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.

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(1) Flood and Disaster Control Action Plans for Telecommunications Rooms, Telecommunications Equipment, and Buildings	
Short-term adaptation plans (1-3 years)	
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.	● Each of the units responsible for management of our telecommunications data centers have established measures for preventing natural disasters, as well as business continuity and emergency response plans. They have also carried out planned data evacuation/data backup and recovery drills, and in 2022 successfully passed third-party certification for ISO 27001/27011. ● All of our telecommunications equipment have been equipped with weather monitoring systems. In the event of a sudden disaster, we are able to quickly grasp our network status, and prepare the appropriate rescue and repair resources according to the scale of the disaster while also constantly monitoring how the situation is developing. ● Drought prevention drills are carried out each year for our Taipei Aiguo Telecom Park. These drills include: Flood proof doors have been installed on four exits, one each at the car path, the motorcycle path, the basement stairwell, and the basement emergency exit, as well as on the exit leading from the outdoors area on the first floor to the

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	basement level.
Reduce the reliance of our equipment and facilities on electricity, conduct a carbon inventory of our operational processes to identify areas where our greenhouse gas emissions can be reduced and improve 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).	● Based on a statistical analysis, we managed to conserve the most electricity in these three areas in 2022: 1. Electricity (energy) conserved by fixed network server rooms Replaced older air-conditioning equipment, SMR equipment, stopped using NG SDH-UT, reduced ERI loads, replaced ADSL DSLAM, V1 DSLAM, 7342 GPON OLT, and consolidated AGG-E broadband. Across all of our operating locations, we conserved 62.09 million kWh of electricity as of November of last year, achieving our goal to conserve 17.41 million kWh of electricity. 2. Electricity (energy) conserved by mobile network server rooms (including base stations) Replaced old energy inefficient equipment, adopted the C-RAN framework for our base stations, stopped use of 2G gateway switches, adopted night sleep mode for 4G, stopped providing value-adding services, and adopted energy conservation measures in our building server rooms. In 2022, we conserved 5.52 million kWh of electricity, reducing our electricity expenses by NT$45.99 million (savings from conserved power + changes to power contract terms and time-based electricity pricing) 3. Electricity (energy) conserved by IDC server rooms Procured high-efficiency, low energy consumption, and high heat tolerance communications equipment, reducing electricity consumed by air conditioning. Replaced electrical equipment, adopted high-efficiency transformers and UPS, and inverter air conditioners (such as magnetic centrifugal cold water mainframes, EC fans, and variable-frequency drives).
Medium-term adaptation plans (3-8 years)	
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	● Establishing backup routing: The fragile public routes to Taiwan's eastern regions are often interrupted during typhoons or the flood season, leaving the region connected through a single unprotected route and greatly reducing the eastern region's electrical network stability. Through an

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have taken 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 and establishing backup routing.	OTN network and the WSON (Wavelength Switched Optical Network) function, we have been able to automatically switch and provide a wide variety of different routes, greatly improving electrical network stability. ● Distributed routing design: We have established numerous backbone and core urban network nodes to carry out cross-region information transmission and local information delivery. Our western data links utilize 5 trunk fiber optic cables, while our eastern data links utilize 2 trunk fiber optic cables. In this way, data routing is distributed, protecting our routing networks. ● Analysis of switching and protection functions: Our OTN equipment supports OSNCP (Optical Subnetwork Connection Protection) and Restoration (R;) settings, and we are able to provide our electrical networks with 1+1, 1+R (rerouting), and 1+1+R (1+1 protection + rerouting) protections, based on information category.
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 efficient energy conserving equipment with the goal of improving the Power Usage Effectiveness (PUE) of our data centers from bronze (PUE of 1.94) to silver level (PUE between 1.43-1.67). Due to reliability limitations, and also the rate of our customers' IT	● Reliability is a priority for our IDC server rooms, and the PUE value is also dependent on the IT electricity usage of our customers after they move into the facility. The Company has already made plans to gradually phase out and consolidate less energy-efficient small-scale server rooms in order to increase the overall PUE of our server rooms. ● Adopted more efficient and energy conserving air conditioning equipment, and accelerated the process of replacing older less efficient equipment in order to improve the electricity utilization rates of our server rooms.

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electricity usage, we plan to lower our overall target PUE value to 1.5 by 2030.	
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.	● From an energy storage system safety perspective, analyzed the UL 9540, UL9540A, and IEC62933 safety requirements standards for our existing energy storage system, and our systems for handling energy storage battery fires and energy storage system thermal runaways. Proposed system design recommendations (a. ensure sufficient construction area, b. establish an effective EyeSee energy storage battery monitoring system, c. establish fire containment zones, d. optimize ventilation and fire-fighting systems for energy storage areas, e. obtain system safety certification) that can serve as a basis for the Company's energy storage safety and prevention systems, allowing the Company to improve communications equipment safety. The above measures are only applicable to lithium-ion batteries, and not to lead-acid batteries. ● Continued to procure lithium-ion batteries, and establish a timetable for independently building solar power systems for the Company's buildings in line with the Company's renewable energy procurement and policies, increasing the proportion of renewable energy used by server rooms.
Long-term adaptation plans (More than 8 years)	
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	● The Company has launched scientific research projects on climate change in collaboration with government and public agencies for disaster analysis. For example: the Taiwan Climate Change Projection Information and Adaptation Knowledge Platform (http://tccip.ncdr.nat.gov.tw). In the future, the Company may integrate and collaborate with industry-academia-government organizations, and apply climate change disaster analysis data to develop technologies for preventing these disasters, reducing the impact of climate change risks.

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us being significantly impacted. (Such as the Earthquake Public Warning Cell Broadcast Service)	
(2) Climate Change Adaptation Action Plans for Network Facilities	
Short-term adaptation plans (1-3 years)	
Telecommunications Rooms Underground infrastructure: Continue making improvements and inspections (such as to drainage systems), gradually replace older equipment to prevent accidents from occurring due to aging equipment.	● Conducted regular maintenance inspections based on the specific requirements for different buildings and equipment, and conduct regular (quarterly/annually) inspections of the Xing Tong Building's facilities, such as its electrical system/miscellaneous facilities/plumbing system. Based on the inspection results, a rolling management approach was adopted to implement continued improvements and inspections. ● Established the Operating Guidelines for Underground On-Site Self Inspections pursuant to the Chunghwa Telecom Main Criteria for Assessing External Network Equipment Maintenance. Inspection items include 20 operations and equipment categories, including network equipment and disaster prevention and rescue operations. These inspections are focused on maintaining the safety of our underground cables, preventing disasters from happening and ensuring that rescue operations are sound. ● Conducted regular self inspections each quarter, and conducted repeated inspections and performance assessments during the annual Mid-Term Inspection and External Network Equipment Maintenance Assessment. ● In the 2022 External Network Equipment Maintenance Assessment, 39 separate issues were discovered across 15 inspection items in the Company's overall underground system assessment (described in attachment). These issues have been corrected within 30 days.
Above ground telecommunications infrastructure: DJ box, distribution board, telecommunications enclosures, and other infrastructure	● We have fully committed to building further facilities to improve Fiber-to-the-Home (FTTH) network coverage. The Company plans to increase Fiber-to-the-Home coverage to above 90% across all regions by 2026, and in 2022 we increased our total Fiber-to-the-Home facilities by 8.25%, achieving 81.39% network coverage.

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supporting Fiber-to-the-Home (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.	● Removed V1 and V2 equipment used in consolidated cross connection cabinets. In 2022, we implemented plans to reduce 3,767 pieces of such equipment (removed 2,968 pieces of V1 equipment, and 799 pieces of V2 equipment), reducing the usage of cross connection equipment and reducing the probability of network obstructions. ● Worked together with our clients to change from V to H cable networks, reducing the use of cross connection cabinets.
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.	● Continued to optimize filled gas monitoring software, and gradually update to smart gas filling machines. In 2022, we replaced 60 gas filling machines, and removed 57,391 detected cable obstructions. We plan to gradually replace 120 machines in the next 3 years, and improve our EyeSee obstruction advance warning system to prevent cable obstructions.
Overhead cable infrastructure: Optimize the surveying software used for transmission towers and cables, in order to more effectively inspect any power cables or transmission tower equipment experiencing issues and make improvements, preventing cable obstructions.	● In 2022, we completed inspections and reporting data for our overhead cables, optimized software for surveying specific targets and GIS tracks, improved safety for our telecommunications equipment, recorded and archived survey data, and simplified the survey process, preventing climate-related disasters from becoming a major obstacle.
Medium-term adaptation plans (3-8 years)	
Telecommunications Rooms Underground infrastructure: Update our network technologies, reduce the use of copper cables, and begin **converting** our cable systems to fiber-optic cable, with these technological updates allowing us to reduce the number of exchange points.	● Gradually began implementing plans to replace copper cables with fiber-optic cables. Reduce the use of copper trunk cables by adopting MSAN equipment and technologies in our cross connection cabinets. Convened meetings when necessary to discuss strategies and plans for implementing these actions. As of 2022, our progress for our POC locations is as follows: copper cable usage decreased by 9.96% for Taipei Business Office- North One Computer room, 10.70% for New Taipei Business Office-Fuhe Computer room, 5.01% for Taoyuan Business Office-

Adaptation plans	2022 Operational Results/Progress
	International Airport Computer room, 2.79% for Taichung Business Office- Tianxin Computer room, and 4.78% for Nantou Business Office- Fuliao Computer room. ● Continued operations to replace copper cables with fiber-optic cables, and to convert to MSAN. Reduced usage of exchange points and cross connection cabinets, reduced utilization rate of copper cables in cross connection cabinets, and, through adopting NGCO technology, reduced the number of exchange point server rooms. ● Continued implementing the POC project for reducing use of copper cables in server rooms. We plan to be able to complete consolidation operations for the Taoyuan International Airport server room by 2025, with current consolidation and conversion progress at approximately 35%.
Above ground telecommunications infrastructure: **Accelerate** converting our DJ boxes, distribution boards, and telecommunications enclosures to use fiber-optic cable, **gradually** phasing out the use of copper cables and exchange equipment from cross connection cabinets.	● We have fully committed to building further facilities to improve Fiber-to-the-Home (FTTH) network coverage. The Company plans to increase Fiber-to-the-Home coverage to above 90% across all regions by 2026, and in 2022 we increased our total Fiber-to-the-Home facilities by 8.25%, achieving 81.39% network coverage. ● Reduced V1 and V2 equipment in consolidated cross connection cabinets. Plans implemented in 2022 helped conserve 1.514 million kWh of electricity (Reduced V1 electricity consumption by 1.01 million kWh, and V2 electricity consumption by 504,000 kWh). Empty cross connection cabinets have been re-utilized. In the past 8 years, we have worked together with exchange points to reduce and consolidate our operations, and have worked together with our clients to continue converting older cables to fiber optic cables.
Underground cable infrastructure: **Accelerate** converting all cables laid in manholes, handholes, and underground tunnels to fiber-optic cables , reducing the	● Launched the Server Room POC cable conversion and copper cable removal project, which plans to remove 2,611 km of copper trunk cable by 2026. ● Implemented project to replace copper cable with fiber-optic cable. Across all regions, established and implemented annual schedules for removing 66.9km of

Adaptation plans	2022 Operational Results/Progress
number of copper cables used.	underground cables from 2022 to 2026. Continued implementing policies to reduce usage of copper cables, and reduce use of these cables in manholes, handholes, and underground tunnels.
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.	● Prioritized installing FWA in regions where fiber-optic cable cannot be easily laid, substituting fixed broadband networks with mobile networks, and reducing construction costs. In 2022, we installed 27 routes for MOD HD.
Long-term adaptation plans (More than 8 years)	
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.	● Cable maintenance has included internal and external cables, facilities (equipment) and client terminal equipment. The Company has developed operational and maintenance management systems for managing the operational and maintenance functions required for each of these facilities and equipment. These management and monitoring systems have also continued to be optimized, following the constant evolutions of network technology and equipment. We focused on making these processes more systematic, automated, smart, and consolidated as our development goals, in order to avoid having to re-invest resources into redundant efforts. ● In order to inspect, repair, and assign labor to address client equipment issues, we have collaborated to developed the iTRIS system as a replacement for the original eTRIS system. This new system is able to integrate inspection and repair operations for various different issues, and also possesses innovative new system functions that make it more consolidated and smart.
(3) Climate Change Adaptation Action Plans for Cellular Base Station Networks	
Short-term adaptation plans (1-3 years)	
Improve safety: Periodically inspect and repair our base	Established the Main Criteria for Assessing Mobile Communications Equipment. Inspected and repaired base

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station's cell towers/equipment/electrical supply equipment, and gradually replace older electrical equipment to prevent accidents from occurring due to aging equipment.	stations every six months, with these procedures including an external alerts test, battery discharge test, firefighting equipment inspection, inspection of how the air-conditioning system is operating, and fan filter cleaning. We completed inspection and repair of all of our base stations in 2022, achieving a successful inspection and repair rate of 100% and completing all improvements.
Improve electricity supply: Convert base stations into C-RAN architecture, installed in data centers with a stable electricity supply and sufficient backup electricity sources.	● Adopted C-RAN architecture for 5G networks. When planning the construction of C-RAN server rooms, the Company has determined the server room requirements, including their electricity consumption/air-conditioning/space requirements, together with the fixed network planning office, electricity office, and the head office's administration and asset development office, confirming the electricity required for each server room and collaborating on other construction issues. We have also adopted a dual power supply to provide a reliable supply of power to our base stations. ● At the moment, we have already constructed 16,000 5G base stations across all regions. In line with plans to increase 5G network coverage this year (2023), we have continued to build C-RAN server rooms to accommodate our base station. We plan to increase our proportion of C-RAN servers across our entire network to above 85%.
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.	● Our electricity conservation measures have included gradually replacing old energy inefficient equipment, implementing measures to reduce electricity consumed for air-conditioning at our base stations, adopting the C-RAN architecture for our base stations, stopping use of 2G gateway switches, adopting night sleep mode for 4G, stopping provision of value-adding services, and adopting energy conservation measures in our building server rooms. In total, we saved 60.4 million kWh of electricity in 2022.
In line with the construction of our 5G N2100 base stations,	● In line with the construction of our 5G N2100 base stations, we have shut down 3G F2 cells, effectively utilizing the 3G

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shut down 3G F2 cells, and effectively utilize the 3G U2100 frequency. Extend 5G signal coverage to achieve the twin goals of reducing our electricity requirements and our maintenance and operational expenses.	U2100 frequency. From 2021 to 2022, after shutting down our 3G F2 cells, we have managed to save 3.7 million kWh of electricity. In the future, we shall continue to follow our 3G Sunset timeline and implement these measures on a larger scale in order to reduce the energy consumed by our base stations.
Medium-term adaptation plans (3-8 years)	
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.	● Relying on the multi-band properties of 4G, we have implemented smart electricity-conserving measures for our 4G base station cells (reducing the number of usable frequencies) during the low-traffic nighttime hours. In 2022, these measures were in place for 5 million cell hours, saving us 1.05 million kWh of electricity. We plan to implement these efforts on a larger scale in the future in order to reduce our energy consumption.
Long-term adaptation plans (More than 8 years)	
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.	● Promoted green base stations, utilized renewable energy sources such as wind and solar to improve base station backup. ● 4G base stations are already protected by automatic multiple route switching while transmitting across the OTN network. Electrical systems for 5G base stations have also gradually been converted to MSER circuits, and also provided with backup and protection systems. ● 5G Mobile network adopts the C-RAN (Centralized Radio Access Network) architecture for the base stations. Major modules and routes of MBH (Mobile Backhaul) transmission and aggregation equipment are protected by backup recovery mechanism. Maintenance and operational

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	tools will continue to be developed to promote smart management and maintenance, and improve the network monitoring system and cyber resilience of access network. ● In order to ensure reliable transmissions from our base stations, we have not only considered the appropriate adoption of FSO (Free-Space Optical Communication) to replace the older narrowband microwaves that cannot be used for 4G or higher transmissions, but may also in the future adopt the use of commercial low earth orbit satellites, using the properties of these broadband signals to serve as an important backup transmissions method for our base stations.