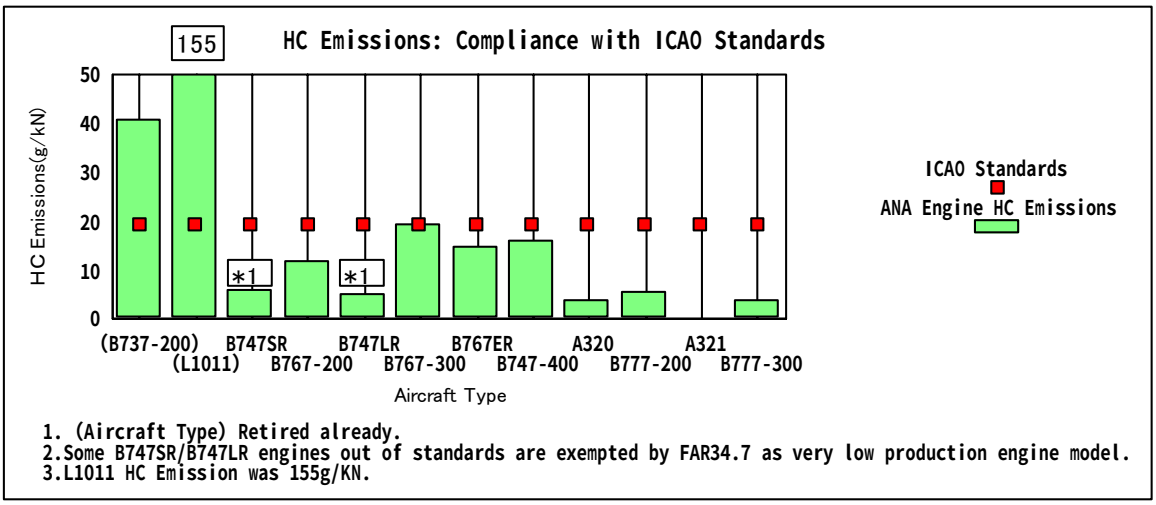


Fig.3-2 ANA Fleet Engine Emissions and ICAO Standards

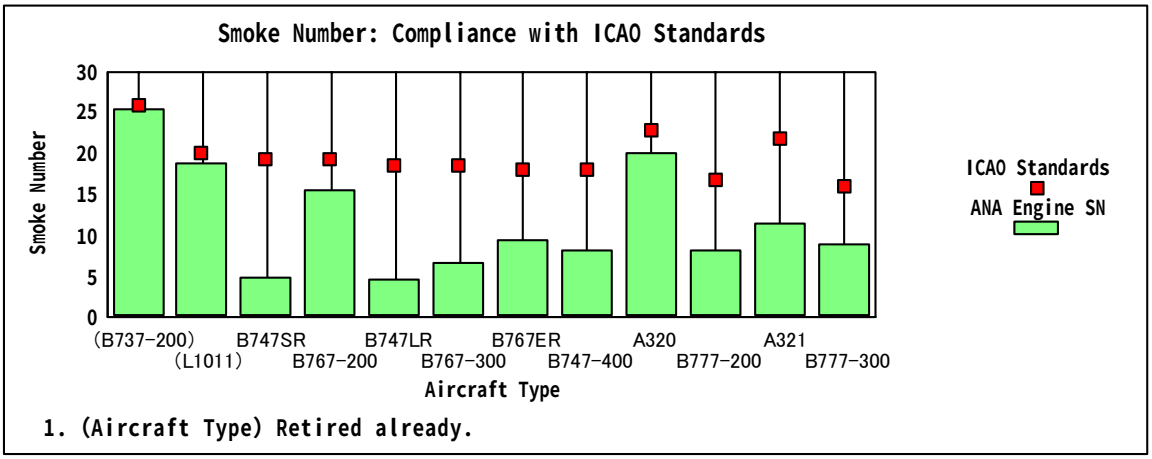


Fig.3-2 ANA Fleet Engine Emissions and ICAO Standards

(2) Ground Vehicles and related matters

There are about 2,200 or more vehicles of various kinds (ground support equipment car, aircraft maintenance vehicle, airport handling car, tag car, AC power supply car, forklift and so on) that our group companies use in the airport throughout the country. ANA is making an effort for introducing low-pollution vehicles and renewing those to the latest vehicles with lesser harmful emissions in permissible range. ANA possess 78 low-pollution vehicles in total as of June 2001 such as the battery type (storage battery), the natural gas type, the hybrid type and so on.

According to the automobile NOx control measures of Tokyo (Guidance Outline of Automobile NOx Emission Gross Weight Control), ANA has submitted the automobile NOx emission gross weight control plan since 1998 fiscal year, and have been executing the plan for "reducing the emission 10% by 2000 fiscal year based on the value of 1997 fiscal year". Actual reduction of NOx emission in 2000 fiscal year was 53% by means of reducing the number of vehicles and run, and renewal from diesel engine vehicle to gasoline engine vehicle.

Nagoya Airport Motor Service Co. Ltd. introduced a natural gas vehicle as a new low pollution vehicle in April 1996 to use as liaison vehicles for maintenance in the airport. This was the second case to introduce a natural gas vehicle within ANA group following ANA Motor Service Co. Ltd. in 1994. At Narita airport Eco-gas station was established in March 2001 and ANA is planning the trial of natural-gas powered towing tractor and so on.

(3) Examination of Low VOC (volatile organic compound) Paints for Aircraft Exterior

Because VOC is emitted from paints, we introduced 6 airplanes that are painted with new low VOC paint (polyurethane) at the production line, and started its evaluation in 1999 fiscal year. In addition, we are researching on the paints with

better performance.

(4) Fuel Dump due to Unexpected Landing

Throwing the fuel away in order to make an airplane land safely in the case of the unexpected landing due to aircraft system malfunction and/or a sudden passenger illness might reduce the weight of the aircraft. The number of fuel dumps by ANA aircraft in the fiscal 2000 is 8 cases about 454 kiloliters. Figure 3-3 shows the change of the number of fuel dumps and its quantity. Airport authority and other rules specifies the location and its altitude to throw fuel away, avoiding a town area. The fuel thrown away at the higher altitude becomes vaporized and diffused, which doesn't effect air pollution and marine pollution.

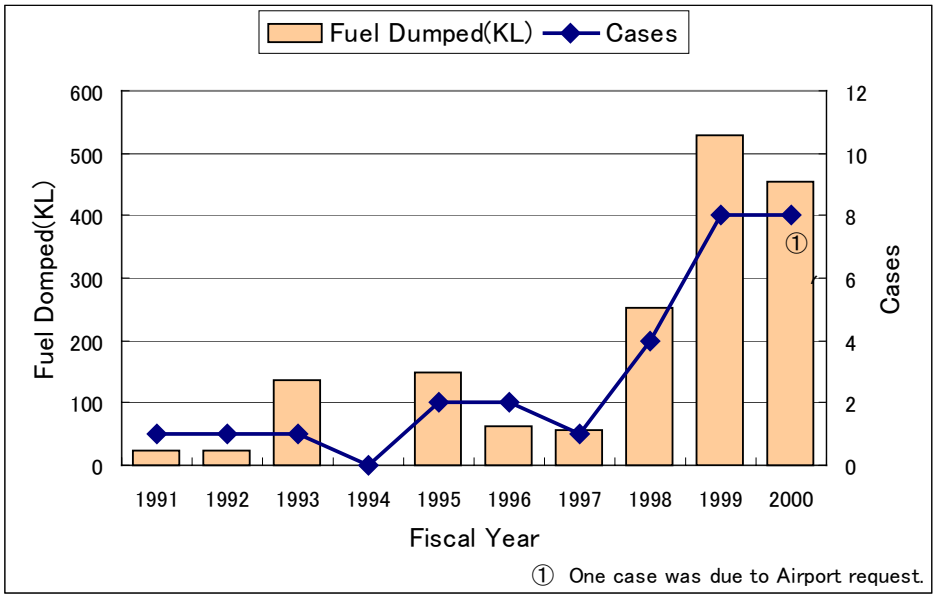


Fig.3-3 Fuel Dumps

Chapter 4 Waste and Recycling

4.1 Air transport and Emission

The emission related to the air transport is classified below.

(1) Aircraft engine emissions
(2) Waste disposal or drainage/waste water from the facility and so on with the maintenance work of the aircraft
(3) Garbage from the aircraft cabin
(4) Garbage from the offices

"Aircraft Engine emissions" is taken up in "Air Pollution" in Chapter 3.

4.2 The main legal regulation about the waste disposal

(1) Waste Disposal and Public Cleansing Law（executed in 1992）
(2) The legislation of recycling（executed in 1991）
(3) The law of recycling for containers and packing（executed in 1997）
(4) Tokyo ordinance concerning waste disposal and recycling（executed in 1992）
(5) Tokyo ordinance to charge for the waste（enforced in 1996）
(6) Fundamental Law for the promotion of the formation of recycling style society (enforced in 2000)
- ・Containers and Packaging Recycling Law,
- ・Electric Appliance Recycling Law,
- ・Law for the Promotion of Utilization of Recycled Resources,
- ・Waste Disposal and Public Cleansing Law,
- ・Law for the recycled resources of building construction material wastes,
- ・ Law for the promotion of reclamation of food waste,
- ・ Law for the promotion of green purchasing.

(7) Law Concerning Reporting, etc. of Release to the Environment of Specific Chemical Substances and Promoting Improvements in Their Management (enforced in 2001)

4.3 Our Situation

(1) Office Wastes

The municipal wastes are properly managed and disposed under Tokyo guidance in our facilities and offices where are the crew training center area and each maintenance center（maintenance factory) in the maintenance area by drafting plans of the waste reduction and recycling and using manifests （shipload list system). The quantity of the municipal waste disposal in Haneda area in 2000 was about 1,420 tons. The change of the quantity of the municipal waste disposal in Haneda area is shown in figure 4-1.

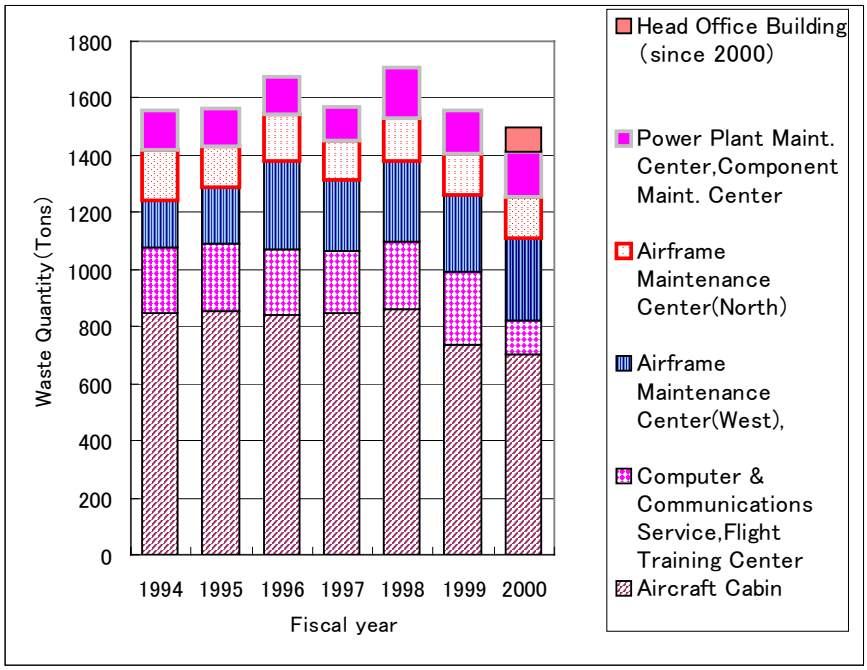


Fig.4-1 General Wastes(Haneda Area)

① Situation of the use of papers

The quantity of the papers to use on the business in the whole company is approximately 5,600 tons in a letter size paper including flight time-table and in-flight magazine and so on. The gross weight of copy papers used in Tokyo area(head office building, Haneda airport area and Shinagawa area)in the fiscal 2000 was about 59 million sheets (about 236 tons)in a letter size paper.

② Situation of the use of the recycled paper

The offices using recycled papers for copies are about 50 % of all offices, about 40% of copy papers used. The publication using recycled papers are; time table, in-flight magazine, company telephone books, executive lists, "flight safety review" journals, personnel service news, management news, computer output papers, maintenance work cards and so on. Organs of Health insurance and benefit society started using 100% recycling paper and soybean ink from 2001.

③ Recycling of papers, cans and bottles and situation of enforcing the energy conservation

Each office recycles papers, cans, and bottles by itself, and public buildings except the headquarters do in cooperation with other enterprises. 85% of the offices enforce classified collection of papers and almost offices including aircraft cabin recycle cans and bottles. 91% of the offices enforce the energy conservation.

④ Recycling of air ticket stubs

Because a used air ticket stub has a magnetic tape, it was considered not to be able to recycle because of magnetic tape and was disposed by fire, but in July

1996 we changed it to the dissolution process that makes it possible to recycle the stubs. Approximately 100 tons of air ticket stubs in a year are utilized for the recycling.

⑤ Other recycling

A passenger seat headrest cover, nickel cadmium battery for OA equipment and so on are collected separately and are utilized for the recycling.

(3) Industrial wastes and Special Management Wastes

In our company each maintenance center（maintenance factory）in the maintenance headquarters emits the industrial wastes and the special management wastes, which are properly disposed by the use of the manifest（shipload list system）. Table 4-1 shows the waste quantity according to the kinds of the industrial wastes and the special management wastes in 2000 fiscal year. The change of the waste quantity according to the kinds in the industrial wastes and the special management wastes is shown in figure 4-2. About 42% of the total waste quantity have been recycled, that lead to cut down the wastes.

Materials	Waste Quantity (Tons)	
Sludge	134.9	
Oil Wastes(*)	99.4	(*)Recycled Materials
Acid/Alkali Wastes	14.0	： 178.6 Tons
Plastic Wastes	83.3	Recycled Rate：41.5%
Metal Wastes(*)	52.8	
Inflammable Oil Wastes (*)	26.5	
Strong Acid/Alkali Wastes	18.9	
Noxious Materials	0.03	
Total	429.7	

Table4-1 Industrial Wastes/Special Industrial Wastes Quantity

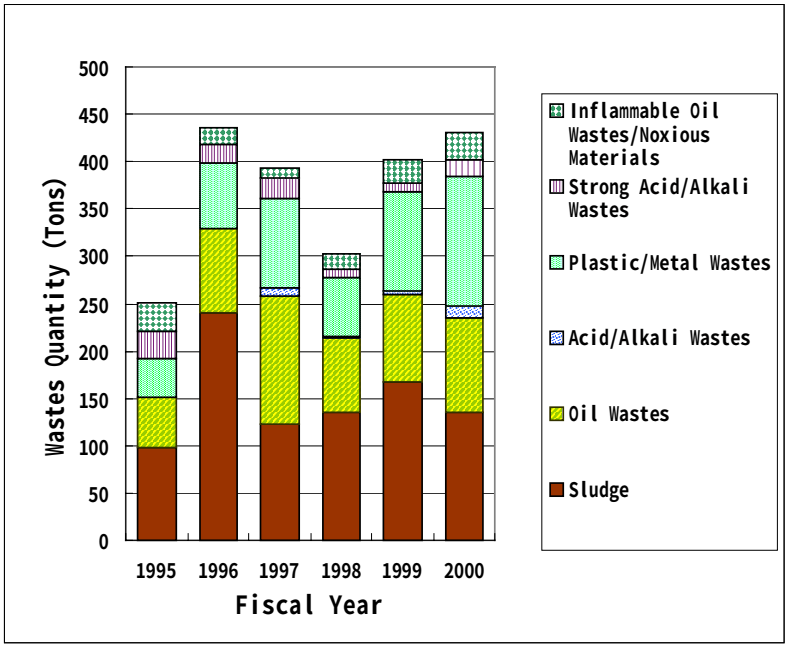


Fig.4-2 Industrial Wastes/Special Industrial Wastes Quantity

① When the aircraft center of gravity inspection is conducted, changing the procedure to which measures without making a fuel tank empty reduces fuel disposal quantity(about 8.5 tons for a year). Narita Maintenance Center plans to reduce the industrial wastes by effectively utilizing the aircraft fuel(was necessary to dispose as the special management industrial wastes) which is discharged by the maintenance work as boiler fuel of hanger(about 10,000 liters a year).

② The active carbon(charcoal)to be used for the aircraft air-conditioning system and for the water processing of hangar had been disposed in the regular exchange but recycling it reduces the disposal quantity(about 2 tons annually).

③ In ANA Power Plant Maintenance Center, acid and alkaline coating-remover had been used to remove the coating of the engine parts. The facility was changed to the one with the super high-pressure water in 1998 fiscal year, so that about 30% or less of the amount of special control industrial waste could be reduced.

④ New Paint Remover(Stripper)

A new non-chlorine painting remover, by which the content of a chlorine organic solvent became almost zero, has been developed in cooperation with Chemical Company in USA. In 1998 fiscal year approval of the aircraft manufacturer (Boeing) was acquired. New non-chlorine painting remover was adopted in November 2000 after the evaluation examination with a real aircraft. Following two effects were confirmed. The reduction in the quantity consumed by the

improvement of the stripping duration and the effect in reduction of the waste by the improvement of the procedure. Continuous use of new material will be after the installation of heating system in the Paint hanger as paint removing performance degrade with lower outside temperature.
On the other hand maintenance requirement for aircraft re-paint was changed to 'alternate mixture of repaint and overcoat method every 6 years' from 'repaint every 6 years'. Painting remover consumed was reduced to a half of quantity consequently.

⑤ Evaluation Test of Low VOC Paints
ANA uses fluorine polyurethane paint for aircraft exterior. The quantity consumed has been reduced by extending the repainting period. Also, the evaluation test of the low VOC paints has been carried out in accordance with the reinforcement of the VOC regulation value in the United States. We are evaluating it in consideration of the combined application with the new paint stripper in the preceding item, and of the repainting period. The evaluation test will be finished within 2001 fiscal year.

⑥ Examination of New Cleaning Agent
The development of a new cleaning agent made of aerosol type hydrofluoroether (HFE), one of the CFCs substitutes, that has no global warming factor, and low Ozone Depletion Potential, is under consideration. We have been requesting the aircraft manufacturers the approval of its application.
However, because the flaking off performance in the hot weather is weak, the possibility of combination use between the low VOC paints, and the required repainting period need to be continuously considered for the actual application in the future.

⑦ Although PCB（polychlorinated biphenyl）containing and PCB deposit substances, of which the disposing method hasn't been legally found yet, haven't been newly produced, the cumulative quantity of PCB storage becomes about 4 tons in the end of 2000 fiscal year. Disposal and treatment time limit was legislated in 2001 fiscal year. The early development of the disposal and treatment method to make PCB harmless is waited.

⑧ The waste article of the aircraft battery (nickel-cadmium type) cell was produced by about 5 tons in 1999 fiscal year, which are recycled by separating metal through the commissioned trader. No actual treatment was in 2000 fiscal year.

(3) Medical Wastes

The medical waste disposed from our health care center is processed properly by the commissioned professional trader. The amount of the waste and the waste fluid in 2000 fiscal year was 3,100 liters in Tokyo area, and had 300 kilograms

abandonment of the X rays films. Figure 4-3 shows the transition of the waste quantity. Medical waste quantity was increased as stomach checkup is done inside company from 2000 fiscal year.

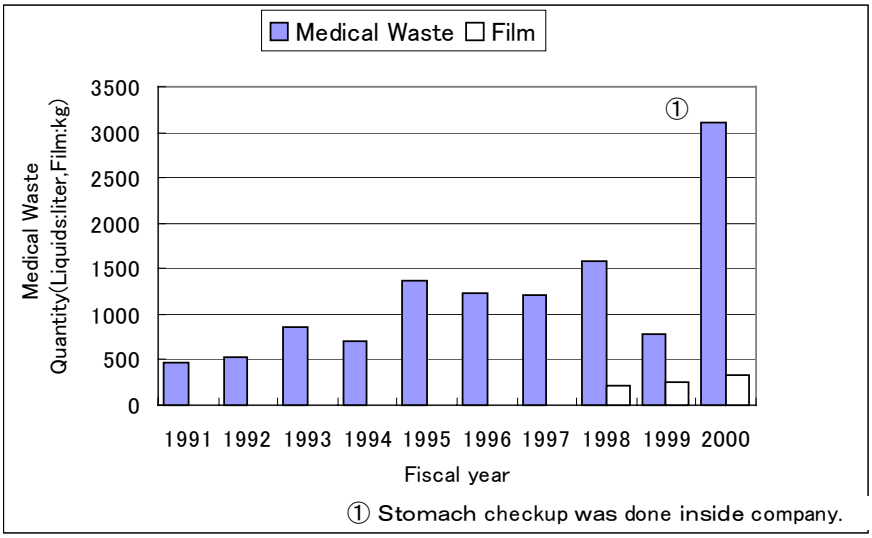


Fig.4-3 Medical Wastes Quantity

(4) Waste Water Disposal

There are 3 kinds of waste water disposed, that are facility waste water to use for aircraft maintenance, washing water to clean aircraft surface and processing water used in winter as aircraft de-/anti-icing fluid to clear away snow and/or ice on the aircraft surface, to prevent the ice and to defrost in ramp area.

① Maintenance facility waste water

There have been no problems in the regular inspection by the local self-government body, the inspection by a facility maintenance company and the independent voluntary inspection by a public organization. The factory wastewater quantity in the fiscal 2000 was 22,699 tons. The change of the wastewater quantity is shown in figure 4-4. In Narita Maintenance Center the rain water reserved in the underground water tank utilizing the hangar roof and used circulated water approximately 4,200 tons a year is also used for cleaning aircraft surface and as service water in the facility. Moreover, in the Haneda west maintenance center approximately 10,000 tons of used catering water was utilized as toilet flushing water.

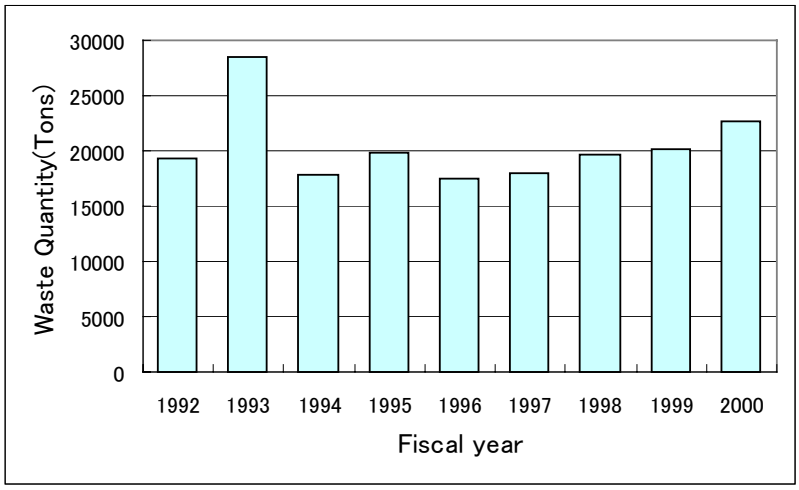


Fig.4-4 Wastewater Quantity (All Maintenance Center)

② Drainage from aircraft surface cleaning

Aircraft surface cleaning is done within a hangar or in a specified are in the airport. ANA is aiming at reducing the drainage amount produced by aircraft surface cleaning as much as possible. It is properly processed as the hangar drainage when the cleaning is done in the hangar and also in the designated area. Approximately 7,629 tons of water was used to clean aircraft surface (No.2 cleaning) at Haneda, Narita and Kansai airport in the fiscal 2000. The change of the waste water quantity is shown in figure 4-5.

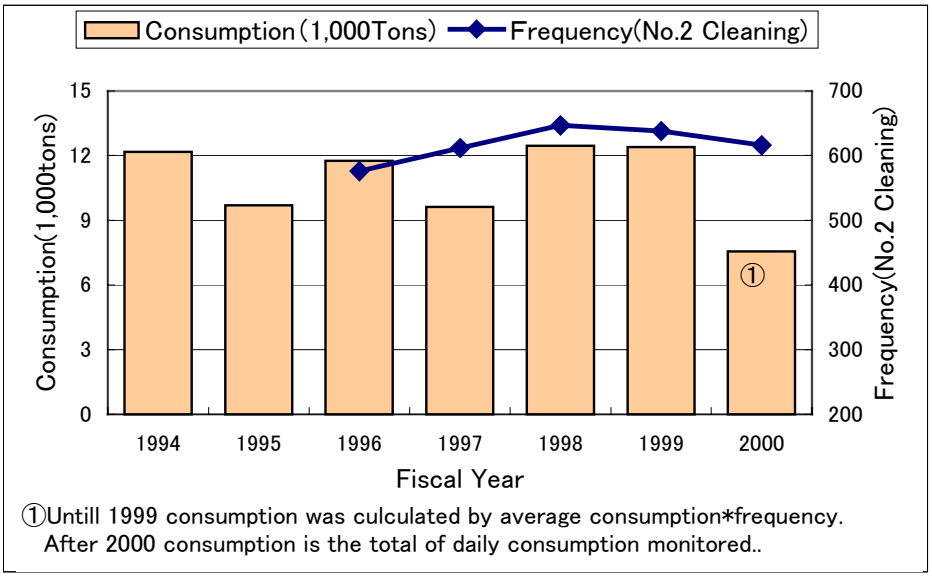


Fig.4-5 Aircraft Water Washing Results

③ Drainage by aircraft de-/anti-icing work

The substances containing propylene glycol are mainly used as aircraft de-/anti-icing fluid. It is diluted with water before work and with snow dissolving into water. By flowing into the river, such substances sometimes temporarily aggravate BOD (biochemical oxygen requirement) and/or COD (chemical oxygen

requirement)which are the environmental standard items on the water quality. The number of aircraft de-/anti-icing work in winter of 2000 fiscal year was executed to 4,146 in total including in local airports, and about 1,089 kiloliter of de-/anti-icing fluid was used. The transition of the amount of the waste fluid is shown in Figure 4-6.

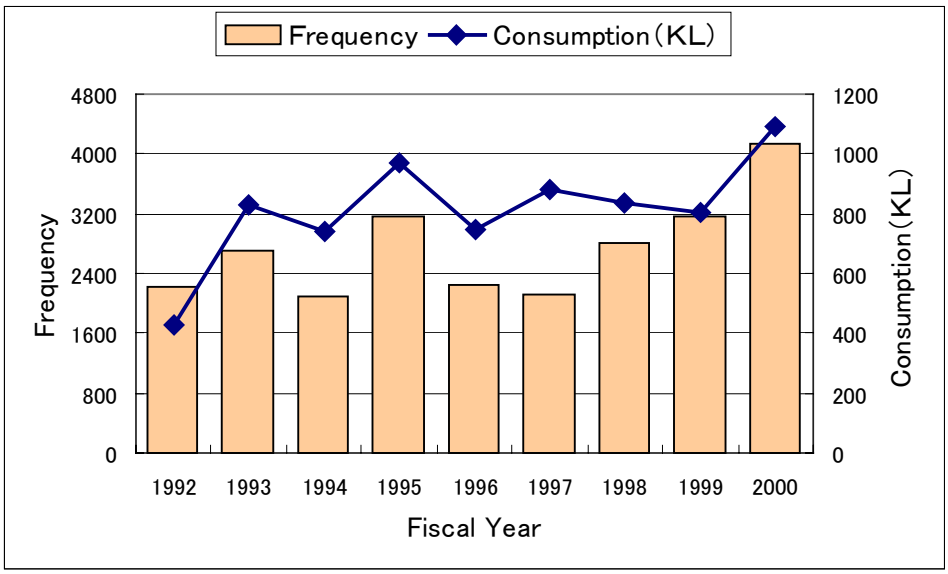


Fig.4-6 Aircraft Anti-Icing/De-Icing Results

ANA will continue to execute, research and examine following 3 points as main items in order to improve water pollution.

(a) To decrease the quantity for use of the de-/anti-icing fluid and to dilute in use as much as possible

Type Ⅳ de-/anti-icing fluid which the holdover time (anti-icing duration)was improved to about twice, was introduced in winter of 1996 fiscal year. It contributes to the decrease at the quantity consumed. In addition, the newest de-icing truck that de-icing fluid is displayed from nozzle after blowing snow was arranged at Chitose airport in winter of 2000 to reduce the quantity consumed.

(b) To examine the introduction of de-/anti-icing fluid with no pollution or low pollution

In winter of 1997, Type Ⅳ de-/anti-icing fluids mainly composed of propylene glycol which would affect less of deterioration of BOD (Biochemical Oxygen Demand)or COD(Chemical Oxygen Demand) which are environmental standard item of water quality was introduced. In winter of 1998, the use of propylene glycol base Type Ⅳ de-/anti-icing fluid has been expanded to all domestic bases. As a result, Type Ⅰ and Ⅳ de/anti-icing fluid to be used in ANA became the one composed of the propylene glycol in place of the ethylene glycol(PRTR Law applicable material).

(c) To examine the collection and recycling method of waste liquid besides the de-icing pad method with Airport authority

Following collecting methods are objects of the examination. The absorption method to collect the liquid by roller car made of the sponge, vacuum clean-up method and the installation of the waste liquid dams (oil fence) etc.

(5) PRTR(Pollutant Release and Transfer Resister): Law Concerning the Reporting of the Release into the Environment of Specific Chemical Substances and Promoting Improvements in Their Management (enforced in 2001)

ANA started studying the content of the Law in 1999 and participated in the project to make「PRTR calculation manual for Airline Industry」by the Ministry of Economy, Trade and Industry/The Society of Chemical Engineers, Japan in cooperation with Scheduled Air Transport Service Association of Japan in 2000 fiscal year, and also conducted the explanatory meeting for the airline industry.

Major chemical substances designated by the Law that ANA aircraft maintenance factory releases into the environment are as follows.

- poly(oxyethylene)octylphenyl ether: Cleaning solvent contains
- tri-n-butyl phosphate: Hydraulic fluid contains

For the chemical substances designated by the Law ANA will make a best effort to minimize the environmental impact by means of investigating alternatives.

The Law Concerning Reporting, etc. of Releases to the Environment of Specific Chemical Substances and Promoting Improvements in Their Management makes provisions for the introduction of PRTR and MSDS systems for promoting the voluntary management of chemical substances by businesses. An outline of these two systems is provided below.(Source: Ministry of Economy, Trade and Industry Home Page)

PRTR System

The PRTR (Pollutants Release and Transfer Register) system consists of "an arrangement for the registration and publication of the volume of harmful chemical substances released into the environment and the volume of such substances transferred as components of waste." Based on the reports and estimates received from individual businesses, government offices shall estimate, aggregate, and publish figures pertaining to the volume of designated chemical substances released into the atmosphere, water, and soil, and the volume transferred as components of waste.

The PRTR system is designed to serve the following purposes:

- providing reference materials for government offices to determine priorities for policies related to chemical substances,
- promoting improved voluntary management of chemical substances by businesses,

- providing basic data for environmental preservation,
- promoting better understanding of conditions pertaining to the release and management of chemical substances through the provision of information to the public, and
- gauging the effectiveness and progress made in environmental preservation policies as related to chemical substances.

MSDS System

The MSDS (Material Safety Data Sheet) system obligates businesses involved in the transaction of chemical substances to provide information on the physical and chemical properties of the chemical substances contained in the items transacted. The MSDS system is designed to be used by businesses to improve the voluntary management of chemical substances.

The issuing of MSDS was made obligatory in January 2001.

Chapter 5 Global Warming

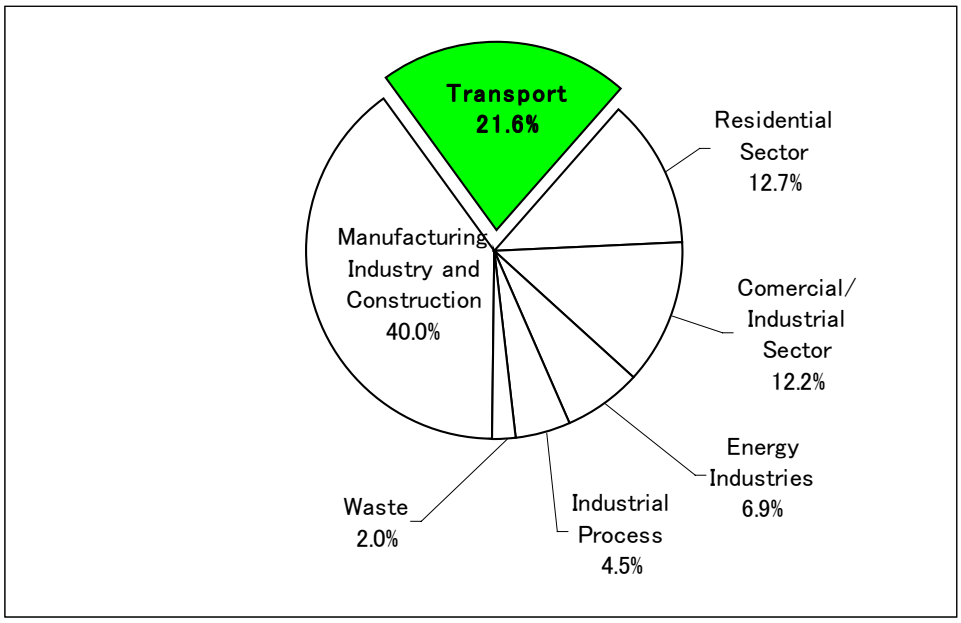
5.1 Global Warming Issue

Since the late 19th century, global mean temperature has increased by 0.3 to 0.6℃ according to the report of IPCC(Intergovernmental Panel on Climate Change)in 1995. Due to the accumulation of greenhouse gases until present, the temperature is expected to be increased by about 1℃ in around 2050. In addition, it is estimated that global mean temperature will be increased by 1.4 to 5.8℃ and the mean sea level will rise by 9 to 88 ㎝ by 2100 if greenhouse gases keep increasing at the present increase rate.

In the protocol concluding a treaty of the COP3(United Nations Framework Convention on Climate Change, the 3rd Conference of Parties)held in Kyoto in December 1997, the reduction target of greenhouse gases in each advanced country with a legal restriction power was prescribed, and the constant participation by the developing counties was urged.

As for Japan, the target, which reduces 6% of the average emission amount of greenhouse gases between 2008 and 2012 from its level in 1990, was set. "Energy consumption efficiency improvement", "Understanding and actions of the people", "Technological development and its spread", and "International cooperation" are to be examined as the measures.

Taking a look at the amount of the CO_2 emission of each categories in Japan in 1998 fiscal year, an industrial section is 40.0%, the public welfare section is 24.8%, and the transportation section is 21.6% (refer to Figure 5-1). The public welfare section and the transportation section are increasing in its amount as a recent tendency compared with the industrial section where the emission amount is decreasing by the conservation of energy measures. It is shown that the emphasis of a social economic structure moves from production to consumption, and the resource is used for the convenience of daily life and amenity.



CO_2 Emission Sources (Fiscal Year 1998)

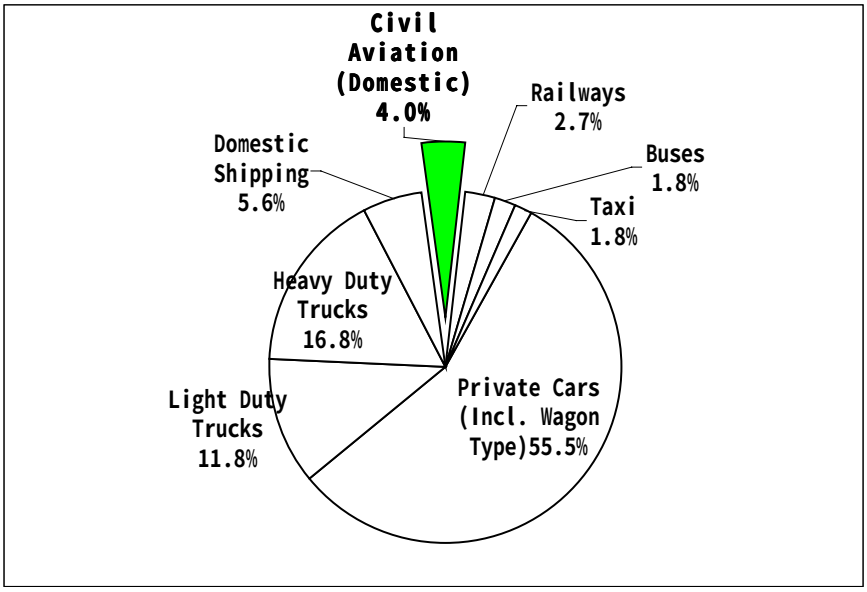
(Source: Ministry of The Environment, White Paper 2001)

Fig.5-1 CO_2 Emission Inventories All Over Japan

5.2 Relationship between Air Transport and Global Warming

CO_2, NOx (it increases tropospheric Ozone), H_2O, CFC and HCFC are greenhouse gases emitted along with air transport. CFC and HCFC will be described in Chapter 6, Protection of ozone layer. The amount to be used in the airline company is not only very small but the restriction based on Montreal protocol has already been effective so that it does not have to be a big problem to be assumed.

The amount of CO_2 emitted by the aircraft in the world is said about 3% of the total amount of CO_2 emission from the fossil fuel according to statistics of ICAO. The emission ratio of CO_2 by airlines in Japan accounts for 4.0% of the transportation sections. It is only 0.9% or less among entire domestic C02 emission. Therefore, the contribution to the global warming by airlines can be said as quite little. (Refer to Figure 5-2)



Transport Sector Details（Fiscal Year 1998）
(Source: Ministry of The Environment, White Paper 2001)

Fig.5-2 CO_2 Emission Inventories All Over Japan

5.3 Active Plan by Airline Industry

In September 1996, the Federation of Economic Organizations had requested all domestic industries to make a plan for independent course of action（the target value of the CO_2 emission reduction and the concrete measures for the reduction etc.) concerning the environmental protection. Japanese Airline Industry (ANA,JAL,JAS) set the target value of CO_2 emission reduction that is “By 2010, CO_2 emission per transport unit（ASK：Available Seat Kilometer）will be reduced by 10% from the 1990 level”. Followings are the main works in the concrete measure to achieve the goal. Promotion of adoption of new type aircraft and switching equipment and materials to new type aircraft, Adoption of FANS（Future Air Navigation System, CNS/ATM）, and execution of daily service consuming as little fuel as possible etc.

In February of 1998, there was a request to make a Voluntary Plan to Arrest Global Warming Prevention from the Ministry of Transport so that Scheduled Air Transport Service Association of Japan represents Japanese 10 scheduled airlines has arranged and submitted a plan which was almost the same content as the one submitted to Federation of Economic Organizations. The plan has been reviewing regularly.

5.4 Transition and Current State of Fuel Saving Measures of ANA

(1) The emission amount of carbon dioxide

The amount of CO_2 emitted along with the operation of the aircraft in our company in 2000 fiscal year is about 2.14 million tons in terms of carbon converted amount (7.85 million tons of CO_2). The aircraft fuel consumption has no

choice but will increase because the growth of passenger traffic is forecasted to increase more and more in the future.

In the current state that we have no suitable substitution except the fossil fuel, the airlines company should effectively use the fuel, that is to carry the customer efficiently with lesser energy.

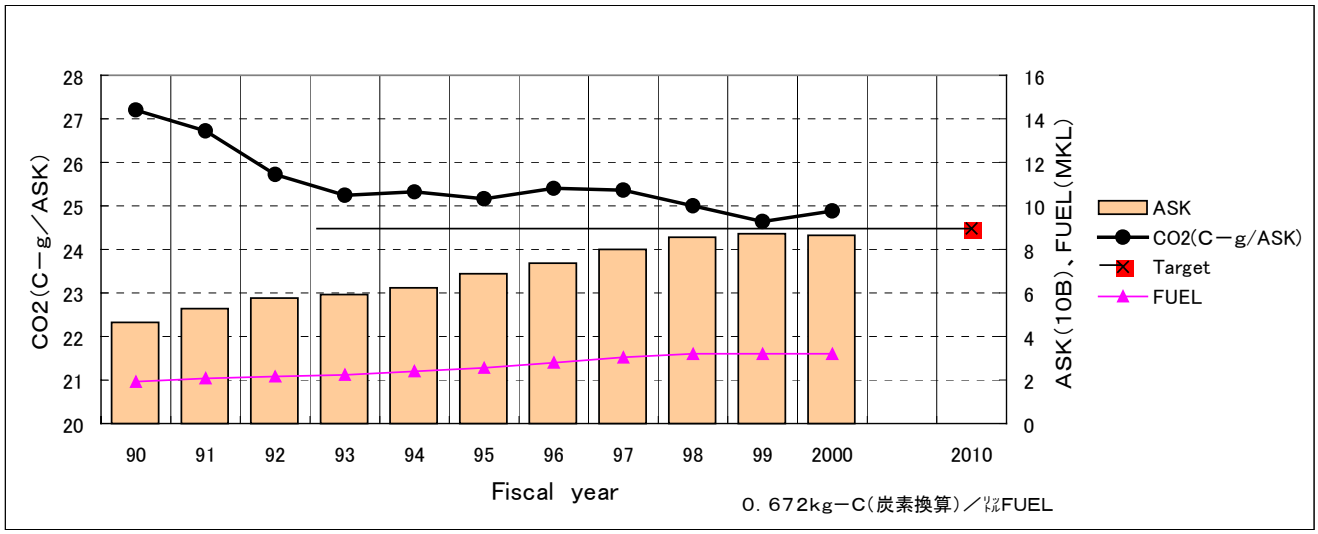


Fig.5-3 CO_2 Emission per Available Seat-Kilometer(ASK)by Aircraft Operation

Figure 5-3 shows the transition of the amount of CO2 emission for each Available Seat Kilometer(ASK). The number of ASK increases greatly as the demand of passenger traffic increases but the amount of C02 emission per ASK shows the tendency to decrease. In fiscal 2000 fuel used was almost the same as in fiscal 1999 but the amount of C02 emission per ASK shows the tendency to increase as the available seat number on international flight was reduced (refer to Fig. 5-4).

(2) The Fuel Efficiency

The transition of the fuel efficiency of ANA fleet(fuel consumption per ASK, fuel consumption per RPK) is shown in Figure 5-4 (Overall, domestic, and international). The fuel quantity consumed increases with ASK expansion too, but it is understood that the fuel efficiency improves by about several % every year. Because of joining (interruption) to new routes and so on, the fluctuation is violent depends on each fiscal year in the international service. However, the decrease is remarkable in the domestic service. The improvement of such fuel efficiency was achieved by the combination of the fuel saving measures and the introduction of a new model to be described next section.

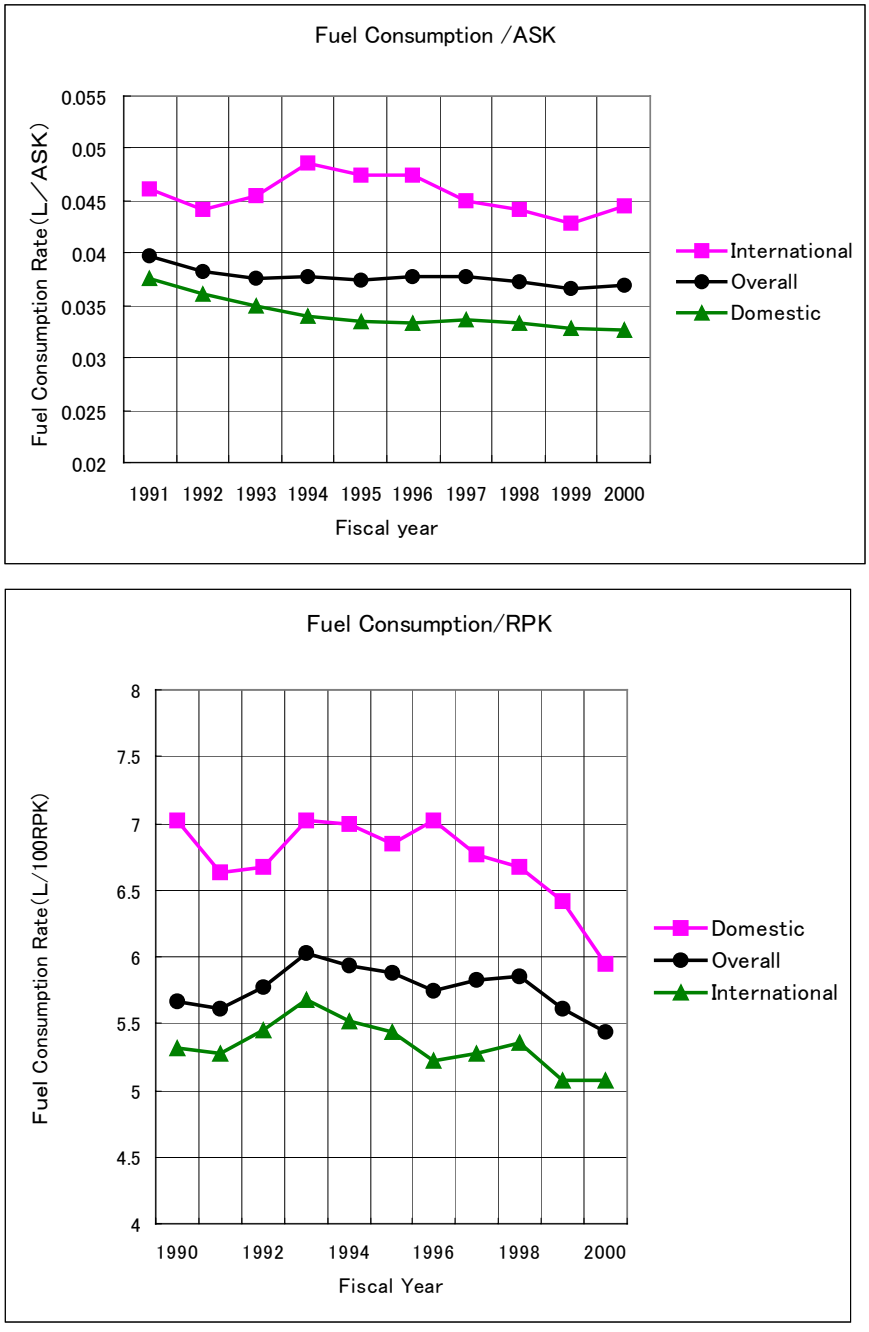


Fig.5-4 Actual Fuel Efficiency

(3) Introduction of New Generation Aircraft

The most effective method to reduce CO_2 emission, that is, to cut down the fuel consumption is achieved by introducing fuel efficient new generation aircraft. Using the latest engine technology, it adopts an efficient engine with high by-pass ratio, the improved wing shape etc. to decrease the air resistance and reduced weight by the use of composite materials etc. Figure 5-5 shows how introducing a new model aircraft has reduced CO_2 emission. The model name is shown from the left to the right in order of the introduction period.

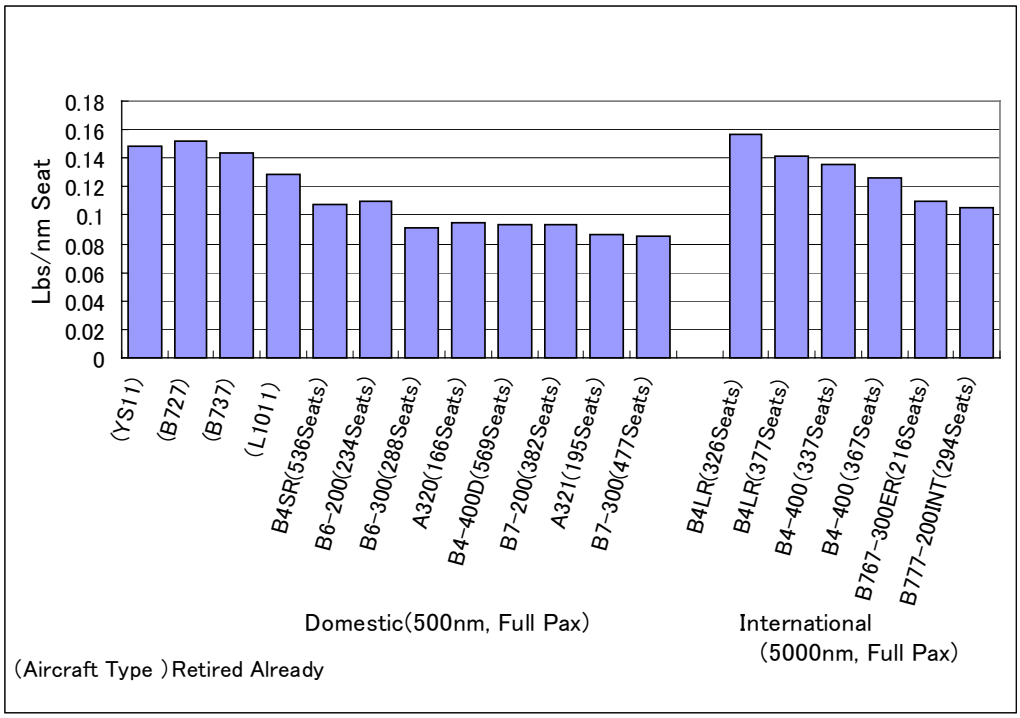


Fig.5-5 ANA Fleet Fuel Efficiency Comparison

Fig.5-6 shows actual flight specific fuel consumption by type of aircraft (Liter/100ASK) in fiscal 2000

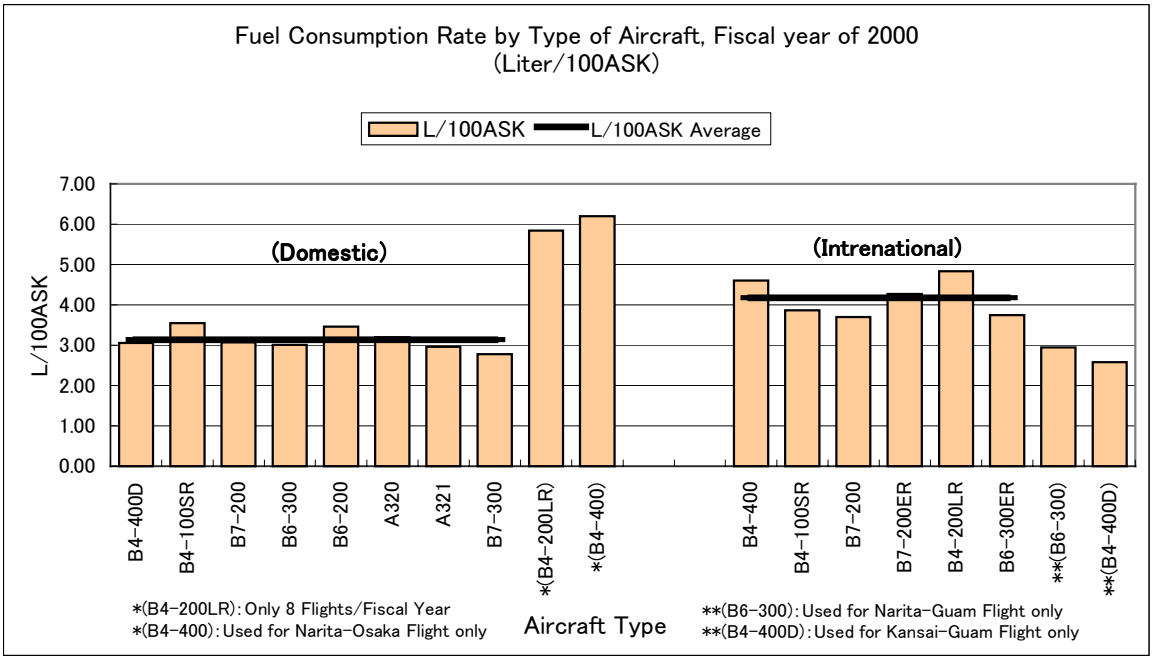


Fig.5-6 Flight-specific Fuel Consumption by Type of Aircraft in 2000

(Note)ANA Fleet Introduction and Retirement

Aircraft Type	(Engine Type)	Introduction start	Retirement finished
YS-11	RR DART543-10/10K	1965	1991
B727-200	JT8D-17	1969	1990
B737-200(*)	JT8D-17	1969	1992
L1011	RB211-22B	1974	1995
B747SR	CF6-45A2	1979	—
B767-200	CF6-80A	1983	—
B747LR	CF6-50E2	1986	—
B767-300	CF6-80C2B2	1987	—
B747-400	CF6-80C2B1F	1990	—
A320	CFM56-5A1	1991	—
B777-200	PW4074,PW4077	1996	—
A321	V2530-A5	1998	—
B777-300	PW4090	1998	—

(*)ANK B737-200 had retired in 2000.

(4) The Fuel Saving Measures

All thought fuel saving measures were examined from the first oil crisis in 1973 and also from the second oil crisis in 1979 in ANA, and a lot of measures had been introduced. In addition, in 1994 fiscal year these measures were reviewed, and in 1999 fiscal year the fuel saving by reducing the airplane weight was examined. Table 5-1 shows the main fuel saving measures.

Table 5-1 The main fuel saving measures

No.	Fuel saving measure items	Contents
1	Suitable approach and departure method for Kagoshima airport	Improvement of departure and approach method To revise SID (Standard Instrument Departure method) and STAR (Standard Arrival Route), and to shorten the route in order to reduce the fuel consumption.
2	Profile Descent to new Chitose airport RWY01	
3	Selection of suitable approach method and shortening radar inducement route in Kumamoto airport	
4	Improvement of radar inducement route in Fukuoka airport	
5	Change of Matsuyama airport departure route	
6	Passing through the test and training area of the Air Self Defense Forces	To shorten the route distance by passing the area on weekends (Saturday, Sunday, and national holiday) in which the Air Self Defense Forces do not train.
7	Select the best cruise speed	To save the fuel by optimizing the cruise speed.
8	Select the best cruise altitude	To save the fuel by optimizing the cruise altitude. As the altitude is raised, the efficiency improves at 1% per 1000 feet.
9	Delayed Flap Approach	To delay the use of the flap with a lot of air resistance when approaching the airport in order to reduce the fuel consumption.

10	Use of low flap angle	To use a low flap angle that decreases the air resistance in order to save the fuel.
11	The best bleed air management (Reduced Pack Flow Operation)	Air for the air conditioner is taken from the engine. By optimizing the amount of taking this, the lowering of efficiency of the engine is minimally suppressed, which in turn saves the fuel.
12	Unnecessary engine shut down when taxiing in	Stopping unnecessary engines after the landing to ramp in leads to save the fuel.
13	Delayed Engine Start Procedure B767	To make one engine start during push back and the other while removing flags after push back. As a result, it saves the fuel and the departure time can be shortened.
14	Standardization of Max. Climb Thrust (MCLT) use	To stop the use of delayed thrust, and to use the thrust with which the higher altitude can be reached early with the efficient fuel consumption.
15	The best effect approach	An effective approach by the idling pass planning leads the fuel saving.
16	Optimization of the loading fuel	Reviewing the fuel loading standard and improving its operation leads the fuel saving.
17	Engine start during push back	The aircraft used to be pushed out to the taxiway after all engines are started. But from now on the engines will start going during push back.
18	Expansion of reducing APU (Auxiliary Power Unit) operation	Delaying the time of the APU start before the departure and after the landing will save the fuel.
19	Reducing APU use	Not to use APU until right before the departure(so far operated in ramp area during en-route). To expand its operation to other airports.
20	Washing the engine in clear water (CF6-45 Engine)	The decreasing compression efficiency is recovered by washing the compressor with clear water and by taking off the dirt of the compressor blades.
21	Modification of Thrust Reverser Nacelle Seal (CF6-45 Engine)	Thrust reverser and the seal around nacelle are improved and added in order to prevent the air leakage, that will improve the efficiency of the thrust of the fan.
22	Controlling the position of center of gravity	In general, the fuel saving of about 0.05% can be expected once the center of gravity moves backward by 1%.
23	Using a simulator for flight training	The flight training is done with the simulator instead of actual flight. Using the simulator for the co-pilot promotion training at the right seat. Using the simulator at the periodical check.
24	Using a simulator for maintenance training	The maintenance crew training for the engine run-up is done with the simulator, and it saves the fuel.
25	Removal of Brake Cooling Fan	Fans are removed for weight reduction by examining the necessity in operation.
26	Removal of Rain Repellent System	Depletion of ozone layer related problem. This system was removed by examining the necessity in operation.
27	Tankering	The tankering becomes an increase of the weight of the airplane. Evaluate carefully the expenses and effects when the tankering is executed.
28	Removal of APU No.2 generator (B747SR)	One generator is good enough in the domestic operation so that parts are removed from some airplanes (Weight reduction of 45 kg is accomplished). Comparative study of modification expenses and effect of fuel saving.
29	Lightening cargo containers	Development of container made of carbon fiber.
30	Reduction in loading of drinking water	Reduction in loading of the drinking water is examined in the international flight.
31	Removal of drinking water cooler	Removal of cooler which is not in use. Reduction of about 40 lbs.

32	Other weight reduction measures	Reducing the amount of equipped blankets. Lightening trays for wagon. Removal of a drinking water tank. Lightening seat cushions. Lightening seats for passenger. Lightening carpets. Replacement to lighter life jackets. Review of necessary number of knives and forks. Review of necessary number of wet towels. Changing the wet towel made from the fabric to the paper. In-flight articles are loaded at each station. Reduction of cockpit manuals. Reduction of the number of spare in-flight magazine "Kingdom of Wing". The reduction of in-flight magazine (weekly magazine etc.). The reduction of ice and dry ice. Lightening servicing cart.
33	Introduction of FMS/R-Navigation Method on Domestic route	Reduction of flight time due to R-Nav route setting and R-Nav operation around terminal area.
34	RVSM (Reduced Vertical Separation Minimum) operation on International flight	Vertical separation of aircraft by 1,000 ft above FL290.
35	CAT Ⅲ Automatic landing system Operation	Effective on bad weather condition.
36	Execution of Economy Re-clear Flight plan method	The purpose of the re-clear method is expanded not only to the former payload relief, but also to the reduction of the amount of the loading fuel (weight saving).

Table 5-1 The main fuel saving measures

(5) Fuel Saving in daily operation

The airport congestion is also a cause of a fuel consumption increase. The waste fuel is consumed by holding over the airport and go-around at landing(re-doing of the landing). At Haneda airport where is crowded most in Japan for example, 148 go-around took place in total of all airline operation in 1994. There are many reasons for the go-around, 43 % is due to the shortage of the interval between a preceding aircraft caused by its delay of the breaking away from the runway. If each aircraft make a prompt breakaway from the runway, it is expected to be improved traffic flow. ANA is always bearing the followings in mind.

① Before landing, understand the capable distance for stopping and the distance to the taxi-way.
② After landing, decelerate smoothly to break away from a runway at a safe speed without the delay.
③ When departing, prepare for the lineup at once after the preceding aircraft begins take-off roll.
④ Work in the cockpit after the take off permission will be finished in a short time as possible.

Excluding above, "Intersection take-off" and "Rolling take-off" are appropriately executed.

(6) As for the Airport Congestion

The airport congestion is one of the big obstacles to consume fuels effectively.

Moreover, the length of the distance from the spot to the runway also produces a big influence on the fuel consumption.

The completion of the second terminal of Narita International Airport and a new C runway of Haneda made an increase of the time to taxi. The taxiing time before and after the using of Haneda new C runway (March, 1997) was investigated. As a result, the taxi-out time increased about three minutes on the average at the take off to the north in winter (January, 1997: 12.6 minutes versus January, 1998: 15.7 minutes). However, the taxi-in time has been shortened from 6.7 minutes to 5.7 minutes oppositely at the same season. In fiscal 2000 average taxi-out time was 14.0 minutes and average taxi-in time was 4.5 minutes at Haneda airport.

(7) Conservation of Energy other than Aircraft Fuel

Even though it is insignificant amount compared with the fuel consumption of the aircraft itself, consideration of the reduction measures of various energy that ANA uses in each ground facilities are important as well. The energy conservation activities of ANA for electric power, gas, water and fuel consumed by facilities and offices, and ground vehicle fuel used have been developed. The transition of the amount of the electric power consumption in Haneda area is shown in Figure 5-7 as one example.

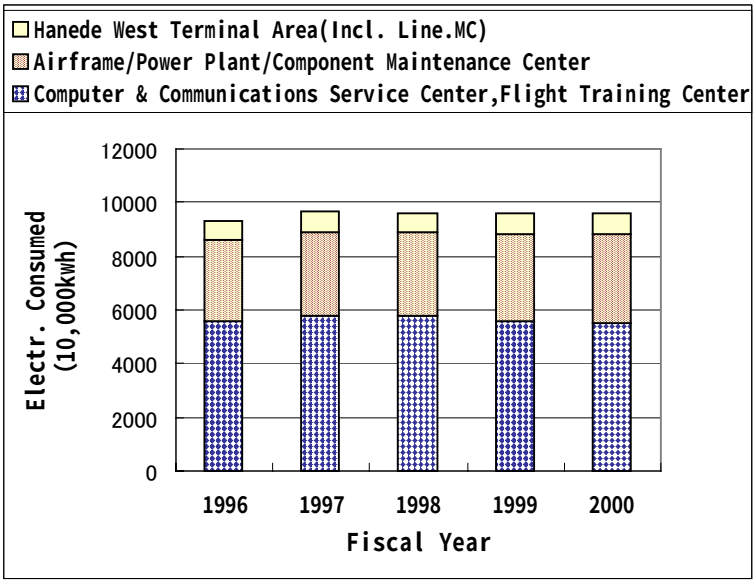


Fig.5-7 Electricity Consumption (Haneda Area)

(8) Energy saving at Offices and Factories

"Law Concerning the Rational Use of Energy" was amended, and became effective from April 1999, as one of the global warming prevention measures aiming to reduce the quantity of energy consumed. The Class II designated energy

management factory, in addition to a present Class I designated energy management factory, was added to this amendment. Our four offices are designated as the Class II energy management factory. We have been doing our best by establishing the "Energy Management Study Group Meeting", which is composed of the offices that consume much energy, including those designated factories.

5.6 IPCC Special Report「Aviation and the Global Atmosphere」(May 1999)

The IPCC published a special report on Aviation and the Global Atmosphere, In response to a request by the ICAO, to assess the effects of aviation on The earth's climate and atmospheric ozone. The report also examines Scientific, technological, social and economic issues associated with Various options to mitigate adverse effects of aviation on climate and Atmospheric ozone.
The brief overview of the report is as follows.

(1) In response to a request by the ICAO, IPCC assesses the effects of aircraft on climate and atmospheric ozone, both in the past and in the future (2050).

(NOTE) IPCC Second Assessment Report, published in 1995, estimated reaching approximately 1.4 times the CO_2 concentration levels in 1994 by the end of the 21st century, if CO_2 emissions were maintained at 1994 levels, the rise in global average surface air temperature from 1 to 3.5 ℃ and the rise in sea level from 15 to 95 ㎝ by 2100 relative to 1990. IPCC Second Assessment Report estimated also stabilization scenarios that assumes policy measures are enacted which begin to reduce CO_2 emissions in the year 2000 relative to business as usual with eventual stabilization of the CO_2 concentration at 550 PPM by 2150 (current CO_2 concentrations are about 360 PPM).

(2) Global passenger air travel, as measured in RPK, is projected to grow by 3.1 to 4.7% per year in average between 1990 and 2050, whereas total aviation fuel use (CO_2 emissions) is projected to increase by 1.7 to 3.8% per year.

(3) The range of increase in total aviation carbon dioxide emission to 2050 would be 2.6 to 11 times the value in 1992.

(4) Emissions of carbon dioxide by aircraft were about 2% of anthropogenic carbon dioxide emissions in 1992 and will be 3% of the projected total anthropogenic Carbon dioxide emissions in 2050.The best estimate of the radiative forcing, The perturbation to the energy balance of the earth-atmosphere system, in 1992 by aircraft is about 3.5% of the total radiative forcing by all anthropogenic activities. Radiative forcing by aircraft in 2050 will be about 5% of the radiative forcing by all anthropogenic activities.(the effects of possible changes in cirrus clouds is not included)

(5) Over the period from 1992 to 2050, the overall radiative forcing by aircraft (excluding that from cirrus clouds) is a factor of 2 to 4 larger than the forcing by aircraft carbon dioxide alone. The overall radiative forcing for the sum of all human activities is estimated to be at most a factor of 1.5 larger than that of carbon dioxide alone.

(6) CO_2: The range of increase in aviation emissions to 2050 would be 1.6 to 10 times the value in 1992.

(7) NOx: The NOx emissions from subsonic aircraft in 1992 are estimated to have increased ozone(O_3) concentrations at cruise altitudes in northern mid-latitudes. Aircraft NOx emissions are expected to decrease the concentration of Methane (CH_4) that are global in extent. Global average radiative forcing are of similar magnitude and opposite in sign, but the net regional radiative effects are not cancelled.

(8) Water vapor(H_2O): Water vapor is a greenhouse gas. For subsonic aircraft this effect is smaller than those of other aircraft emissions such as carbon dioxide and NOx. For high speed civil transport(HSCT) aircraft, although there is considerable uncertainty, additional radiative forcing due to accumulation of stratospheric water vapor is estimated as supersonic aircraft consume more than twice the fuel per passenger-km.

(9) Contrails: Contrails are triggered from the water vapor emitted by aircraft and their optical properties depend on the particles emitted or formed in the aircraft plume and on the ambient atmospheric conditions. Contrails tend to warm the Earth's surface, similar to thin high clouds. In 1992, aircraft line-shaped contrails are estimated to cover about 0.1% of the Earth's surface on an annually averaged basis with larger regional values. The contrail cover is projected to grow to 0.5% by2050. The radiative effect of contrails is similar to that of CO_2 and O_3, but still uncertain.

(10) Cirrus Clouds: Extensive cirrus clouds have been observed to develop after the formation of persistent contrails. The mechanisms associated with increases in cirrus cover are not well understood and need further investigation. An increase in cirrus cloud cover tends to warm the Earth's surface.

(11) Sulfate (SOx) and Soot Aerosols: The aerosol mass concentrations in 1992 resulting from aircraft is small relative to those caused by surface sources. Increase in soot tend to warm while increases in sulfate tend to cool the Earth's surface. The direct radiative forcing is small compared to those of other aircraft emissions.

(12) Impacts of Supersonic Aviation: Supersonic aircraft consume more than twice the fuel per passenger-km compared to subsonic aircraft. The radiative forcing of civil supersonic aircraft is estimated to be about a factor of 5 larger than that of the displaced subsonic aircraft. The addition of a fleet of civil supersonic aircraft is assumed to begin operation in the year of 2015 and grow to a maximum of 1,000 aircraft by the year of 2040, which is projected to add a further 40% Increase of radiative forcing. Most of this additional forcing is due to Accumulation of stratospheric water vapor.

(13) Aircraft and Engine Technology Options: A 40 to 50% improvement in fuel efficiency is projected by 2050. The typical aircraft and engine life expectancy, 25 to 35 years, have to be taken into account when assessing the Improvement rate. (Substantial aircraft and engine technology advances are already incorporated the aircraft emissions scenarios used for climate change calculations)

(14) Operational Options: Improvement in air traffic management(ATM) and other operational procedures could reduce aviation fuel burn by between 8 and 18% (The Air traffic management improvements are already incorporated in the aircraft emissions scenarios used for climate change calculations). The large majority(6 to 12%) of these reductions comes from ATM improvements which it is anticipated will be fully implemented in the next 20 years.

(15) Regulatory, Economic, and Other Options: Policy options to reduce emissions further include more stringent regulations, environmental levies(charges and taxes), emission trading, modal shift(substitution of aviation by rail and coach) and so on. Some of these approaches have not been fully investigated or tested in aviation and their outcomes are uncertain.

Chapter 6 Ozone Layer Protection

6.1 Depletion of Ozone Layer

Ozone (O_3) layer is surrounding the earth at a height of approximately 20 to 30Km. This ozone layer blocks much of the dangerous ultraviolet rays radiated by the sun, and protects lives on the Earth. Recent observations show that this ozone layer has decreased globally, especially in high latitudes. This tendency has also been observed in Sapporo, Japan, which rate is statistically significant. So-called ozone hall being developed above the Antarctic has been observed. (Fig. 6-1 Transition of Ozone Hall Area above the Antarctica)

The substances contributing to the ozone layer depletion include fluorocarbon, halon, methylchloroform, trichloroethane, and carbon tetrachloride.

Fluorocarbon and halon are extremely stable materials; however, they diffuse to the stratosphere after being emitted to the troposphere, and produce chlorine atoms by being decomposed by the strong solar ultraviolet radiation. This one chlorine atom reacts with tens of thousands of ozones, which depletes valuable ozone layer.

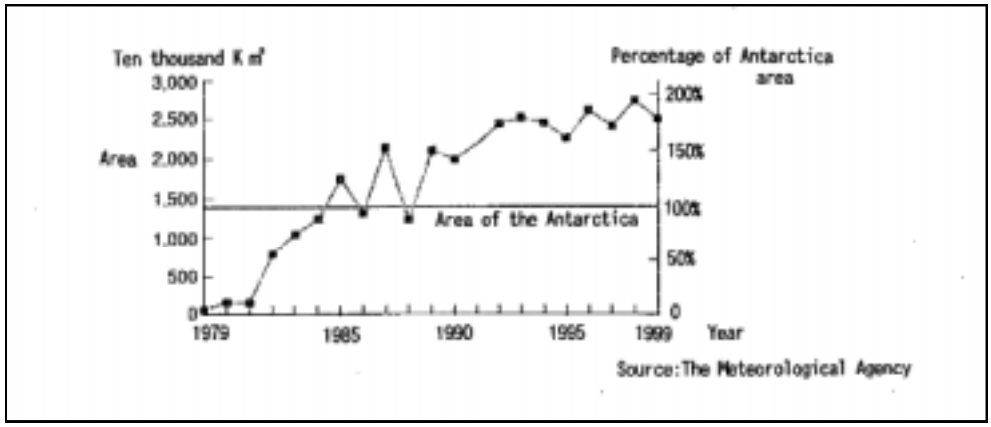


Fig. 6-1 Transition of Ozone Hall Area above the Antarctica

6.2 Montreal Protocol

"Montreal Protocol on Substances that Deplete the Ozone Layer" was adopted in 1987 out of necessity of protection of the ozone layer. Since then, revising the protocol five times by 1999, based on the new scientific findings has reinforced the regulation. The production of halon was suspended in the end of 1993, that of fluorocarbon, trichloroethane, and carbon tetrachloride was suspended in the end of 1995, and of CFC alternatives will be suspended roughly by the end of 2019.

In Japan "Ozone Layer Protection Law" was enacted, and Montreal Protocol was ratified in 1989.

In the United Nations Environment Program (UNEP) report, the depletion of ozone layer is predicted to be at its peak by 2020, and the ozone density will return to the level before 1980 by 2050 if all countries observe the protocol.

6.3 Relation between Aircraft and Depletion of Ozone Layer

The influence on the ozone layer by aircraft emissions has not yet elucidated. According to the "SPECIAL REPORT" on the influence of aviation emissions on the climatic change, issued by the United Nations IPCC (Intergovernmental Panel on Climate Change) in 1999, nitrogen oxides (NOx) in aircraft emissions are effective in producing ozone in the troposphere, especially in the northern hemisphere mid-latitudes, where flight services are frequent. However, in the stratosphere, it is predicted that ozone is depleted by sulfur and moisture emitted by the aircraft, although its level has not been measured yet. Consequently, the report suggests the necessity to evaluate the influence of aircraft emissions on the ozone in the stratosphere in the future.

The substances such as fluorocarbon and halon that influence the ozone layer are utilized in aircraft components and when aircraft maintenance works, besides aircraft emissions. Chart 6-2 shows Ozone Depletion Materials and Potential.

	Ozone Depletion Potential	Global Warming Potential	Main use
CFC (Chlorofluorocarbons)	0.6～1.0	8,100	Coolant, Cleaning solvent
HCFC (Hydrochlorofluorocarbons)	0.005～0.52	1,500	Coolant, Cleaning solvent
HFC (Hydrofluorocarbons)	0	1,300	Coolant, Cleaning solvent
Trichloroethane	0.1	100	Cleaning solvent
Halon	3.0～10.0	5,400	Fire extinguishing material
	(CFC=1.0)	(CO2=1.0)	

Chart 6-2 Ozone Depletion Materials and Potential

Fluorocarbon, used for a cooler refrigerant and a cleaning agent for electronic parts, are classified into two kinds. One is the specific fluorocarbon (CFC), which is restricted as a substance that deplete the ozone layer, and the other is the CFCs substitute (HCFC, HFC), which are developed as alternatives of CFC to prevent the depletion of ozone layer. HCFC is still a target of the restriction, although the potential of ozone depletion is smaller than CFC. (It influences the global warming.) HFC is also a target of the reduction due to its strong influence on the global warming as a green house gas, although it does not damage ozone.

Halon, used for the fire extinguishing appliances in the aircraft and buildings, has much stronger ozone destruction power compared with fluorocarbon. Halon, used for the fire extinguishers installed in the aircraft, would not be emitted unless the fire occurs. However, it is important to avoid unnecessary halon ejection in the atmosphere by unexpected leakage or fire drills.

(1) Our Solution to Restricted Substances which relate to Aircraft Operation

① Chlorofluorocarbon and Trichloroethane used on Aircraft Maintenance

The application of both substances has been completely abolished in 1994 according to the reduction plan drew up in 1990. The quantity of specific fluorocarbon consumed is reduced by introducing the recovery system of the fluorocarbon cleaning solvent to recycle the fluorocarbon solution, while incorporating substitutes of fluorocarbon cleaning agent. Trichloroethane was replaced to the alkali-cleaning agent.

② Measures to Halon Emitted by Fire Drill

The fire drill for the crews with the use of an actual halon fire extinguisher has been changed to the training with a mock fire extinguisher and a water fire extinguisher along with the video use since February 1993. The mock fire extinguisher is almost equal to the halon fire extinguisher installed in the aircraft in its shape, weight, handling methods, the jet duration time of the extinguisher, and the extinction capability. By this, unnecessary ejection of Halon in the atmosphere became to be avoided.

③ Correspondence at Checkout Maintenance of Fire Extinguisher installed in the Aircraft

The halon recovery equipment has been introduced into the fire extinguisher Maintenance Company to establish the halon recycling system. As a result, it became much easier to save halon (1311) because the fluorocarbon leakage at maintenance can be reduced less than 2 %. Halon(1211)recycling system is going to be introduced in the near future. Present halon holdings are about 15 tons.

④ Correspondence to Restricted Substances such as Fluorocarbon used in Aircraft Components

The water cooler installed in the aircraft has been removed as it has not been used. In 2000 fiscal year 5.1kg of specific fluorocarbon was destroyed and treated in the Disassemble-Maintenance Company. The specific fluorocarbon used for the refrigerant of air chillers (refrigerators) has been completely replaced by CFCs substitute (HFC134a), not a restricted substance. The specific fluorocarbon solution (fluorocarbon 113) was being used for the injection material of the rain repellent system (raindrop removal equipment in the cockpit windshield). However, the all systems installed in aircraft have been completely deactivated in 1998 fiscal year (Not applicable to ANK YS11).

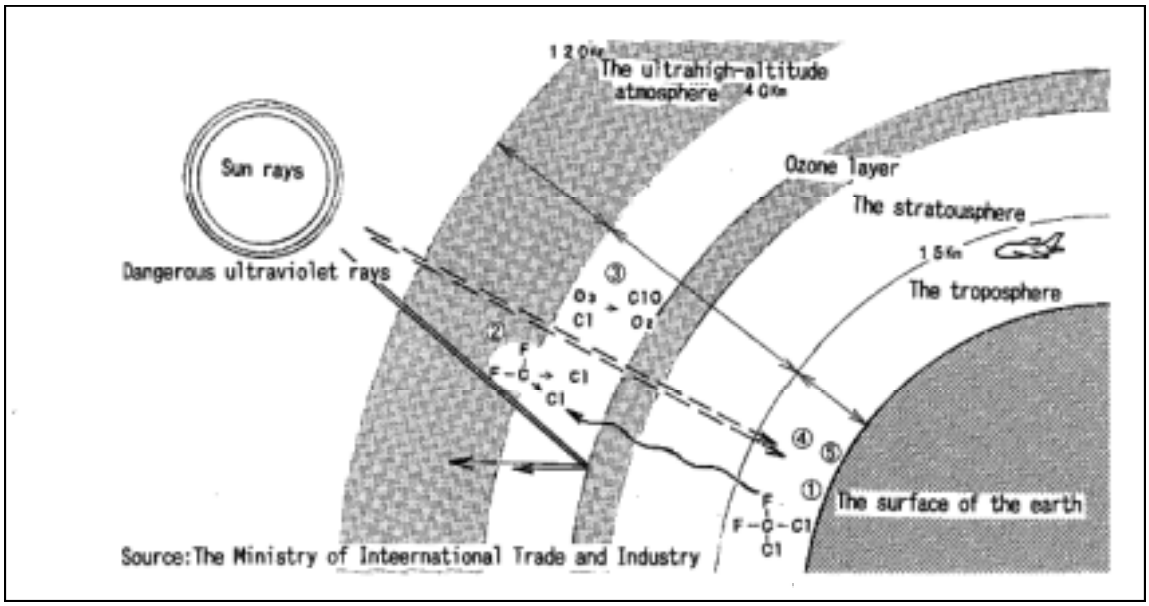
⑤ Correspondence to Refrigerant Fluorocarbon used for Air Conditioner of Maintenance Vehicle

When being renewed, vehicles are positively replaced to the ones using CFCs substitute.

⑥ Correspondence to Halon Fire Extinguisher used in Building

The halon fire extinguishing appliances are installed in the transformer room and the computer room in our company building. The gaseous extinguishant, an alternate of the halon extinguishant, has been recently developed. ANA has been introducing it to our new buildings. And thorough control to avoid careless halon ejection other than the emergency is carried out as before.

Fig. 6-3 shows the Mechanism of Ozone Layer Depletion.



① Atmospheric emission of ozone layer depleting substances (halon and fluorocarbon, etc.)

② Halon and fluorocarbon, etc. being photolyzed by the strong ultraviolet rays radiated by the sun, and emitting chlorine.

③ Chlorine reacting with ozone, depleting the ozone layer.

④ The amount of the dangerous ultraviolet rays reaching the surface of the earth increases.

⑤ Influence on animals and plants in the earth surface.
(Human's skin carcinoma, cataract, and growth hindrance of animals and plants etc.)

Fig. 6-3 Mechanism of Ozone Layer Depletion

Abbreviations

ACI	Airport Council International
AEA	Association of European Airlines
AESA	Atmospheric Effects of Stratospheric Aircraft Flyer
APU	Auxiliary Power Unit
ASK	Available Seat Kilometers
ATEC	Association of Air Transport Engineering and Research
BOD	Biochemical Oxygen Demand
CAEP	(ICAO) Committee on Aviation Environmental Protection
CFC	Chlorofluorocarbons
CH_4	Methane
CNS/ATM	Communications, Navigation and Surveillance Systems for Air Traffic Management
CO	Carbon monoxide
CO_2	Carbon dioxide
COD	Chemical Oxygen Demand
COP	Conference of Parties (to the UNFCCC)
DPM	Diesel Particles Matter
ECAC	European Civil Aviation Conference
EU	European Union
FANS	Future Air Navigation System (CNS/ATM)
FCCC	(United Nation) Framework Convention on Climate Change
FIP	Federal Implementation Plan
FMS	Flight Management System
g/KN	gram/Kilo-Newton Emission weight per engine unit thrust during LTO cycle
GSE	Ground Support Equipment
GPS	Global Positioning System
GPU	Ground Power Unit
GWP	Global Warming Potential
HC	Hydrocarbons
HCFC	Hydrochlorofluorocarbons
HFC	Hydrofluorocarbons
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IPCC	Intergovernmental Panel on Climate Change
ISO	International Organization for Standardization
LTO	Landing/Take Off (cycle)
MSDS	Material Safety Data Sheet
NASA	National Aeronautics and Space Administration
NO_2	Nitrogen dioxide
NO_X	Nitric oxides
N_2O	Nitrous oxides

O_3	Ozone
ODA	Official Development Assistance
ODP	Ozone Depletion Potential
PCB	Polychlorinated biphenyl
PPM	Parts per million
PRTR	Pollutant Release and Transfer Register
R-NAV	Area Navigation
RVSM	Reduced Vertical Separation Minimum Vertical separation of aircraft by 1,000 ft above flight level 29,000
SO_2	Sulfur dioxide
SO_X	Sulfur oxides
SPM	Suspended Particle Matter
SST	Super Sonic Transport
UNEP	United Nation Environmental Program
VOC	Volatile Organic Compound
WECPNL	Weighted Equivalent Continuous Perceived Noise Level