1 Paper resource management

◆*Telephone directory: for environment-friendly telephone directories**

The NTT East and NTT West issue some 125 million telephone directories annually, manufactured from some 150,000 tons of paper, which account for approximately 0.5% of Japan's total annual paper consumption.

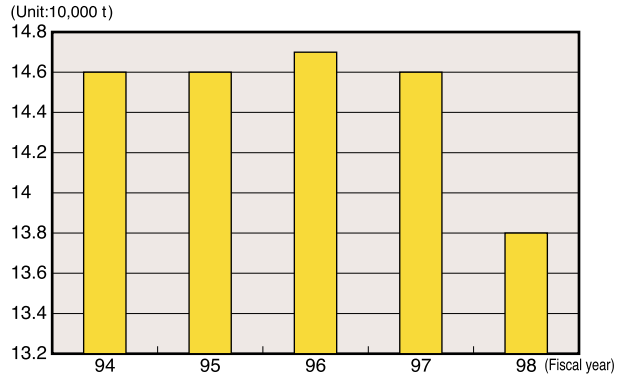

Fig.4.1-1: Paper consumption for telephone directories

[Reduction of virgin pulp consumption]

The NTT has taken the following measures to reduce paper consumption:

* *Dividing listed regions through the publication of various area-specific telephone directory editions, and reducing publication frequency*
* *Using more accurate calculations regarding the proper number of copies to be distributed*
* *More thorough checking of customer requests for telephone directories*
* *Development of multimedia directories, such as CD-ROM directories and Internet Town Pages**

We are also reducing the virgin pulp content of the paper used for telephone directories. *(Fig. 4.1-2)*

The current content ratio for recycled paper (recycled pulp) is approximately 50%. We plan to increase this ratio in near future.

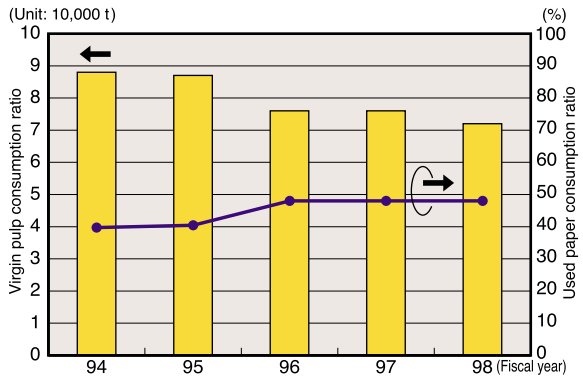

Fig. 4.1-2:
Virgin pulp and recycled paper consumption ratios in telephone directories

[Handling of facilitating collection of old telephone directories]

Both NTT East and NTT West have established a coordinated system for collecting old telephone directories when new ones are delivered. Thorough training is provided in advance to delivery personnel to ensure that they collect old directories. Even if a customer is not home at the time of delivery, the delivery personnel will visit again to collect the old telephone directories free of charge at the customer's request. The delivery notice and contact number are printed on the polyethylene bag containing new directories. These and other measures have dramatically increased the amount of old directories collected *(Fig. 4.1-3)*.

Most of the collected directories are recycled into corrugated medium or cardboard. They are also made into materials used internally as magazines, invoices, envelopes, flowerpots, and toilet paper, as well as auxiliary construction materials and water purification agents.

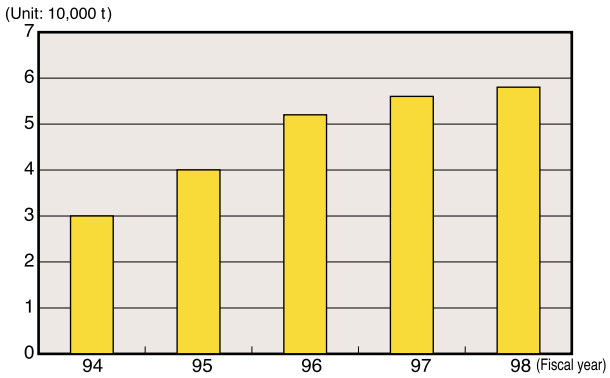

Fig. 4.1-3: Weight of collected telephone directories

The current Town Page* paper is tinted yellow, with adhesive agents used for the covers, making it difficult to recycle. In 2000, to make recycling technically easier, we plan to use white paper. We also plan to request paper manufacturers to soon introduce recycling facilities capable of completely removing the adhesive agents. Once these obstacles are cleared, currently planned for 2001, we are able to have a circulatory recycling system in which old directory paper is used to produce new directories—closed loop recycling for telephone directories.

[Development and introduction of environment-friendly materials for telephone directories (Green Procurement)]

We introduced the Green Procurement system in June 1996. This system is scheduled for expansion to cover procurement of ink and adhesive agents.

◆*Introduction of recycled paper into telegram paper; use of environment-friendly material*

In fiscal 1998, the total number of telegrams handled by NTT East and NTT West was 36.18 million, all of which were carefully packaged on mounting cardboard for delivery to recipients.

There are approximately thirty types of mounting cardboard, made of paper, cloth, or paper and cloth for different social occasions, such as celebrations and condolences.

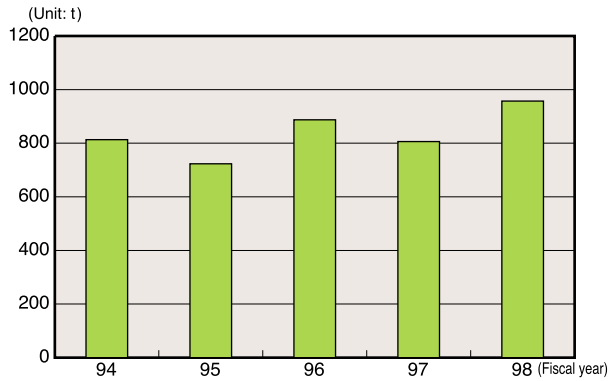

Fig. 4.1-4: Virgin pulp consumption for telegram-related paper

As a paper resource management measure, we have actively promoted the use of recycled paper in place of virgin paper. Currently there are ten of the thirty types of telegram mounting boards, as well as for message output paper. We have increased the rate of recycled paper used for the telegram message output (for condolences and for general use). As a result, in fiscal 1998, the content ratio of the recycled paper reached approximately 50%. Overall consumption in fiscal 1998 increased slightly, despite efforts to reduce the consumption of virgin pulp from fiscal 1991, due to increased sales of the mounting boards.

In the future, we plan to increase recycle paper use in the mounting cardboard, especially for congratulatory telegrams, which to date have not incorporated recycled paper. We will also promote the use of recycled paper and other environmentally preterable materials for new mounting board designs.

◆*Introduction of recycled paper into bills and other documents*

Paper consumption for invoices and other business correspondences sent to NTT East and NTT West customers amount to about 10,000 tons annually. Since 1991, we have promoted the use of recycled paper for invoices and other documents; the current content ratio of recycled paper for them is 50% (3% of which is provided by recycled telephone directories), and that for envelopes stands at about 40%. These have reduced the use of virgin pulp to about 6,000 tons annually.

Although some technical difficulties have prevented the reduction of invoice paper, we plan to increase the recycled paper content of other paper materials, such as envelopes, which do not require technical complication.

We also send a single invoice to customers even when they use multiple telephones. We are further working on reducing the numbers of bills and envelopes by recommending that customers receive these documents on magnetic format, with free of change.

◆*Activities in office paper recycling: Kanazawa (Kanazawa Branch, NTT West)*

"Office paper recycling: Kanazawa" is a voluntary club of companies (offices and building maintenance companies), waste recovery companies, wastepaper wholesalers, paper manufacturers, and paper wholesalers, etc. in and near Kanazawa City. It was established in order to contribute to global environmental protection activities including prevention of global warming and reduction of waste in the Kanazawa region, under the initiative of the Kanazawa Branch of NTT West. With a Branch secretariat established in October 1995, the club began with 42 member companies. The number of participating companies has steadily increased since, to a current membership of 85.

The main objective of the club is to establish a recycling circle, or implement 'locally completed recycling systems' through the seperate collection of wastepaper from offices, and to produce100%-recycled toilet paper and other products under the club's brand name. These products are then purchased and used by club members. Its activities have been well-received, winning a prize from the Minster of International Trade and Industry in October 1997.

In future, the club plans to recycle shredded and incinerated confidential documents through a confidential document recycling system, and to develop new club-branded products, such as file-holders and letter files. We plan to expand the market for club-brand products, currently used by members only, to the general public.

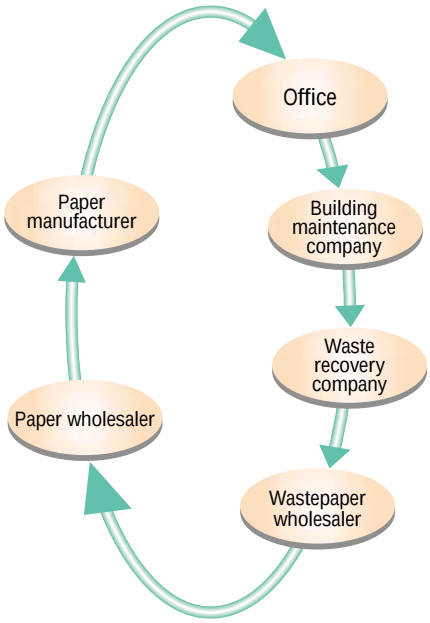

Fig. 4.1-5: Recycling circle (locally completed recycling system)

◆*Paperless office through use of the internal intranet system (Miyagi Branch, NTT East)*

The Miyagi Branch of NTT East (formerly the Sendai Branch) began work on establishing an internal intranet system in fiscal 1995, and has since worked on BPR(Business Process Reengineering) throughout its entire business operations from beginning to end by using PCs. As a result, various BPR tools have been developed and deployed. For example, a BPR tool called SO-^ was introduced in July 1997 to contribute to a paperless environment. This BPR tool directly inputs data for area construction instructions and communication line testing instructions into PCs to facilitate paperless constructions and improve operational efficiencies. These documents were formerly output on hard copy from our integrated customer information system (CUSTOM). This system has achieved a reduction of 2,000 papers per day, or 480,000 papers annually, reducing paper output from CUSTOM by 25% and achieving an overall 2.5% reduction of paper consumption at the Miyagi Branch.
Other operational initiatives include the following.

NetStep 98 System
A series of operations, from customer applications to actual construction, can be performed on the intranet, eliminating paper use.

Net Authorization System
All internal materials are shared over the intranet to expedite approval and authorization.

Paperless Conference
All conference materials are entered into shared servers connected through the intranet, then used in actual conferences with projectors, without paper-based output.

◆*Lightning Fax*

NTT began offering systems promoting the paperless office from September 1997. Since July 1999, NTT-ME has offered Electronic Fax as a next-generation service.

Electronic Fax connects fax machines, PCs, and LANs, enabling clients to send and receive fax messages on their PCs. The fax documents are stored and maintained in servers in the form of electronic data, enabling a paperless office environment.

In a conventional fax system, both sending and receiving ends are paper-based. In contrast, Electronic Fax enables a sender to send messages directly from a PC. Since messages are received and stored by servers, a receiver can check the contents of the message on-screen and choose to print only those documents that are necessary.

Introducing Electronic Fax to the marketing department reduced fax paper consumption by an average of 250 pages (A4 size) per day per PC.

2 Preventing global warming

◆*Total Power Revolution (TPP) campaign involving the entire NTT Group*

In fiscal 1998, electricity purchased by the NTT Group amounted to 5.2 billion kWh (¥71 billion), which translated to 510,000 t-C (*) in CO_2 emissions.

(*) t-C* is a unit for which the weight of all greenhouse gases, including carbon dioxide and methane, is converted to that of carbon (C). For example, *100t-C* indicates a carbon-converted weight of 100 tons, or approximately 367 tons in carbon dioxide (CO_2) (multiplied by 44/12).

Power consumption is expected to increase due to the widespread use of multimedia and ISDN services, as well as other information technology advances, such as the use of optical fiber cables. If energy consumption continues to grow at the present rate without efforts to curb our requirements, the amount of electricity purchased in 2010 will reach 10 billion kWh. At this level, the NTT Group would emit approximately three times the carbon dioxide (CO_2) of the 1990 level.

The NTT Group has taken up initiatives to reduce electricity consumption. In October 1997, NTT launched the Total Power Revolution (TPP) to cope with electricity-related issues from the early R&D stages.

In February 1998, we established "the Vision for Reducing Electricity Requirements Toward 2010" to ensure the success of the TPR initiative. *(Fig. 4.2-2)*

To achieve these goals, the TPR initiative has been targetting with the following four major areas.

1. Energy reduction measures through R&D

We are currently involved in technical development of reduction of power consumption so that lower operating voltages of LSI-comprising communication facilities could be achieved. By 2000, power consumption is scheduled to be reduced to 1/5 the current level, then to 1/25 by 2005.

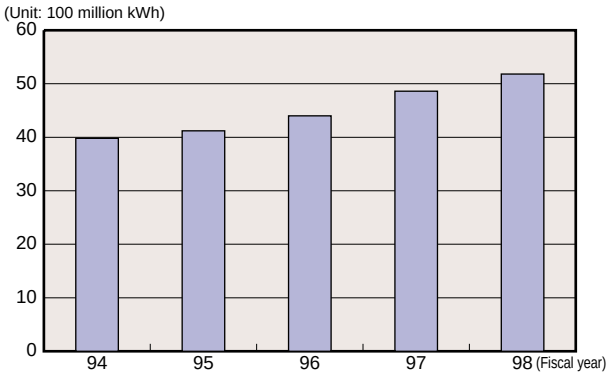

Fig. 4.2-1: Electricity purchased

With the use of the low-voltage LSI, we plan to develop communications equipment requiring only 2/3 of the current level of electrical consumption in 2000 and 1/3 by 2005.

2. Energy reduction measures at departments that use communications equipment

In order to achieve energy consumption reduction, it is important to introduce the appropriate technology to the right department. NTT is committed to do so, based on a various assessment, such as on geographical location of a building, degree of efficiency of communication equipment installed, etc.

3. Energy reduction measures at departments that maintain and manage power-generating equipment

Ensuring proper management of power consumption at each building requires voluntary and self-initiated cost management activities in daily operations. Energy management personnel are appointed and allocated throughout the country to promote more meticulous TPR activities.

4. Establishing the most appropriate energy system for efficient use of NTT resources

* Development of low-power devices and parts, such as LSI, in the first step toward 2005
* Efficient introduction of communications facilities equipped with the results of the first step by the end of 2010, in the second step
* Improving the self-supply ratio of electricity from the current 2% to 10% by 2005 and 30% by 2010 through private power generation

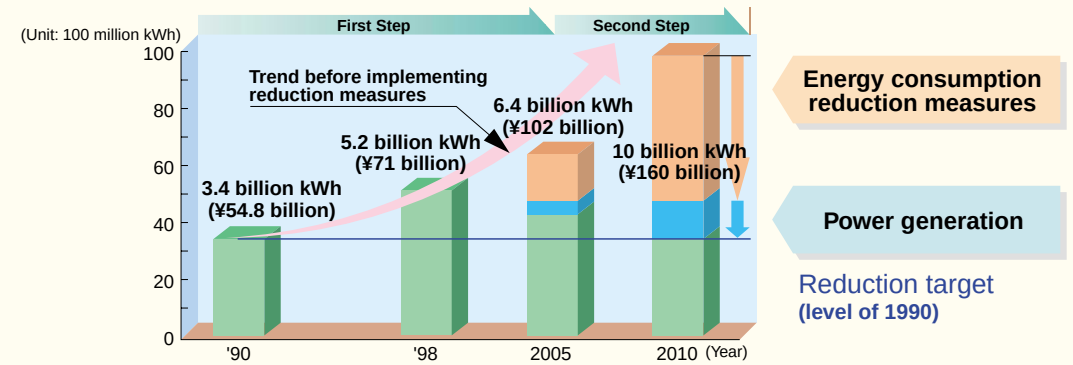

Fig. 4.2-2: Electricity purchased

In certain cities, we have worked on self-power generation with the co-generation system (CGS) and photovoltaic power generation. We also plan to increase the self-supply ratio through self-power generation from the current 2% to 10% in 2005, and 30% by 2010, reducing our costs and reducing peak power consumption loads. As future R&D targets, we plan to study the possibilities of using fuel cells and solar cells.

Through these four measures, we managed in 1998 to reduce the amount of electricity purchased by the entire Group by 210 million kWh (¥3.6 billion), compared to a case in which no countermeasures were taken. This result translated to a reduction in CO_2 emissions by 22,000 t-C.

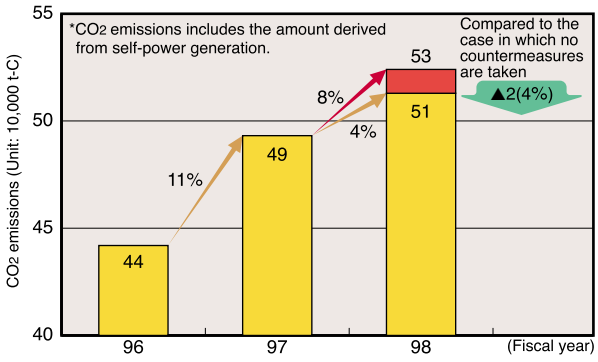

Fig. 4.2-3:
CO_2 emissions produced by generating electricity purchased by the NTT Group

◆*Low-power devices*

As an option to reduce power consumption, NTT <holding company> is conducting research on low-power communication devices, especially technologies to reduce LSI power consumption in communications equipment.

Conventional LSI operates at about 5 V of source voltage. LSI power consumption changes proportionally to the square of the power of the source voltage. NTT <holding company> plans to reduce LSI power consumption by developing low-power LSI with a source voltage of 2 V by 2000, further reducing this voltage to 1 V by 2005. Using the low-power LSI will reduce the power consumption of newly developed communications devices to 2/3 of current levels in 2000, and to 1/3 of current levels by 2005.

In addition, we are carrying on our research to produce LSI capable of operating at very low source voltage, about 0.5 V. This will allow clean mobile terminals capable of operating from solar cells.

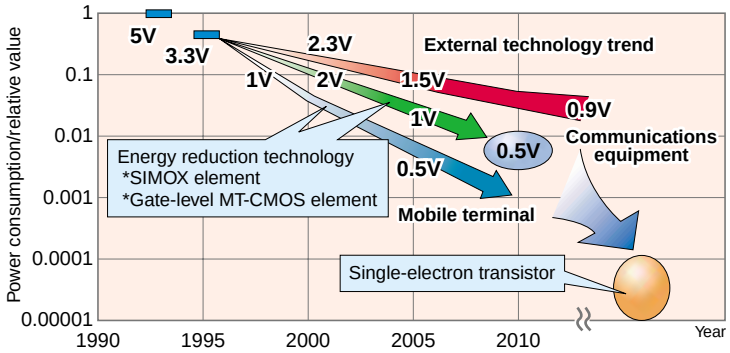

Fig. 4.2-4: Development of research activities for lower-energy LSI

◆*Development and introduction of clean energy (solar light and wind power) facilities*

The NTT Group built and began operating a 555-kW photovoltaic power generation system (the largest outdoor installation of its kind in the world) at the NTT East Training Center (Chofu city, Tokyo) in March 1996. After taking this first step, we established 38 photovoltaic power generation systems (about 1.2 MW) and four wind power generation systems (0.2 MW) in a varios areas of Japan as of March 1999, providing a total power generating capacity of about 1.4 MW. Approximately 1.9 million kWh of electricity annually can be obtained from cleaner sources of energy, such as solar and wind, which translates into about 2,000 drums of oil. These contribute to reductions in carbon dioxide emissions of about 320 t-C annually.

More specific operations include technologies for more efficient energy use, such as changing the angles of installed solar cells and use of reflected light, the evaluation of promising amorphous solar cells, establishment of more economical systems by reducing the size of framing (using angled framing and block framing), and data analyses and technical verifications performed with data collection equipment.

In March 1998, at Kume Island, Okinawa Prefecture, we constructed a hybrid system that combines wind power generation of 230 kW and photovoltaic power generation of 20kW. This facility makes use of a fluctuation-reduction technology capable of absorbing fluctuations in voltage and frequency of electricity, generated by a wind power generator. We believe this represents an effective use of energy in harmonious with the environment.

In future, we plan to realize an optimal energy system* based on long-term perspectives as a preparatory step for the advent of a full-fledged clean-energy age.

◆*Water purification system based on solar power generation*

The NTT Group constructed a photovoltaic power generation system for water purification in Mitsugi Park, Itabashi-ku, Tokyo, in May 1998 (currently operated as part of the NTT Facilities). This photovoltaic power-generating system for water purification is based on a floating body with power storage functions. It is capable of purifying water without damages to the ecosystem. It also can operate withought external power supply in case of emergency.

This system is a disc-floating structure with 10 m in diameter, mounting solar cells capable of generating 5 kW electricity It efficiently utilise solar energy, regardless of the direction of the disc. The water purification system has the following four processing functions:

**** Aeration***
To improve dissolved oxygen concentrations and to reduce hydrogen sulfide

**** Filtering***
To remove suspended solid matter in water

**** Phosphor absorption process***
To prevent algae proliferation through phosphor removal

**** Pressurization***
To reduce algae propagation

These functions can be chosen and combined in accordance with water quality and contamination levels of the pond or lake in which the system is installed.

This system also allows the general public, particularly children, to embark on it, so that they can acquire hands-on experience with aquatic environment mechanisms. With this use in mind, thorough safety precaution measures have been taken for this facility.

◆*Promoting low-pollution vehicles*

Reduction of carbon dioxide emissions from automobiles

As of the end of fiscal 1998, the NTT Group owned approximately 44,000 company vehicles, which annually produce approximately 24,000 tons of carbon dioxide. Carbon dioxide emissions increased slightly from 1996 to 1997. However, due to large-scale introductions of vehicles for high-lift tasks at NTT-TE companies to promote safer and more efficient operations, CO_2 levels are far below 28,000 tons, the level for fiscal 1990, which is the action plan target for the entire NTT Group (*). To reduce CO_2 emissions from these vehicles, the NTT Group has promoted the introduction of low-pollution vehicles, anti-idling campaigns, and reductions of vehicle numbers.

As of the end of 1998, the number of low-pollution vehicles introduced within the NTT Group was 130 *(Fig. 4.2-6)*, indicating a steady increase from 1994 levels. We plan to introduce more low-pollution vehicles with technical advances in this field in our mind.

*** NTT Group Action Plan Target is:**
To maintain CO_2 emissions at 1990 levels in and after 2000.*

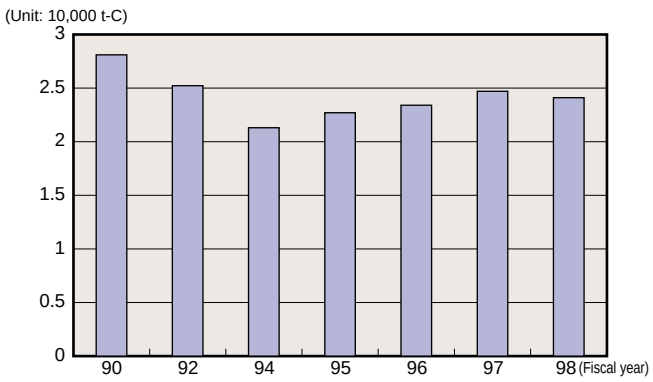

Fig. 4.2-5: CO_2 emissions from company vehicles

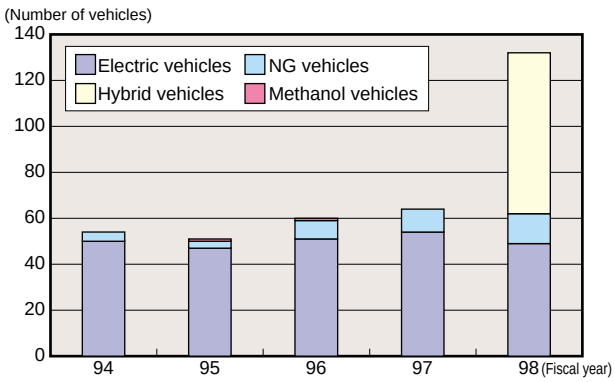

Fig. 4.2-6: Number of low-pollution vehicles introduced

◆*Promoting anti-idling campaign*

The NTT Group has promoted an anti-idling campaign for all company vehicles to reduce emissions of carbon dioxide and nitrogen oxide, noise, and fuel consumption. Stickers were placed on all company vehicles and a brochure distributed to all employees to raise awareness.

In December 1998, these actions were recognized by an Effort Prize in the first Eco-Drive Contest.

*** Eco-Drive Contest**
Reducing vehicle emissions by reducing engine idling and promoting environment-friendly driving, held under the sponsorship of Transportation Ecology Mobility Foundation and supported by the Ministry of Transportation

◆*Fuel cell*

Fuel cells provide an environment-friendly clean-energy system with low noise and a high total energy efficiency of about 80% (twice the levels achieved by thermal power generation). Since 1986, the NTT Group has consistently promoted R&D activities on fuel cells, ranging from materials and parts to entire systems. In fiscal 1999, following a system introduced to NTT East Training Center, a second system (a multi-fuel cell system with an output of 200 kW) was introduced to Musashino R&D Center. In all, two systems are currently being operated.

The multi-type fuel cell system, developed by NTT, is equipped with backup capabilities to ensure operations even in emergencies. If the city gas supply is suspended due to disaster or accidents, the fuel supply system is automatically switched to LPG, the contingency fuel, prepared in advance. Power generation is maintained, ensuring stable supply of electricity and heat to the appropriate facilities. The switching from city gas to LPG is made instantaneously and causes no fluctuation in power supply to facilities.

By 2000, we will further push R&D activities to develop high-molecular fuel cell systems expected to realize cost reductions, as well as solid-electrolyte fuel cell system, which are expected to improve overall power generation efficiency. These will allow extensive introduction of fuel cell systems.

3 Waste management and proper disposal

◆*Proper disposal of dismantled communication facilities and equipment (Maintaining an industrial waste database and promoting recycling, etc.)*

The NTT Group employs a wide variety of communications facilities and equipment, including communications cables and switchboards. The replacement of old equipment generates about 250,000 tons of waste each year, representing a significant potential environmental impact. Rather than merely disposing of such facilities as waste materials, we promote waste reductions through recycling.

**** Promotion of proper disposal and creation of database of disposal results on the Internet***
Since 1997, we have introduced and managed manifest/statement systems to promote the proper disposal of removed communications facilities. Concurrently with the introduction of these statements, we have established and maintained systems that manage manifest/statement processes and collect data on disposal results entered through the internet.

This system manages the completion of waste disposals and provides the database with disposal results, which can then be used as an important tool for further waste reduction and recycling.

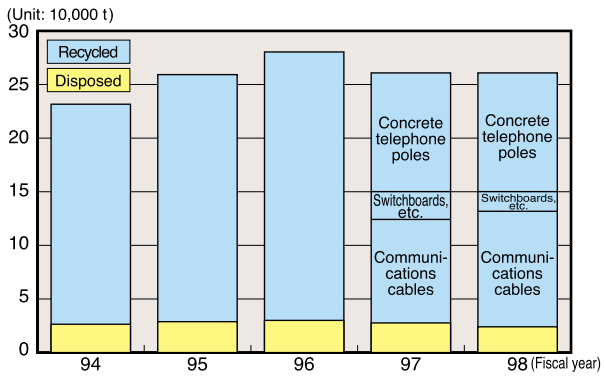

Fig. 4.3-1: Historical development of discharge, recycling, and disposal of removed communications facilities

*** Manifest/statement**
When using external disposal companies, this system enables us to track and manage the flow of waste, with access to

information listed on the manifest/statements such as names, quantities, and qualities of waste materials, the names of collection and transportation agents and disposal companies, and instructions on waste handling.

*** Reduction of wastes and promotion of recycling**

We are promoting waste reduction by recycling the copper in removed communications cables, using concrete telephone poles as roadbed materials, wooden poles as chips, and battery recycling. However, we continue to face the challenge of recycling plastics and optical fiber cables, the removal of which is expected to increase. We are currently studying various recycling methods. In the procurement of communications facilities, we are currently developing the Green Procurement system *(for more information, please refer to p.9.)*, in which priority is given to purchase items containing less hazardous substances and more recyclable items, so that procured items, when disposed, have lower negative environmental impacts.

◆*Proper disposal of soil removed from civil engineering work sites and other construction waste products*

To reduce the amount of soil discarded from construction projects involving pipe conduits and tunnels, we established a manual for their disposal in May 1993. The basic policies guiding this manual include the reduction and reuse of waste materials, and thorough implementation of proper final disposal.

The replacement of conventional excavation methods with the ACE mole method introduced in 1985 has successfully reduced the surface area of excavations and the amount of soil displaced from construction sites. In the new method, a special machine automatically excavates the ground, simultaneously laying pipes, thus contributing to improved safety and cost reductions.

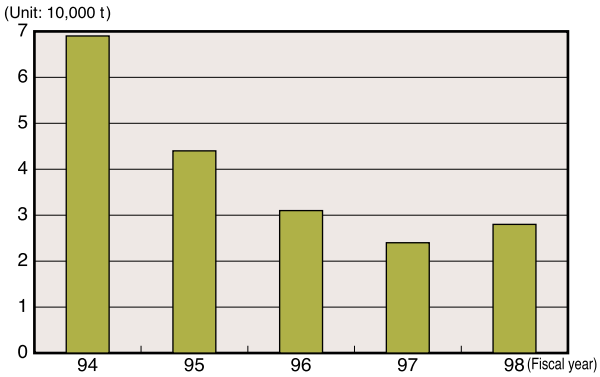

Fig. 4.3-2:
Discharge of industrial waste materials (in civil engineering projects)

◆*Proper disposal management of construction-related waste products (construction waste products and removed soil)*

Construction byproducts, or materials generated from construction projects, are divided into soil displaced from construction and construction waste materials. Traditionally, these have been disposed at seaside landfills and inland disposal sites. However, as the pace of urban development accelerates, it has become more and more difficult to secure environmentally appropriate disposal sites, with generated amounts increasing year by year.

The Ministry of Construction has established a construction recycling plan to implement a three-pronged basic policy consisting of reduction and, reuse of wastes, and proper disposal for construction waste materials and displaced soil, at each stage of planning, design, and construction. To realize these goals, the Ministry has also prepared action plans.

In 1999, the NTT Group adopted a new action plan target of reducing waste materials to less than 65% of 1990 levels by 2010, and has since promoted construction byproduct management by systematizing waste disposal plans, promoting the use of recycled resources, and curbing waste generation.

NTT promotes reductions and reuse of construction byproducts through sludge disposal management, reduction of excavated soil, reuse of concrete waste materials, and reductions in frame materials made of plywood.

Industrial waste materials (including specially-controlled industrial waste materials) generated from construction sites are to be reported by the original contractors, or construction companies, to which we have contracted the projects, to relevant local governments. Given the social responsibilities of the ordering parties, we provide instructions to our contractors and check that waste materials are properly disposed of by confirming manifests.

To ensure future waste reductions, we have established recycling targets and promoted the recovery of resources, including concrete waste materials. The recycling targets for 2000 are 80% for construction waste materials and 60% for soil displaced from construction sites. The final disposal amounts in the NTT Group as of 1998 were approximately 70,000 tons for construction waste materials and 80,000 tons for soil displaced from construction sites. We are now actively promoting waste reduction policies to maintain levels at about 1990 levels.

◆*Proper disposal of medical waste products*

Medical facilities in NTT East and NTT West (hospitals and healthcare centers) produced 3,399 tons of medical waste in fiscal 1998, of which infectious waste amounting to 698 tons were carefully controlled so that proper labelling is ensured as infectious waste. It is done by separating these products in specified containers with universal bio-hazard mark, according to specific characteristics (sharp edges, such as injection needles and scalpels, and solid matter). It is to protect public hygiene and to prevent the dispersion of pathogenic microorganisms.

To eliminate the possibility of accidental infections, storage facilities are tightly locked to prevent the entry of unauthorized personnel. Disposal of these waste products are contracted out to specialized disposal companies authorized by local governments. The disposal process from collection and transportation to final disposal are rigorously controlled with manifests/statements to ensure proper disposal to be carried out.

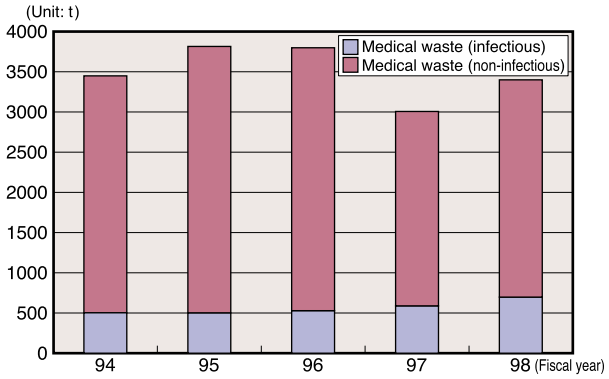

Fig. 4.3-3: Amount of industrial waste materials (medical)

◆*Disposal of general office and industrial waste products (Recycling confidential documents and recycling box, etc.)*

The NTT Group promotes the proper disposal of waste materials generated from offices and works to reduce waste brought for final disposal (incineration and landfill disposal). These efforts help realize a society that recycles as much as possible, and in which waste disposal is minimized.
Our offices implement thorough separation of waste collection through the distribution of recycled paper recycling boxes, dust bins for incinerable waste and others for non-incinerable waste, and through the recycling of paper (copy paper, discarded documents, and newspaper, accounting for 70% of office waste) and non-incinerable wastes (bottles and cans). In 1998, the recycling ratio of recycled paper was 85.2%, representing a reduction of about 27,500 tons of final disposal waste. In the near future, we plan to improve our separated waste collection routes, which is the key factor in recycling.

To assess proper waste disposal, we use a manifest/statement system to confirm that all industrial waste materials (desks, lockers, and Styrofoam materials) generated from offices are properly treated and disposed of, thus coping with such problems as inappropriate disposal (illegal dumping) and accidents within the disposal process.

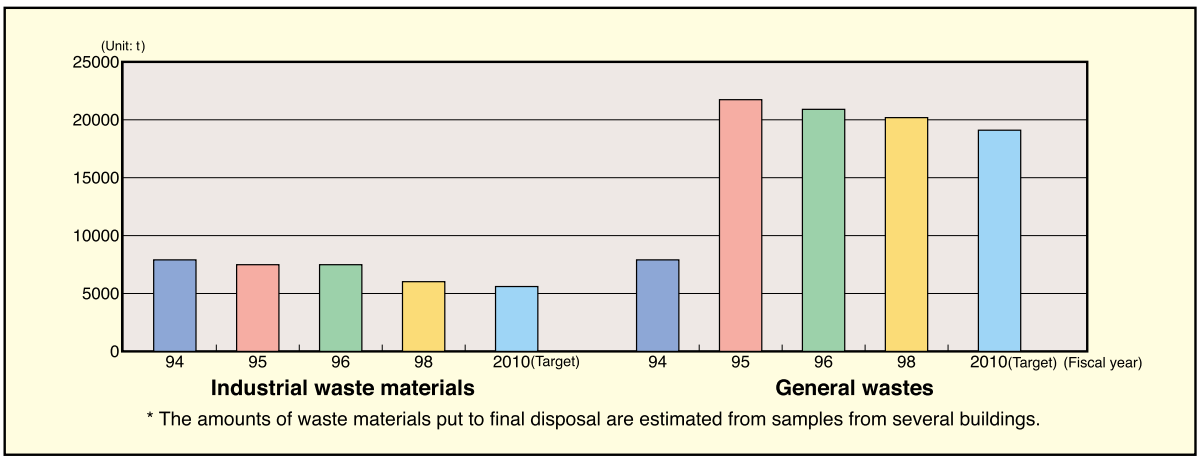

Fig. 4.3-4: Amounts put to final disposal (incineration and landfill disposal)

*** Separately collected waste materials are categorized as follows:**

Copy paper and fine-graded paper used in internal magazines; newspaper and magazines; cardboard; paper waste other than the above; non-incinerable wastes generated from offices; cans; paper cups.

◆*PCB storage and harmless processing technologies*

PCBs (polychlorinated biphenyl) offers excellent chemical stability, heat resistance, insulation capacity, and resistance to flammability, and was widely used as an insulation material for transformers and capacitors, as well as for thermal catalyzers and pressure-sensitive paper. But in 1972, due to its toxicity, its production was banned and the use is restricted. Since then, PCB waste has been stored by manufacturers and users, with no definitive disposal measures implemented. With prolonged storage periods, many of the storage facilities have become deteriorated. In the event of a fire at these facilities, highly toxic substances such as dioxin will be released into the atmosphere. The treatment and disposal of PCB currently represents a major problem.

In November 1997, the NTT Group established a PCB storage and disposal committee under the global environmental protection promotion committee to study methods of internal processing of the PCB, which is stored at our facilities.

In June 1998, with the enactment of the Revised Waste Processing Law (law governing the disposal and cleanup of waste materials), it became legal to render PCBs harmless through chemical decomposition. In response to this regulatory change, the NTT Group chose to processe PCB through safe decomposition at current storage facilities (on-site), eliminating the risk of contaminating the off-site environment.

In order to expedite processing, we will establish processing methods based on the BCD (Base Catalyzed Decomposition) process, regarded as most suitable for the NTT Group and our goals, embarking on actual processing with administrative assistance from local governments.

Four main NTT companies possess some 100 tons of PCB, in the form of various electric facilities, such as transformers, capacitors, and fluorescent lamp ballast, of which about 20 tons are still in use. Considering the risks resulting from the obsolescence of storage facilities (over 27 years have passed since PCBs were first stored at these facilities) and the time required for complete decomposition of PCB waste, we have re-examined the deterioration status of the storage facilities. Prior to these examinations, we established PCB storage guidelines in April 1998 for proper storage of PCB waste. We then applied the required countermeasures against facility deterioration and are now implementing further appropriate storage management.

For equipment currently in use (fluorescent lamp ballast), we began replacement operations in fiscal 1998 in order to alleviate environmental pollution due to disposal of obsolete units.

*** BCD (Base Catalyzed Decomposition) Process:**
A method of applying hydrogen to an organochlorine compound, adding a carbonaceous catalyzer and alkali, heating to 300˚ to 350˚C C at normal pressure in an ambient atmosphere of nitrogen, to achieve dechlorination. This method is capable of decomposing even highly concentrated PCB (initial concentrations should be less than 15% in the reaction chamber).

◆*Asbestos replacement (buildings)*

Asbestos was used for many years as a construction material due to its excellent noise-absorption and fire-resistant capabilities. However, its fibers were found to be highly hazardous to human health, leading to lung cancer through accumulation within the body. Sprayed asbestos, which is most likely to produce this hazardous dust, was introduced for construction in Japan around 1955, and widely used in NTT Group buildings, since NTT's expansion coincided with the popularization of asbestos use. Sprayed asbestos was banned by "the 1975 revisions to the Ordinance on the Prevention of the Hazards due to Specified Chemical Substances", based on the Labor Standard Law.

In the 1980s, the NTT Group established a manual for preventive measures against dispersion of asbestos dust from existing facilities and has since implemented removal operations, as well as the identification of asbestos quantity and scheduled monitorings. The removal of asbestos is conducted in accordance with a safe and secure method approved by the Japan Construction Center.

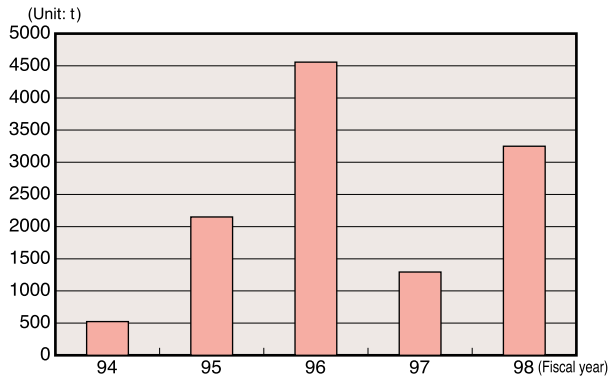

Fig. 4.3-5: Discharged amounts of specially controlled industrial waste (sprayed asbestos for construction use)

Construction materials currently in use for new buildings and renovation projects have been asbestos-free since 1990, in accordance with general construction specifications.

In May 1994, we recognized the asbestos problem as a health and safety issue, and established the target of complete asbestos removal by 2000. Accordingly, we reestablished feasible planning targets for each region, and established basic policies to implement action at the global environmental protection promotion committee in May 1994.

We are currently pushing our efforts to achive the target, as indicated in *Fig. 4.3-6*.

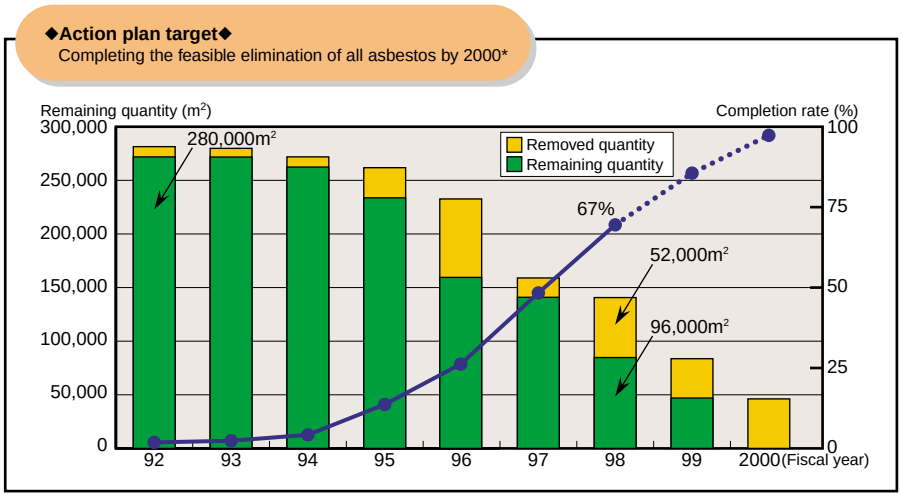

Fig. 4.3-6: Asbestos removal plan

◆*Asbestos replacement (bridges)*

The NTT Group used fireproof asbestos in refractory facilities (pipes and container cables) attached to bridges to protect against possible fires beneath the bridges.

However, in 1982, asbestos was designated as a specially controlled industrial waste due to its hazardous qualities. From 1983 to 1997, we used the rock wool method in place of asbestos for refractory facilities attached to bridges. Since 1997, we have used the pre-cast method, which realizes insulating and armoring functions simultaneously, to permit more economical replacement.

We are now proceeding with the systematic replacement of old fireproof facilities (bearing asbestos) that have deteriorated or suffered damage. The replacement of all entire asbestos facilities is scheduled to be complated in 2000.

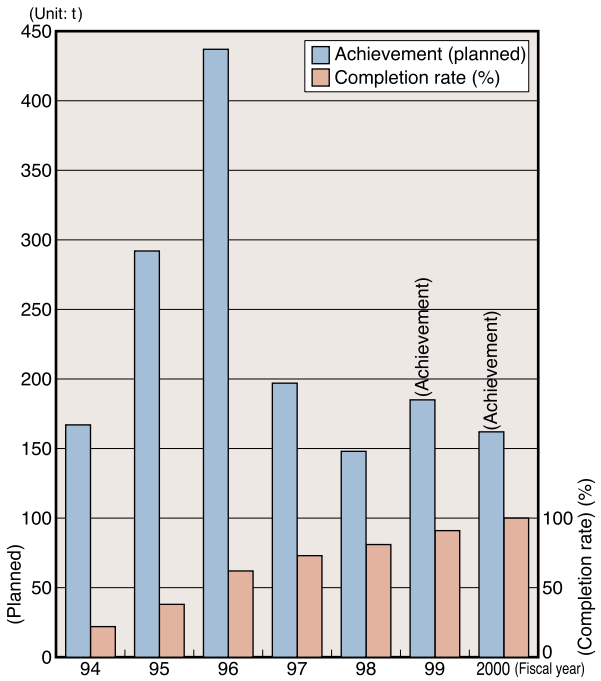

Fig. 4.3-7:
Removal and replacement of asbestos and completion rate

4 Promoting recycling

◆*Promoting recycling for dismantled communication facilities and equipment*

We at the NTT Group are promoting the reuse and recycling of removed communications facilities to reduce waste materials.

**** Promotion of reuse and recycling***

We are currently promoting the reuse of communications cables, telephone poles, and public telephones by sharing information through LANs and by using them at the appropriate business offices.

We are also promoting the recycling of copper, steel, and precious metals contained in communication cables and facilities through collection and recycling. Concrete telephone poles are used as roadbed materials, wooden poles are made into chips, and batteries are recycled.

**** Promotion of plastic recycling***

Regarded as a bottleneck and key point in our waste reduction efforts, plastic recycling has been stymied by problems involving markets development, separate collections, and financial costs.

We plan to work on plastic recycling in the following order.

(1) Material recycling (NTT closed):
Removed NTT items -> Recycled NTT items

(2) Material recycling (open):
Removed NTT items -> Recycled NTT items

(3) Thermal recycling
Cement materials used as reducing agents in blast furnaces

Cases of material recycling (NTT closed) include connection terminal boxes (made of polypropylene) and branch line guards (made of polyethylene).

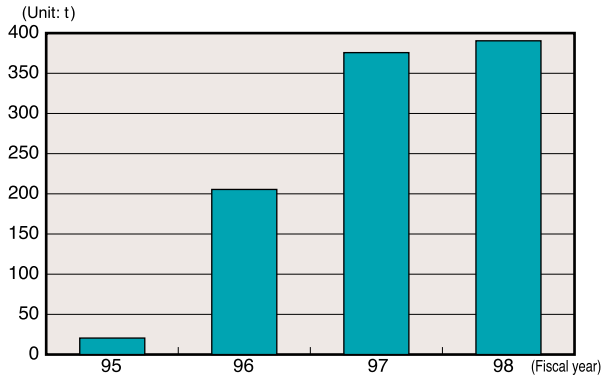

Fig. 4.4-1: Amounts of material recycling (repelletization)

Branch line protection materials formerly displayed stickers indicating recycled status, but the marking has been integrated to the materials from the molding process, eliminating the need to remove the stickers and realizing a 100% recycling of the material.

Through these efforts, the amount of recycled products has been increased year by year.

**** Promotion of recycling through the Green Procurement system***

We intend to strengthen our efforts in recycling through the Green Procurement system, which promotes the procurement of recyclable items, through more consistent use of materials, selection of materials that can be recycled easily, reducing hazardous materials, and adopting designs facilitating disassembly.

◆*Handling of nickel-cadmium (Ni-Cd) batteries*

Recycling Nickel-Cadmium (Ni-Cd) Batteries

Unlike non-rechargeable primary batteries (such as common dry-cell batteries), nickel-cadmium types are secondary batteries that can be discharged and recharged repeatedly. These economical and high-performance Ni-Cd batteries are used in NTT-Group cordless telephones. However, these high quality batteries do not last forever and must eventually be discarded or recycled. The nickel and cadmium in these batteries can be extracted and used again.

Since the Ni-Cd batteries were designated as recyclable by the Recycling Act in June 1993, they have been designed to be easily removed from equipment and are explicitly marked to show that they are a recyclable resource for separate collection.

To contribute to efforts to conserve limited resources and to promote Ni-Cd battery recycling, the NTT Group has

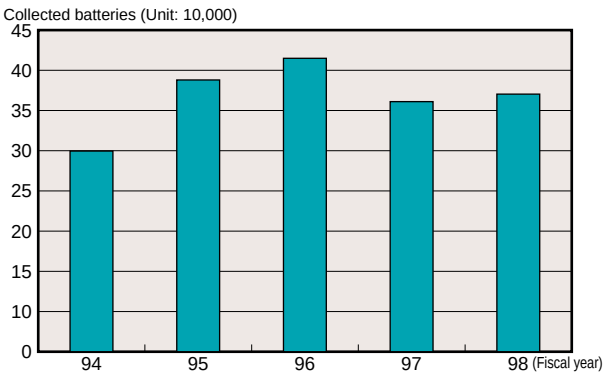

Fig. 4.4-2: Historical development of collection of nickel-cadmium batteries

implemented the following three actions primarily for cordless phones equipped with Ni-Cd batteries:

(1) To ask customers to recycle batteries, by inserting a statement in user's manuals and on the battery pack itself.

(2) To provide recycling boxes for Ni-Cd batteries at sales offices, etc.

(3) To deliver used battery packs collected from users to recycling companies

In 1997 and 1998, the NTT Group collected 350,000 and 360,000 battery packs respectively through our sales and affiliated offices.

In order to minimize the number of Ni-Cd battery types, we are developing technology that allows a small number of models to be used in a wide variety of cordless telephones.

◆*Recycling cellular phones/PHS units and batteries*

To protect the global environment and to recycle resources, NTT DoCoMo has undertaken "the Return Your Battery Campaign" to collect used battery packs since February 1996.

Since July 1998, the items collected have been expanded to cover portable phones and PHS units and chargers in the company-wide DoCoMo Return* campaign. We collected 2.1 million units in fiscal 1998 and will continue similar efforts during the current fiscal year.

◆*Improving packing and packaging materials*

In 1990, about 257 tons of Styrofoam were used as cushioning material (to protect precision devices from shock during transportation) in packaging for communication products sold by NTT East and NTT West.

Styrofoam (polystyrene) has excellent packaging characteristics in protecting products from shock, moisture, and humidity, but is difficult to decompose under natural conditions, making it necessary to promote recycling after use to reduce environmental impact. An advantage of the material (its light weight compared to its bulk) becomes a negative factor (high cost) for recycling.

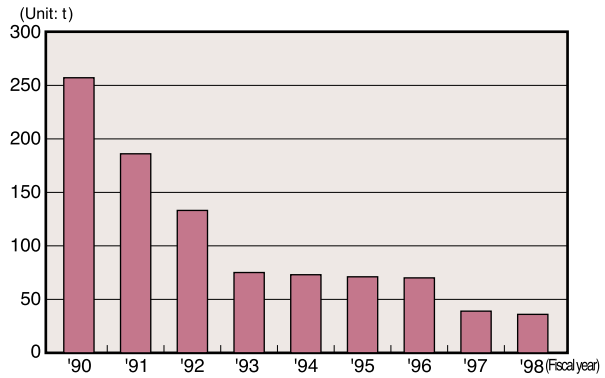

Fig. 4.4-3:
Use of Styrofoam used as a packing material for communications products

NTT East and NTT West have changed the cushioning material for cordless phones or fax machines for domestic use from Styrofoam, which is most likely to be discharged as domestic waste, to cardboard, which has a lower negative environmental potential than Styrofoam, phasing out the use of Styrofoam for new products.

For heavy items, such as fax machines for office use and internal switchboard equipment, and precision equipment that do not allow the use of replacement materials, we are reduceing amounts used by making the Styrofoam cushioning material thinner.

In 1996, we achieved our initial target of 70 tons of annual consumption (about one-fourth of 1990 levels, or 257 tons), further reducing consumption to 36 tons in 1998. The cushioning material for cordless phones and fax machines for domestic use has been 100% cardboard.

◆*Eliminating kitchen garbage output*

The NTT Group operates approximately 600 dining halls for employees, generating some 3,000 tons of kitchen garbage per year. Since April 1999, we have established a recycling system to reduce waste product levels to zero, launching model operations in the Tokyo metropolitan area.

(1) Recycling starts with biological decomposition of garbage generated from each dining hall with aerobic fermentative bacteria.

(2) Next, the generated compost is carried to fertilizer facilities and mixed with organic components such as oil cake, fishmeal, or fish bone for proper composition adjustment. This process enables the compost to be used as ordinary organic fertilizer. (If the compost is to be used directly as fertilizer, certain additional treatments are required for different types of vegetation that a fertilizer is applied.)

(3) Finally, the produced organic fertilizer is used for vegetations

which are then used as foodstuffs, completing the recycling circle and achieving zero emissions of kitchen waste.

The NTT Group has already established a system up to the second preceding stage, indirectly completing the recycling loop by leaving the last stage to the general market. We have introduced large garbage processing machines at three dining halls that provide over 500 meals a day in the Tokyo metropolitan area. Along with other dining facilities equipped with similar processing machines, the system was launched in April 1999.

The NTT Group also has many small dining facilities that provide fewer than 200 meals a day. For these facilities, we developed a small garbage processing machine capable of handling approximately 20 kg of waste daily (the actual introduction date has yet to be determined). We have succeeded in miniaturizing the system by improving heating and mixing mechanisms to one-third of the volume of comparable models.

◆*New materials derived from papermaking sludge produced in the paper recycling process*

The NTT Group has developed technologies to recycle papermaking sludge by dehydrating and pelletization processes as a mudding agent for the construction of communications tunnels, and as PMF (Paper Micro Fiber), which can be used as a soil improvement agent for soft ground conditions. PMF offering water-absorbing functions and connecting functions effective for soil particles, both of which are realized by the pulp fiber contained in the papermaking sludge, has been in use since 1991.

Papermaking sludge contains coating materials, such as kaolinite and calcium carbonate to create a smooth paper surface. When this sludge is incinerated at 950˚C to 1100˚C, these minerals can be extracted in the form of combustion residue (ash). Ash is melted during incineration and made into hyaline (amorphous substance). It was found that amorphous aluminum silicate reacts with alkali to crystallize into a mineral called zeolite.
Based on this knowledge, we have discovered that incinerated ash of papermaking sludge placed in hydrothermal synthesis reaction in water solution changes into a porous material.

This material filled with minute pores is called MPM (Micro Porous Material). MPM has the cation exchange function and can be formed into various shapes due to its large specific surface area. Offering these specific qualities, it can be used as a water-purifying agent for domestic wastewater, as an absorbing agent for various types of gases, and as a supplementary material for producing concrete highly resistant to acid rain.

After field tests with domestic wastewater drains as a water purification agent, the results have revealed that nutrient salts, such as nitrogen and phosphor, both of which are water contaminants, are reduced by 30% and 70% respectively, and that up to 90% of BOD, indicating the organic substances contained in water, can be removed. The MPM used as a water purification agent can be used in ordinary soil. When MPM is used as a gas absorbent, it is capable of absorbing formaldehyde, which causes sick house* syndrome, reducing concentrations from 68 ppm to 13 ppm within 30 minutes. Similar effects have been confirmed for other gases, including carbon dioxide. We are currently working on various research and development activities to explore the possibility of MPM application in a wide range of fields from 2001.

◆*Recycling soil removed from construction sites*

The NTT Group has promoted recycling of construction-displaced soil.

To recycle this, we have adopted the soil recycling (SR) system and the fluidized back-filling technique.

The SR system improves soil by adding lime to enhance its land support and endurance capabilities, enabling it to be used as a back-filling material. This technique is now in a trial and scheduled for full introduction before long.

The SR technique is recognised as an excellent technology by a public organization, which is authorized by the Construction Minister in June 1995.

The fluidized back-filling method, is to mix construction-

displaced soil with water and solidifying agents. It can be used to fill the gaps around the pipes, and is scheduled to be introduced in 2001.

This method does not require rolling compaction of soil for back-filling and is capable of realizing ground strength sufficient for traffic in a short period. It is expected to be most effective in cases where buried facilities are intricately layered.

5 Protecting the ozone layer

◆*Elimination of CFCs used for cable gas leakage detection*

The underground cables used by the NTT Group always contain dry air (gas) to prevent the infiltration of water. Since 1981, we have used a system to detect the level of internal gas pressures. We were using mixed CFCs in the cables for this purpose. However, we have stopped using CFCs since 1994, introducing an alternetive detection technology with helium gas.

◆*Elimination of CFCs used for washing crossbar switch contacts*

As for CFC-based cleaning agents, a specified CFC (CFC-113) used for metal connection points was eliminated by the end of 1995 in accordance with the CFCs Control Law and the NTT Global Environmental Charter. Instead, we have used cleaning agents containing a CFC substitute (CFC-225). However, the NTT Global Environmental Charter pledged the elimination of CFCs for cleaning wire-spring (*1) relay connections, and we have suspended the use of cleaning agents containing the CFC substitute, and disposed of these agents. (liquid cleaning agent disposed: ca. 6000 kg, and cleaning agents in spray cans: ca. 1800 cans)

After disposing of CFC-based cleaning agents used to clean metal connection points, we are using pure alcohol, which has no negative effects on other components and was once used in the past. Following the last crossbar (*2) switch removal in June 1997, we have used no CFC-based cleaning agents.

***1 Wire-spring**
A type of relaying device in crossbar switch.
***2 Crossbar**
A switchboard that adopts the hard-wired logic for controlling circuit switching.

◆*Elimination of CFCs used for washing semiconductors*

Laboratories at NTT <holding company> have eliminated the use of ozone-depleting CFCs since 1992. CFCs were widely used to clean semiconductor materials. Our laboratories also used CFCs for R&D involving semiconductor LSI. Ozone layer depletion due to CFCs was first pointed out by American scientists in 1974, and the phenomenon was studied at various international organizations. In 1992, the Fourth Conference of the Contracting Parties to the Montreal Protocol scheduled the total elimination of CFCs and other ozone layer-depleting substances by 1996. Prior to this, in 1991, the NTT Group had pledged the total elimination of CFCs used for research purposes by the end of the fiscal year. Led by Atsugi Laboratory, our R&D center for LSI at the time, we promoted the conversion to substitute materials*. As of March 31, 1992, we had accomplished the total elimination of CFCs. We have also prohibited the use of cleaning agents considered to be carcinogenic, such as trichloroethylene and carbon tetrachloride.

*** CFC substitutes:**
A cleaning agent, Diflon™, was replaced by Fluorinert™ and Solfine™. We have also used alcohol, acetone-related substances, and simple water cleaning in its place.

◆*Removal of CFC-using turbo refrigerators and proper storage at internal CFC banks*

In the Fourth Conference of the Contracting Parties to the Montreal Protocol in 1992, the elimination schedule for specified CFCs was established. The production of specified CFCs (*1), which is associated with extremely serious consequences to both ozone depletion and global warming, was banned at the end of 1995. At NTT, where we used turbo refrigerators using large amounts of the specified CFCs, it was imperative to replace these devices.

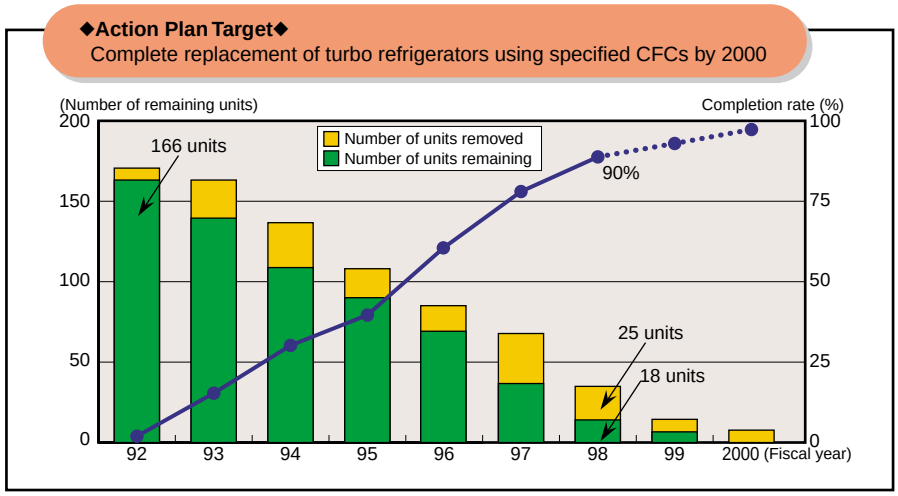

Fig. 4.5-1: Turbo refrigerator replacement plan

In November 1992, the NTT Group adopted a basic policy of no further installation of turbo refrigerators using specified CFCs, with replacement of the existing pool of turbo refrigerators by 2000 at the global environmental protection promotion committee. We are thus promoting the replacement of these machines with non-CFC devices, such as those using air-cooled heat pumps and absorption refrigerators.

As of the end of 1992, the NTT Group had 166 turbo refrigerators requiring replacement. This number was reduced to 18 units as of the end of fiscal 1998. Most of the replacement has progressed as scheduled. *(Fig. 4.5-1)*

Since July 1994, the NTT Group has established an internal CFC-bank system and promoted effective management of specified CFCs. This system recycles specified CFCs used for the existing turbo refrigerators. Excess CFCs can be stored, and used at necessary sites. When the use of specified CFCs is finally completed, they must be decomposed into harmless substances. Several CFC decomposition methods have already been developed, including the rotary kiln and cement kiln methods. NTT continues to investigate methods for rendering the stored CFCs harmless.

For new air-conditioners for communications equipment rooms, introduced since May 1998, we have adopted the HFC (*3) coolant in place of HCFC (*2).

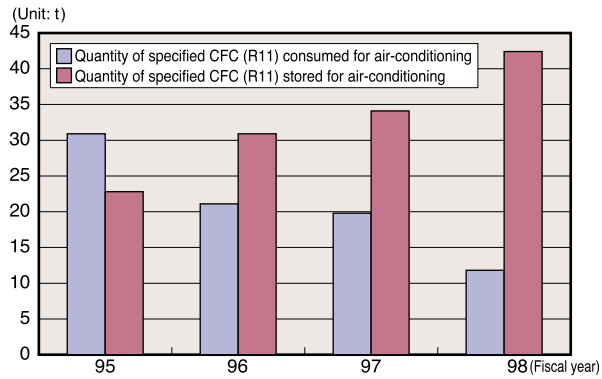

Fig. 4.5-2:
Quantity of specified CFC (R11) consumed and stored for air-conditioning

***1 CFC (Chloro Fluoro Carbon)**
A chemically stable, nonflammable, and non-toxic substance composed of fluorine, carbon, and chlorine. Due to its excellent traits, it was widely used as coolant in turbo refrigerators, foaming agents for insulators, and cleaning agents for electronic parts. Due to its chlorine content, it has a high ozone-depleting factor.

***2 HCFC (Hydro Chloro Fluoro Carbon)**
A substance made by replacing a part of the chlorine in CFC with hydrogen, reducing ozone-layer depleting potential

***3 HFC (Hydro Fluoro Carbon)**
A substance made by replacing chlorine in CFC with hydrogen, completely removing ozone-layer depleting potential

◆*Elimination of a specified halon used as a fire-extinguishing agent*

For halon used as a fire-extinguishing agent, the Fourth Conference of the Contracting Parties to the Montreal Protocol held in 1992 concluded that production would be prohibited after January 1, 1994, except for some exceptional cases.

The halon gas used as a fire-extinguishing agent is primarily halon-1301.
Due to its excellent fire-extinguishing capabilities, high insulation performance, low toxicity, and high damage-resistant quality, the NTT Group has used it widely for fire-extinguishing facilities at communications equipment rooms, computer rooms, and power rooms. Overall, the NTT Group possesses some 900 tons.

In November 1992, in response to international regulations governing halon use, the NTT Group adopted a basic policy: A ban on new installation of halon-based fire-extinguishing facilities, with smaller fire-limits in communications equipment rooms, and continuing investigations and research on post-halon fire-extinguishing facilities at the global environmental protection promotion committee.

In July 1993, to promote more effective use of halon and to prevent its release into the atmosphere, we participated in the Halon Bank Promotion Forum established at the national government level. The director of the NTT real estate planning office became a commissioner of the Forum to lead halon recycling and global environmental protection efforts.

In July 1997, we established a new fire extinguishing/preventing system, aiming at the implementation of investigation and research into domestic and overseas developments on halon-substitutions as well as development of early detection system for overheating of communications equipment and cables. In accordance with this policy, we have been systematically working on the introduction of safe and reliable fire-extinguishing systems.

Halon-substitution for fire-extinguishing systems uses new environment-friendly fire-extinguishing agents that provide high fire-extinguishing performance, safety, without the risk of emitting ozone-depleting substances. We have decided to use three fire-extinguishing agents: NN100 (*1), Inergen (*2), and FM200 (*3).

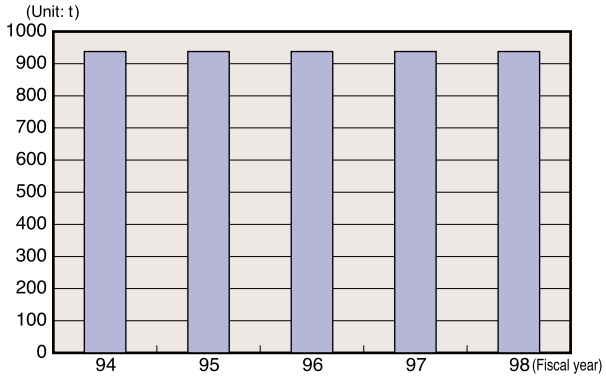

Fig.4.5-3:
Quantity of retained specified halon gas for fire extinguishing facilities

***1 NN100:**
Inert gas-based fire-extinguishing agent composed of nitrogen gas. Both its ozone-depleting and global-warming potentials are zero.
***2 Inergen:**
Inert gas-based fire-extinguishing agent composed of a mixture of N2, Ar, and CO_2 gases. Both its ozone-depleting and global-warming potentials are zero.
***3 FM200:**
Fluorine-based fire-extinguishing agent with limited release time. There will be fewer cylinders than with NN100 and Intergen, since FM200 can be stored as a liquid. Its ozone-depleting potential is zero, but its global-warming factor is 2050.

6 Preventing soil contamination

◆*Measures to prevent soil contamination (automatic oil leakage detection system for underground tanks used as communication power sources)*

Several leakage accidents at underground fuel filling and storage facilities occur annually throughout Japan. Leaked fuels and hazardous substances contaminate soil and water, seriously affecting the life of local residents. NTT Group has underground tanks to store fuel for auxiliary power generators at some 1,500 switchboard buildings and other major buildings across the country. Switchboard buildings provide −48 V of direct currency to customers. These auxiliary facilities ensure reliable communications services in case of emergencies.

The NTT Group has worked on this issue based on the 1998 decisions of the global environmental protection promotion committee, and has since introduced and improved an automatic oil leakage detection system for underground tanks. This is comprised of monitors for oil levels and flow rates and continuous remote surveillance and recording systems for oil leakage detection results around tanks.