



# Environmental Sustainability Management

Although telecommunication is regarded as a low-polluting industry, Chunghwa Telecom is well aware of the environmental impacts associated with energy, resources, waste, maintenance, purchasing and other aspects of our operation. We have devised a new set of "Environmental Sustainability 5-year Plan (2016~2020)" that outlines our overall strategy and roadmap for sustainable development in 2016. In addition, budgets will be provided in each year to support action plans.





Office Environmental Protection

Tree Planting

Changing Patterns of Work

Greenhouse Gas Measurement

Energy Efficiency Architecture

Replacement of Equipment

Green Data Center

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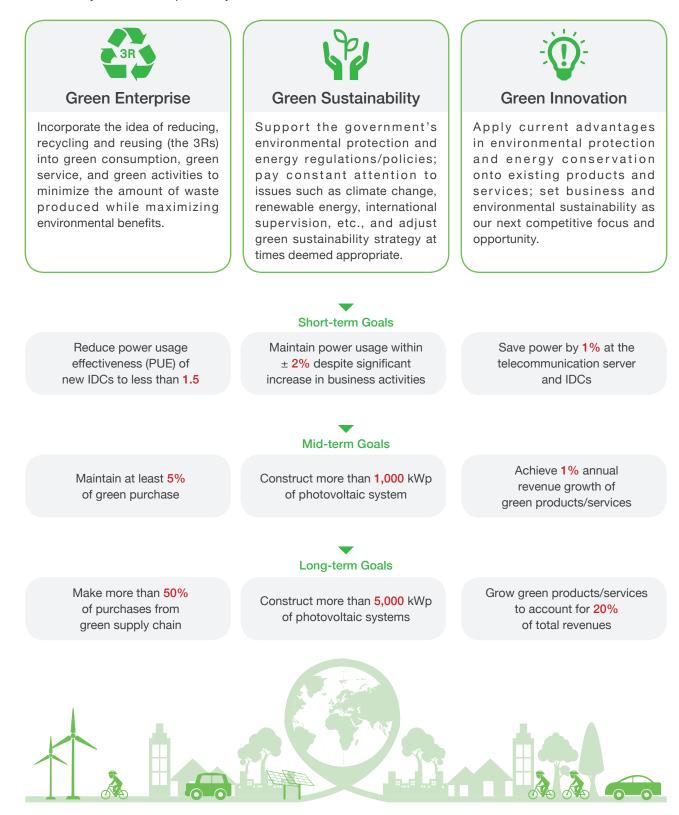
**Energy Saving Services** 

Home-based Work

## Environmental Sustainability Strategy

To fulfill our commitment towards "environmental protection," we have created an "Environmental Sustainability Team" under the "CSR Committee" that specializes in determining short, medium and long-term goals. The team exists to make sure that issues such as energy conservation, carbon reduction, and environmental protection are addressed in the operational plans, and to set codes of conduct, manuals, standards and targets for green energy and greenhouse gas.

To fulfill our green commitment and embrace the world's green challenge, Chunghwa Telecom has adopted a "Green Enterprise, Sustainability and Innovation Strategy" with the introduction of 5G (Green) initiatives: "Green Energy, Green Procurement, Green Operations, Green Stores, and Green Supply Chain" that aim to address financial success, sustainability and social responsibility.





Chunghwa Telecom has set our goal to become a sustainable "Green enterprise," and thus incorporates environmental issues as part of business operation and management. We hope to play a more proactive role in issues such as energy and climate change. By improving energy efficiency and exploring environmental friendly products and services, we are confident of our potential to inspire a new generation of low-carbon industries.

## Environment ARtificer THeurgy

To manage resources and environmental protection more efficiently, we developed Environment ARtificer THeurgy (EARTH) system in 2008 to save the spending on energy consumption and enhance environmental management efficiency.

#### EARTH system features:

Energy Saving and Innovation:

Energy savings and innovation initiatives uploaded by departments to encourage employees to learn from each other. Performance Evaluation:

Performance evaluation is conducted systematically to encourage employees to contribute to environmental sustainability actions.

Fower Management:

Request centralized payment of electricity bill; currently, there are more than 58,645 electricity number and 2.32 million electricity payment data under management.

- Water Management: Request centralized payment of electricity bill; currently, there are more than 1,279 electricity number and 91,254 electricity payment data under management.
- Carbon Emission Management: Provide carbon verification form and the results largely enhanced as 300 man-day operations.
- Fuel Management:

Analyzed the fuel data of hybrid vehicles and ordinary vehicles, to reach energy efficiency and carbon reduction.

Corporate Tree Planting:

Document type, number, management department and location of trees. Currently, there are over 67,236 trees data saved in EARTH database.

Recycling Management:

Document type, number and management department of recycling objects. We have recorded 22 recycling types and 14,607,614 entries.

# 100% ISO 14001 Certification in All Service Locations

All of Chunghwa Telecom's business locations have been certified for environmental management system. In other words, Chunghwa Telecom generates 100% of its revenues from environmental management system-certified service locations.

In terms of energy management, we are the first telecommunication company among local peers to fully implement ISO 50001-Energy Management System.

The Data Communications Business Group, Chunghwa Telecom Laboratories, Mobile Business Group (including offices, data centers and base stations located in Taipei, Taichung and Kaohsiung), International Business Group, Northern Taiwan Business Group (Taoyuan Office) and Southern Taiwan Business Group (Kaohsiung Office) have all been certified as of the end of 2016.

# Cloud-based E-invoice

Chunghwa Telecom's cloud-based e-invoice service allows corporate customers to store invoices permanently in digital form on a cloud server for ease of filing. Meanwhile, printed copy of the digital invoice has been downsized to no larger than 5\*8 cm, and only one sheet of paper is printed regardless of the number of items purchased. As a result, the amount of pulp used has been reduced to somewhere between 1/3 and 1/4, which effectively reduces costs for businesses.

A business that prints 3.8 million sheets of digital invoice per month would be able to save 4,600 trees a year, and given the average carbon absorption capacity of 10-20 kg per tree, the solution may reduce carbon by 90,000 kg a year. In 2016, Chunghwa Telecom had 283 customers using the digital invoice system, which generated annual revenues totaling NT\$ 51.4 million.



# Green Environmental Hostels

Chunghwa Telecom Hostels provide accommodations for employees' business or leisure travel. In response to environmental protection and personal hygiene, the hostels do not provide disposal consumption goods and towels, and implement energy-saving measures such as solar water heater, air conditioning heat pump and LED lighting. 18 hostels had been certified as Environmental Friendly Accommodation in 2016.

In response to Hotel Carbon Measurement Initiative (HCMI 1.0) formulated by World Travel & Tourism Council (WTTC) and International Tourism Partnership (ITP), we introduced the "carbon footprint calculator of hotel rooms" in Siziwan hostel, along with the combination of iEN system to manage the use of facilities and electricity in the hostel. We also construct comprehensive power monitor and room management model to reach maximum energy and water saving efficiency.

	2014	2015	2016
Revenue (NT\$ million)	9.5	9.4	9.2
Carbon Emission (ton)	64,527	57,443	71,301
Electricity Usage (kWh)	123,853	110,256	135,040
Energy Intensity (t-CO <sub>2</sub> /NT\$ thousand)	0.01	0.01	0.01

### Report to Carbon Disclosure Project Annually

Launched by world's leading institutional investors, the Carbon Disclosure Project (CDP) began issuing a series of questionnaires in 2003 to learn about the risk management practices and responding measures that businesses have in place with regards to carbon issues. In response to global institutional investors' interests on how Chunghwa Telecom discloses and reduces carbon, we have chosen to adopt the World Cafe Method since 2010, and we are now the only Taiwanese telecommunication carrier to have consecutively participated in CDP. We actively discuss across departments and use the questionnaires to determine areas of improvement as well as reduction targets.

### Environmental Management Expense

	2014	2015	2016
Environmental management expense (NT\$ thousand)	181,365	275,975	286,734
Accounted percentage of turnover	0.08	0.13	0.12



2G) Green Energy

Given the changing climate and energy shortage, the Taiwanese government began the "National Energy Transformation Program" in 2016 that sought to bring new ideas on energy conservation, innovation, logistics, and intelligent systems. Solar energy is one of the key focuses of this program. Being the largest telecommunication carrier in Taiwan, Chunghwa Telecom recognizes its duty to support government policies and has made energy and carbon reduction as part of daily practices, with strategies and goals set up to guide our actions. We are also taking count of proprietary buildings that would be suitable for the construction of solar power system; furthermore, new IDC servers are being constructed preferably using renewable energy.

Chunghwa Telecom has been applying its long-accumulated ICT background into the construction of solar power stations for many years. By the end of 2016, the Company had 42 solar power stations throughout Taiwan with a total rated capacity of 419 kWp. We aim to expand capacity to 500 kWp by the end of 2017, and at the same time assist government agencies and private businesses in the coordination of photovoltaic projects.

# Target Low-carbon Industries and Promote Solar Energy

Chunghwa Telecom's venture into the energy industry has 3 focuses: solar energy, LED road lamp, and wind power. In terms of solar power, Chunghwa Telecom completed the construction of solar power systems at "Chengkung Telecom Tower and Anping Database" in 2016. Both installations have been recognized as Exemplary Sites under "Tainan City Autonomous Regulation on Low-carbon City." Both installations feature the use of Chunghwa Telecom's intelligent energy system (iEN), which enables real-time monitoring/analysis of power capacity, conversion efficiency, and reporting of abnormalities.

#### **Business model:**

- · Choose a suitable location for solar panel installation
- · Choose an installation service provider
- · Plan system capacity and engineering structure
- Sign contract to sell electricity to Taiwan Power Company once power generation commences Benefits:
- Inject green electricity into Taiwan's power system: The "Chengkung Site" has a rated capacity of 65.52 kWp and generates about 84,000 kWh per year; the "Anping Site" has a rated capacity of 43.68 kWp and generates about 56,000 kWh per year.
- The creation of SOP panels allows solar power systems to be modularized to the needs of government agencies and private businesses in the future.
- After deducting the cost of maintenance and equipment replacement, the solar power stations are expected to generate NT\$ 150,000 in net profit over 20 years, which is equivalent to 7.28% annual return on investment.
   Short-term plan:

The Company will actively expand construction of solar power facilities, including proprietary and commissioned construction. The capacity of proprietary solar power plants is estimated to exceed 500 kWp in 2017 and will contribute more than NT\$ 1 billion in revenues.

### No.1 in Green Power Procurement

Growing demand for telecom services has forced us to install additional equipment, which makes it rather difficult to control increases in the use of power. Nevertheless, we pursue different measures from the energy saving in our buildings as the starting point. Owing to a series of effective controls, we were able to reduce power consumption by 305 million kWh (30.05%) by the end of 2016, reducing greenhouse gas emissions by 161,040 t-CO<sub>2</sub>e compared to 2007. This effective control of power usage was achieved through a combination of enhanced environmental sustainability management system and closer monitoring of telecommunication equipment power usage.

Driven by its care towards environmental sustainability, Chunghwa Telecom actively supports the government's Green Power Purchasing System by purchasing 2 million kWh of green electricity in 2015 followed by another 4 million kWh in 2016. These purchases placed us the first in the ICT industry and the second nationwide, for which we won "Corporate Vision Award" from the Ministry of Economic Affairs. In the future, we shall carry on our determination in promoting renewable energy source and assist the government in the creation of green energy economy, thereby contribute to a three-win concerning energy supply, industry development, and environmental protection.



# Electricity Consumption Analysis

Year	Total Electricity Consumption (A)	General Consumption (B)	Business Consumption- Meter Rate Lighting Service (C)	Business Consumption- Flat Rate Lighting Service (D)	Business Consumption Increment (E)	Business Consumption Increment Rate (F)
2007	135,180	9,420	125,151	609	NA	NA
2012	139,272	8,912	124,166	6,194	1,977	1.42%
2013	142,580	8,835	127,023	6,722	3,385	2.37%
2014	142,216	8,873	126,128	7,215	-402	-0.28%
2015	142,092	8,571	125,740	7,781	178	0.13%
2016	140,438	109,590	24,980	5,867	-	-

Note. 1. The method of calculation was modified in 2016 to more efficiently present power usage. This modification resulted in a significant change in data under columns B-F, but total power usage had actually decreased compared to the previous year.

- 2. Data under columns E and F in 2016 will be presented in 2017 instead due to adjustment of calculation and different basis of comparison.
- · General consumption includes office buildings and employee dormitories.
- Business consumption includes base stations, depot, electric welding, and public telephone, which are not CHT-owned property.
- A=B+C+D, General consumption mainly includes the power consumption of office building. Business consumption increment includes flat and meter rate lighting service.
- · E=Business consumption this year Business consumption last year, F=E/A
- This table presents electricity consumption with customer ID, other consumption without customer ID is covered by Greenhouse gas inventory.

### Energy Saving for Data Center

Chunghwa Telecom places great emphasis on the energy efficiency of our data centers, and is currently implementing energy conservation measures on telecommunication data centers (including IDCs). The Ankang Data Center, for example, obtained its green certification in 2013, while the cloud data center located in Banqiao was also certified for green building in 2016. All future data centers will be featuring our proprietary iEN smart energy management system, which is our scientific approach towards reducing energy, carbon and thereby protecting the environment. Energy conservation measures for telecommunication data centers include:

Air-conditioning Improvement	<ul> <li>Change airspeed, remove vent pipes, or disable small air-conditioner to be compatible with new equipment.</li> <li>Use high sensible heat packaged when replacing air-conditioner in annual replacement plan.</li> <li>Isolate the air-conditioning area of air-conditioner placement to avoid unnecessary air-conditioning usage.</li> <li>Install VFD (Variable Frequency Drive) of temperature controllers on cooling water tower fan units and water pumps.</li> <li>Promote applications of outdoor air systems for the data center, which largely reduce electricity usage in spring, autumn and winter.</li> </ul>
Energy Management	<ul> <li>Monitor air-conditioning temperature, designate personnel to maintain adequate temperature in different areas.</li> <li>The cooling tower fan unit is unloaded (by change speed) according to the water temperature.</li> <li>The ventilation type of heat dissipating should be employed for the lighter load facilities such as the base sites, telecommunication rooms and power distributing equipment.</li> <li>Introduce renewable energy system such as solar power generation system.</li> </ul>
Energy Management Equipment Consolidation	<ul> <li>Cut off disabled equipment and replace worn energy-consumption equipment after the consolidation of mobile base stations, digital switching equipment, transmission equipment, broadband equipment and power supply equipment.</li> <li>Consolidate equipment and isolate unused space to reduce energy consumption.</li> </ul>

#### **Electricity Consumption of IDCs**

Year	2012	2013	2014	2015	2016
Power usage (10,000 kWh)	13,794	14,620	14,700	14,539	15,210

# The Most Environment-friendly IDC in Greater China Region

Chunghwa Telecom's Banqiao IDC, the first international data center in the Greater China Region to be certified for "Rated 4," officially commenced operation in 2016. The IDC offers space for 4,000 server racks, and provides the most stable, fastest and highest quality ICT service in Taiwan and Asia Pacific. Its presence contributes significantly to industries such as banking, securities, ICT, digital contents, e-commerce, etc., and has the potential to globalize Taiwan's cloud services.

#### **Environmental Features:**

- Incorporating Chunghwa Telecom's proprietary iEN smart energy management system for automatic environmental monitoring.
- Energy efficiency is measured using the "The Green Grid" standards, and is targeted to achieve a high energy efficiency of PUE 1.5 and below.
- Rated LEED Gold and obtained Green Building and Smart Building certification in Taiwan.



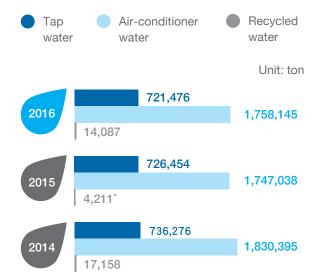
In the future, we will continue applying energy-saving services and products onto old buildings for smarter lifestyle applications, and contribute to green building in addition to our support for IoT, big data and cloud services in Taiwan.

Note: It is a telecommunication infrastructure standard developed by Telecommunications Industry Association (TIA) in the United States. The standard covers four main aspects (telecommunication, building, power, and machinery) and includes more than 2,000 criteria. Each subject is rated into different levels of robustness, from Rated 1 (least robust) to Rated 4 (most robust).

### Water Resources Management

Water usage at Chunghwa Telecom is mostly for domestic purpose. Apart from bathroom use, air conditioner cooling accounts for another major water use. Given the ongoing increase in business activities and manpower, there is limited room for water reduction besides recovery of rainwater and cooling water.

We have identified water resources as part of our management focus, and introduced many initiatives to improve water efficiencies, such as water conservation measures, centralized water bill management, and watersaving goals. Apart from adding a new water leakage detection feature, we have also incorporated water usage monitoring into our environmental sustainability system. Data collected from these two functions are analyzed and managed. Other conservation measures such as recycling and reuse of rainwater and domestic effluents are also being implemented on an on-going basis.



Note: The amount of water in 2015 had reduced significantly due to severe drought, which was believed to have been caused by climate change.

### The Plan and Objective of Water Resources Management

Currently, Chunghwa Telecom's annual business growth is 2%; therefore, we benchmarking 2012 water usage standard, control the annual growth of water usage to no more than 2% and promote water-saving measures accordingly, including:

- Install sink faucet sprayer to reduce water waste.
- Replace toilets with dual-flush toilets to reduce flushing water.
- · Recycle rainwater for office plants watering.
- Encourage the installation of water reclamation equipment in new buildings, so that the treated sewage water can be reused for non-potable and physical separated uses after reaching certain water quality standard.

## Recycling of Water Resource

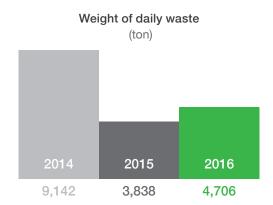
Started from 2007, Chunghwa Telecom initiated water conservation measures by including water resources management into EARTH system, while registering centralized water bill payment through EARTH's "water bill management" function to reduce printing of water bills. Through the information interface, managers can search, generate trend charts and report forms, provide exception reports to avoid mistakes in billing and meter reading. Managers can also review the situation of water uses, reduce expenses in water, and improve the efficiency of management.

We have scheduled a five-year plan to enhance the effectiveness of water recycling and reuse. In the plan, we are expected to establish underground raft foundation water collection systems to collect clean rainwater from rooftops and the ground. Meanwhile, we also initiated recycle of the cool-condensed water project for office air-conditioners. The recycling water will be reused for watering plants and cleaning the sidewalks.

### Waste Management

Understanding the importance of resources reduction, recycle and reuse, Chunghwa Telecom combined our five-year environmental sustainability development plan and EARTH system to manage the use of resources and control energy efficiency, while conducting systematic management on recycled and waste treatment.

Chunghwa Telecom designated professional waste treatment company to transport our daily waste to landfills or incinerator for necessary treatment. For recyclable waste, the contracting cleaning company is designated for the classification and disposal treatment.

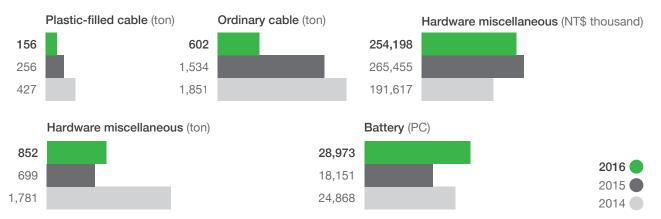




### Industrial Waste

The scrapped lead-acid battery is a recyclable industrial waste regulated by the EPA. To reduce pollution, toxic substance and waste disposal is joint responsibility for the business organizations. In this regard, the recycling and disposal operations are outsourced by joint contract based public auction. The contractor must be a qualified service provider listed on the website of the Recycling Fund Management Board of the EPA to ensure legitimate management and disposal.

All the lead-acid batteries scrapped by each business unit are auctioned on site, and proper documents for their disposal are filed for audit tracking. There were 21,781 scrapped lead-acid batteries, sold for NT\$ 18,177 thousand with a total weight of 1,208,580 kg disposed in 2016. The public and private waste clearance and disposal organizations recognized by environmental institutions are designated to handle the treatment of other industrial waste such as cable and hardware miscellaneous.



Green Stores

Chunghwa Telecom prides itself as a highly-localized telecommunications carrier, a contributor to community development, and one of the most important partners to telecommunication carriers around the world. As technologies progress, we began to operate outside the conventional telecommunication boundaries and gradually incorporated corporate social responsibility concepts into product/service research, development, and application, and into the Company's management strategies. For details regarding green products, please refer to p.52-53.

In addition to developing products that are friendly to the environment, we have actively been promoting Green Stores and was the first company in Taiwan to turn service outlets into Green Stores. We expect to convert all 406 service centers into Green Stores by 2017, and sell more than 3 environmental/energy certified products. Information on future service outlets can be found at the "Green Stores" section of the website of the Environmental Protection Administration, Executive Yuan.

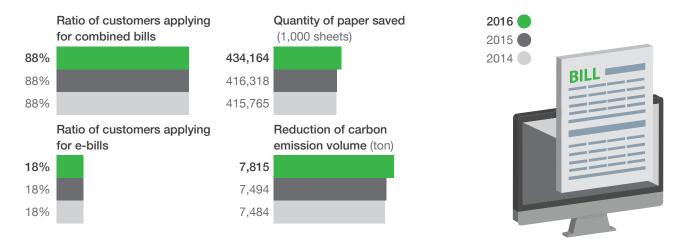
## **Cross-industry Alliance and Low-carbon Transportation**

Chunghwa Telecom actively expands product diversity by utilizing its distribution advantage and forming alliances with partners from different industries. In view of rising environmental awareness and green energy trends, the Company has worked with China Motors since 2016 to sell e-Moving, a two-wheel vehicle, at all direct branches throughout Taiwan (excluding offshore islands). It shows our dedication to supporting low-carbon vehicles with actions.

One of the most significant features about e-Moving is the simple charging solution. The biggest advantage it offers is energy efficiency, which has been well-recognized by the Chiayi Forest Bureau and courier companies. Due to the simplicity of its parts and design, e-Moving only requires changing of gear lubricants and costs only one-fifth the amount required to maintain a gasoline-powered motorcycle. Through its sales and service system, Chunghwa Telecom hopes to promote the use of green transportation and build a sustainable environment with the assistance of allied business partners.

## Merger of Electronic Bills

Since 2001, we have been combining customers' bills and mailing multiple bills from the same address in one envelope, which not only makes billing easier for customers but also helps protect the environment. The Company introduced electronic bills in 2005, saving 420 million sheets of paper each year and was estimated to have saved 38,027 trees, as 7,529 tons of carbon by the end of 2016. It was a good example of how the Company had satisfied customers' needs while at the same time contributed to the mitigation of global warming.



- Note:1. From 2014 onward, the calculation is based on the quantity of paper saved and reduction of carbon emissions after using e-Bills and combined bills.
  - 2. Each electronic or combined bill saves 2.5 sheets of A4 paper on printing and envelope. Total amount of paper saved: 14,472,159 records \* 12 months \* 2.5 = 434,164 thousand sheets of paper.
  - 3. One sheet of A4 paper generates 18 grams of CO<sub>2</sub>; the amount of carbon emission reduced: 434,164,000 sheets \* 18 grams  $CO_2 = 7,815$  tons  $CO_2$ .



"Green of ICT and Green by ICT" are Chunghwa Telecom's responsibilities and missions as the leader in the telecommunication industry.

The trend towards green enterprises is contributed by 2 forces: "market and non-market." The non-market forces come from government regulations, whereas market forces come from supplier management. To co-exist with the environment, businesses must implement "green practices" throughout the entire supply chain. Chunghwa Telecom has been implementing related measures since 2008, and at the end of 2016, we introduced our proprietary green product label and invited every supplier to apply for certification, so that we may ensure the use of energy-saving or green energy products throughout the supply chain, from raw materials, production to packaging.

The concept of a green supply chain is a win-win solution for businesses and suppliers, because it has the potential to increase revenues (financial advantage) and at the same time minimize risks and impacts on the environment (non-financial advantage). In the future, a green supply chain will be more than just having suppliers commit to environmental protection and introduce green products. Chunghwa Telecom will continue exploring value-added applications of ICT, and introduce robust systems to facilitate coordination, management and complete monitoring of its supply chain.

Note: For information on supply chain management, please refer to p.44-49

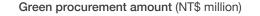


# **Green Procurement**

Chunghwa Telecom supports the government's policies and makes budgets on an annual basis to purchase green products that are either environmental-certified (less polluting, recyclable, resource-saving or green materials) or self-declared to be of less environmental impact throughout the product lifecycle (from raw materials to disposal). The Company also actively participates in green procurement programs and activities in the hope of inspiring green purchases among the industry and the public.

Our goals and policies concerning green procurement have been explained in detail in the five-year plan mentioned above. We hope to maintain green purchases at more than 5% of the total purchases per year over the mid-term, and increase this percentage to more than 50% over the long term.

Accounted percentage of turnover







# Environmental Performance in 2016

Environmental Information Disclosures	<ul> <li>In addition to publishing CSR reports and responding to DJSI annually, we have also been performing the following as part of our transparent disclosures:</li> <li>Obtain ISO 14064 verifications and certifications.</li> <li>Respond to the annual Carbon Disclosure Project (CDP) questionnaire.</li> <li>Respond to the Common Wealth Magazine and Global View Magazine questionnaires.</li> </ul>
Improve Energy Use Efficiency	<ul> <li>Integrate data centers: merge and exploit data center spaces.</li> <li>Save cooling energy: had completed energy saving inverter module of 5,922 HP, high sensible heat air conditioner of 31,865 RT, 8,097 high-efficiency air conditioners, 2,528 RT ventilation air conditioner and 551 natural ventilation air conditioners at the end of 2016.</li> <li>Green buildings and hostels: use green materials for newly constructed data centers or buildings.</li> <li>Solar water heaters: install solar water heaters in Telecommunications Hostels.</li> <li>Water resource recycling: set up rainwater, underground, and condensed cooling water recycling systems.</li> <li>Environment-friendly LED bulbs: set up an internal trial plan for office buildings.</li> </ul>
Implement Green Energy	<ul> <li>Photovoltaic system: a total capacity of 419 kWp at the end of 2016.</li> <li>Wind power: a total capacity of 17.6 kW in 2016.</li> <li>Voluntarily supported MOEA's green energy trial program by purchasing 4 million kWh of green power in 2016, the first in the ICT industry and the second nationwide.</li> </ul>
Autonomous Environmental Protection	<ul> <li>Vehicle energy conservation and carbon reductions: replace old vehicles with environment-friendly, and use electric vehicles for trial.</li> <li>Green transportation: sponsored NT\$ 1.85 million for the construction of the Youbike station at the corner of Xinyi Road and Hangzhou South Road.</li> <li>Clean homes, energy-saving office, health management systems, car-free days, and paperless ODAS.</li> <li>Taiwan Energy Conservation Patrol: focus on increasing energy efficiency within small and medium enterprises and vulnerability of social institutions.</li> <li>Industrial waste recycling: set waste reduction and recycling goals.</li> </ul>
Value-added Products and Services	<ul> <li>Electronic billing: features environmental protection, promote with marketing section.</li> <li>Electronic invoice: invoice data were treated for cloud storage permanently for saving of materials, human resources, and the preferential tax treatment as incentive and exemption from fines by the government.</li> <li>Promote iEN and other energy-saving categories.</li> <li>Mobile device recycling: recycle bins are available at service centers in line with the promotion of waste recycling.</li> <li>Green Stores: Aims to transform 406 service centers nationwide into "Green Stores" in 2017, and sell 3 or more environmental-certified products.</li> <li>Assist suppliers in applying for eco-friendly product labels.</li> </ul>