

Chunghwa Telecom Short, Medium, and Long-term Climate Change Adaptation Plans

Starting from 2020, Chunghwa Telecom has followed the guidance of the Task Force on Climate-related Financial Disclosures (TCFD) in establishing short, medium, and long-term climate change adaptation plans. As our communications facilities and equipment are located across Taiwan, and the effects of climate change are expected to have an increasing impact on us, these plans seek to protect our communications equipment and impact from the long-term climate change. Short-term plans are for the next 1-3 years, medium-term plans for the next 3-8 years, and long-term plans for the next 8 years. These adaptation plans would cover 100% of the existing and newly-built business locations and communications equipment we own across Taiwan.

I. Climate Change Adaptation Plans

Chunghwa Telecom's climate change adaptation plans can be split into three types, all of which address our core operations in the short, medium, and long term. These types are:

1. Flood and Disaster Control Action Plans for Telecommunications IDC, Telecommunications Equipment, and Buildings

(1) Short-term adaptation plans (1-3 years)

- A. Continue monitoring and analyzing climatic disasters (including droughts, tsunamis, floods, wind storms, slope failure, and lightning stroke). In the meantime, improve disaster risk reduction, disaster preparedness, and disaster response measures for our telecommunications data centers, equipment, buildings, and facilities, improve our disaster recovery drills, and optimize our standard operating procedures. We shall also work together with organizations, agencies, and institutions in different fields to enhance our ability to respond to unexpected events.
- B. Conduct a carbon inventory of our operational processes to identify areas where our greenhouse gas emissions can be reduced and improving our ability to save energy and reduce carbon emissions. (For example, potential measures include accelerating the phasing out of older and less energy-efficient data center equipment and improving our data platforms to move towards a fully-online service model).

(2) Medium-term adaptation plans (3-8 years)

- A. Based on climate monitoring and analysis results, and taking into consideration other factors such as potential risks and the impact to our business operations, we shall take measures to make our telecommunications data centers, equipment, buildings, and facilities more resilient to climate change. These measures include implementing flood prevention and water drainage infrastructure, constructing backup data centers in different locations, and establishing backup routing.
- B. In order to reduce our reliance on electricity, gradually standardize the types of locations where the electrical equipment in our telecommunications data centers are installed to avoid rooftops and other areas which heat up easily. In the meantime, make adjustments to how the cold and hot aisles in our data centers are arranged, and procure more highly-certified energy saving equipment with the goal of improving the Power Usage Effectiveness (PUE) of our data centers from bronze (PUE = 1.94) to gold level (PUE = 1.27).
- C. Considering the risk that a climate disaster might cause a blackout, leading to business interruption, and in cooperation with the government's policy encouraging citizens to generate their own electricity, we have developed energy storage technologies and expanded the capacity of our energy storage infrastructure. This has increased the proportion of renewable energy used by our data centers, reduced our reliance on electricity generated by petrol, and allows us to maintain a stable electricity supply in case of intermittent blackouts in the future.

(3) Long-term adaptation plans (More than 8 years)

- A. Integrate state and private resources, combine telecommunications technologies, collaborate with different business, state, and academic organizations, agencies, and institutions to develop disaster analysis and prevention technologies, allowing us to provide faster warnings for climate change disasters and reduce the risk of us being significantly impacted. (Such as the Earthquake Public Warning Cell Broadcast Service)

2. Climate Change Adaptation Action Plans for Network Facilities

(1) Short-term adaptation plans (1-3 years)

- A. Underground data center infrastructure: Continue making improvements and inspections (such as to drainage systems), gradually replace older equipment to prevent accidents from occurring due to aging equipment.
- B. Above ground telecommunications infrastructure: DJ box, distribution board, telecommunications enclosures, and other infrastructure supporting Fiber-to-the-house (FTTH) connections shall continue to be built. Exchange equipment in existing cross connection cabinets shall be gradually phased out, preventing damaged equipment from causing internet outages.
- C. Underground cable infrastructure: By optimizing the gas-filled cable software used for laying cables in manholes, handholes, and underground tunnels, we can discover and address problematic areas in advance.
- D. Overhead cable infrastructure: By optimizing the surveying software used for transmission towers and laying cables, we can quickly inspect any power cables or transmission tower equipment experiencing issues and make improvements.

(2) Medium-term adaptation plans (3-8 years)

- A. Underground data center infrastructure: By updating our network technologies, we can reduce the use of copper cables, and begin converting all of our cable systems to fiber-optic cable. These technological updates would also allow us to reduce the number of exchange points.
- B. Above ground telecommunications infrastructure: Convert all of our DJ boxes, distribution boards, and telecommunications enclosures to use fiber-optic cable, phasing out the use of copper cables and exchange equipment from all cross connection cabinets.
- C. Underground cable infrastructure: Use fiber-optic cables for all cables laid in manholes, handholes, and underground tunnels, reducing the number of copper cables used.
- D. Overhead cable infrastructure: Wireless networks shall gradually replace wired networks for our transmission towers and overhead cables. This replacement process shall begin being implemented in mountainous and more remote regions.

(3) Long-term adaptation plans (More than 8 years)

- A. Implement plans to adopt the use of AI in our business operations. Transform our current decentralized system for managing traditionally manual operations into a more systematic, automated, smart, and centralized system. This would allow us to stay on top of potential climate disaster risks at all times, improving our adaptation plans and ability to respond rapidly.

3. Climate Change Adaptation Action Plans for Cellular Base Station Networks

(1) Short-term adaptation plans (1-3 years)

- A. Improve safety: Periodically inspect and repair our base station's cell towers/equipment/electrical supply equipment, and gradually replace older electrical equipment to prevent accidents from occurring due to aging equipment.
- B. Improve electricity supply: Convert base stations into C-RAN architecture, installed in data centers with a stable electricity supply and sufficient backup electricity sources.
- C. Reduce electricity demand: Natural ventilation/exhaust fans shall be incorporated into our base stations, and RU radio frequency equipment shall be installed outdoors, reducing our electricity consumption. We shall also halt support of our 3G systems, reducing electricity needs and operational and maintenance costs.

(2) Medium-term adaptation plans (3-8 years)

- A. Implement plans to adopt the use of AI in our business operations. Transform our current decentralized system for managing traditionally manual operations into a more systematic, automated, smart, and centralized system. This would allow us to stay on top of potential climate disaster risks at all times, improving our adaptation plans and ability to respond rapidly.

(3) Long-term adaptation plans (More than 8 years)

- A. Improve the ability of our base stations to survive disasters, with a primary focus on maintaining electricity supply. A secondary concern is the stability of our transmission cables,

and strengthening our backup systems. Establish systems for protecting our transmission cable networks, such as by establishing backup routing and equipment redundancy.

II. The adaptation action plans implemented by Chunghwa Telecom as of 2021 are as follows:

1. Flood and Disaster Prevention Action Plans for Telecommunications Data Centers, Telecommunications Equipment, and Buildings

(1) Drought

In order to prevent water shortages from affecting the air conditioning systems of our data centers, Chunghwa Telecom has sufficient water storage in our data center cooling towers to keep central air conditioning systems operational for more than 60 hours. We have also signed contracts ensuring support from the Taiwan Water Corporation and water transportation companies.

(2) Tsunami

After analyzing the tsunami hazard maps provided by the National Science and Technology Center for Disaster Reduction, we have relocated important equipment installed at data centers at risk of experiencing a tsunami to the upper levels of these centers. In the meantime, we have strengthened our network monitoring capabilities, allowing us to rapidly grasp our current network status and the impact of any disasters.

(3) Flooding

After analyzing the flood maps provided by the Central Weather Bureau, we have relocated important equipment at risk of floods to the upper floors of buildings, and installed automatic water pumps on basement levels. Building exits have also been equipped with flood proof doors or sandbags.

(4) Wind Storms

The emergency response center constantly monitors typhoon information from the Central Weather Bureau in order to make advance preparations for typhoons. We have also made our equipment inspections more rigorous, addressing irregularities and issues affecting our telecommunications networks and making disaster handling reports.

(5) Slope failure

After analyzing data provided by the Soil and Water Conservation Bureau's Debris Flow Disaster Prevention Information website, we have stepped up our soil and water conservation efforts and drained water from slopes in areas at risk of slope failure where our data centers and buildings are located, reducing the risk of a slope failure occurring.

(6) Lightning stroke

After analyzing Central Weather Bureau data on lightning frequency for different regions and the number of lightning storms affecting Taiwan each year, we have strengthened lightning protection for our data centers and buildings at risk of being struck by lightning.

2. Climate Change Adaptation Action Plans for Network Facilities

(1) Data center tunnels

We have installed water pumps with outlets which would release pumped water at the same height of our water drains. Water pump outlet pipes have also been installed with check valves, and regular inspections are conducted to ensure that equipment is functioning normally, leaks are fixed, and that equipment is clean.

(2) Above ground telecommunications infrastructure

The emergency response center constantly monitors information on typhoons and heavy rainfall reported by the Central Weather Bureau in order to make advance preparations for typhoons. We have also made our equipment inspections more rigorous, addressing irregularities and issues affecting our telecommunications networks, and making disaster handling reports.

(3) Underground cable infrastructure

We have designated specific units to be responsible for constantly monitoring the pressure within our gas-filled cables, preventing water vapor from infiltrating the inner parts of our cables and maintaining cable communications quality.

(4) Overhead cable infrastructure

We have designated specific units to regularly take stock of and analyze the ability of our transmission cables and towers to resist typhoons. We have also prioritized specific regions for replacing overhead cables with underground ones, in order to improve traffic safety. This raises traffic efficiency while also increasing our network reliability.

3. Climate Change Adaptation Action Plans for Mobile Base Station Networks

(1) Improve safety

Take stock of and analyze the disaster resistance of our base stations. We have designated units responsible for regularly inspecting the tower/equipment/electricity supply of our base stations, and implemented measures to improve their resilience.

(2) Improve electricity supply

In order to avoid being cut off from electricity by a natural disaster, our BaseBand Units (BBU) run on Centralized-RAN (C-RAN) architecture, installed in data centers with a stable supply of electricity and sufficient backup electricity sources.

(3) Reduce electricity demand

In the event of a blackout caused by a natural disaster, in order to prevent electricity shortages if our backup electricity system proved inadequate for meeting electricity demand, we have gradually implemented natural air ventilation/exhaust fans (212 have been installed as of 2021), base station sleep mode (990 cells have completed hibernation as of 2021), and moved RU radio frequency equipment outdoors in order to reduce the electricity used by air conditioning units (80 pieces of equipment have been moved as of 2021).