2DS Scenario (Correspond to RCP2.6)

Climate Risk Path

Sources of Climate Change Scenarios	Climate Risks	Impact and effect on TWM	Financial Impact Projects
CCPI 2DS Path IEA ETP 2DS Scenario LCTPi carbon price estimation IIASA low-carbon investment scenario IPCC AR5 RCP 2.6 scenario IPCC 1.5DC Report	**Transition Risks** Laws, regulations and policies Increased sustainability requirements and regulations	Telecommunications operations According to the IEA Energy Technology Outlook, renewable energy will become the main energy source under the 2DS scenario. It is reasonably estimated that the government should invest in renewable energy building or renewable energy certificate purchase, resulting in higher operating cost	Operating costs
		Telecommunications operations; General Operations Taiwan Mobile's computer room has the highest proportion of electricity consumption, including 83% of base station computer room, 4% of IDC and 2% of information computer room, and even 3% of office. Under the future 2DS scenario, Taiwan Mobile's replacement of telecom equipment with high power consumption and upgrading of office energy efficiency will increase the operating costs, and also accelerate the depreciation of existing equipment assets and decrease the value	Operating costs Asset appreciation
	Transition Risks Laws, regulations and policies Increased in the costs of greenhouse gas emissions	Telecommunications operations If the TWM carbon emission reduction rate fails to meet the 2DS reduction path, it may be fined by carbon trading, carbon tax and other carbon pricing systems, which will increase the operating costs. (At present, the carbon trading system rarely regulates the ICT industry, and it is estimated that this impact is less possible in the future)	Operating costs
		General Operations; Telecommunications operations; Store sales The purchase and introduction of new management tools and equipment, in addition to the purchase cost, also includes the expenditure required for research and development of new technologies and processes, and the transitional operational impact.	Operating costs
	Transition Risks Information technology Increase in cost to transition to lower carbon emissions technology	General Operations; Telecommunications operations; Store sales The increase of the frequency of the scale 4 or 5 strong typhoon will probably lead to the damage or operation interruption of TWM's own operating base, data center and base station equipment due to strong winds and flooding, which will increase the maintenance and renewal costs, and even cause customer complaints due to the unstable network, and will affect the Company's brand image. As for the stores, there should not have high financial loss as all stores have been insured against natural disasters.	Operating costs Asset appreciation
		Telecommunications operations The frequency increase in scale 4 or 5 strong typhoons may affect the safety of outdoor workers (emergency workers in typhoon days), increase the injury rate of employees and increase the Company's operating costs	Operating costs
	Entity Risks Extreme Increase in frequency and severity of typhoons/hurricanes	Electricity suppliers Taiwan's power facilities, such as towers and poles, may be damaged due to the emergence of the scale 4 or 5 strong typhoons, resulting in shortage and instability of power supply, power outages (which may be over 4 hours) or planned power restrictions (which may vary from 5-15% for large power users). As a result, TWM needs its own generators or backup generators provided by the manufacturers for computer rooms. What's more, it will lead to operation disruption (data centers, computer rooms, stores, base stations), resulting into network instability and customers' complaints which could affect the Company's brand image.	Operating costs Asset appreciation
		Logistics The frequency increase in the scale 4 or 5 strong typhoons will probably lead to road interruption or port closure, which will affect the logistics traffic, reduce the service quality of most TWM services, and slightly affect the future revenue. Greenhouse gas laws and regulations may also have an impact on logistics suppliers, requiring them to purchase vehicles with low carbon emissions, such as electric vehicles, which will indirectly increase TWM logistics cost.	Operating revenue Operating costs

2DS Scenario (Correspond to RCP2.6)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM	Financial Impact Projects

Transition Risks

Laws, regulations and policies

Increased sustainability requirements and regulations

2DS Renewable Energy Development of IEA and CCPI

The International Energy Agency (IEA) pointed out that under the 2DS scenario, CO_2 emissions would peak before 2020, and then be reduced to about a quarter of that of 2014 in 2060. At that time, the proportion of renewable energy must reach 74% According to Climate Change Performance Index (CCPI) Result 2019, under the 2DS path, the proportion of renewable energy supply in Taiwan should reach 50% in 2030.

Impact and effect on TWM

Telecommunications operations

According to the information of IEA Energy Technology Outlook, it is necessary to develop a low-carbon power generation system based on renewable energy. Taiwan Mobile has set a target 1.2% for the total renewable energy consumption in 2018. Under 2DS scenario, renewable energy will become the main energy source, so that it should invest more in renewable energy building or renewable energy certificate purchase, resulting in higher operating cost.

→ Operating costs

Telecommunications operations | General Operations

In the current operation, Taiwan Mobile's computer room has the highest proportion of electricity consumption, including 83% in base station computer room, 4% in IDC and 2% in information computer room, and even 3% in office. Under the future 2DS scenario, Taiwan Mobile's replacement of telecom equipment with high power consumption and upgrading of office energy efficiency will increase the operating costs, and also accelerate the depreciation of existing equipment assets and decrease the asset value.

→ Operating costs

→ Asset appreciation

Transition Risks

Laws, regulations and policies

Increased in the costs of greenhouse gas emissions

IEA 2DS Scenario

The International Energy Agency (IEA) pointed out that under the 2DS scenario, CO_2 emissions would peak before 2020, and then be reduced to about a quarter of that of 2014 in 2060. To achieve this goal, the building-related CO_2 emissions in 2060 need to be reduced by 85% compared with RTS, while the CO_2 emissions in transportation system need to be reduced.

In order to achieve the goal of Paris Agreement, the carbon price should be raised to $40~80 tCO2e in 2020.

Impact and effect on TWM

Telecommunications operations

If the TWM carbon emission reduction rate fails to meet the 2DS reduction path, it may be fined by relevant carbon trading, carbon tax and other carbon pricing systems, which will increase the operating costs. (At present, the carbon trading system rarely regulates the ICT industry, and it is estimated that this impact is less possible in the future)

→ Operating costs

General Operations | Telecommunications operations | Store sales

The purchase and introduction of new management tools and equipment, in addition to the purchase cost, also includes the expenditure required for research and development of new technologies and processes, and the transitional operational impact.

→ Operating costs

Transition Risks

Information technology

Increase in cost to transition to lower carbon emissions technology

IIASA model lower than 2℃

According to the research report released by International Institute for Applied Systems Analysis (IIASA) in 2018, if the global temperature rise is not more than 2℃, the annual average global investment in energy transformation needs to reach $2.978 trillion (US$ 2015) from now until 2050, including investment in energy storage, carbon capture, nuclear energy, renewable energy and energy efficiency improvement. (According to the estimation of IEA ETP 2017, under 2DS Scenario, the contribution of energy efficiency improvement accounts for about 40% of carbon reduction, which means that the equipment-renewal related investment is an important path in low-carbon transformation)

Impact and effect on TWM

General Operations | Telecommunications operations | Store sales

The increase of the frequency of the scale 4 or 5 strong typhoon will probably lead to the damage or operation interruption of TWM's own operating base, data center and base station equipment due to strong winds and flooding, which will increase the maintenance and renewal costs, and even cause customer complaints due to the unstable network, and will affect the Company's brand image. As for the stores, there should not have high financial loss as all stores have been insured against natural disasters.

→ Operating costs

→ ..... appreciation

Telecommunications operations

The frequency increase in scale 4 or 5 strong typhoons may affect the safety of outdoor workers (emergency workers in typhoon days), increase the injury rate of employees and increase the Company's operating costs

→ Operating costs

Electricity suppliers

Taiwan's power facilities, such as towers and poles, may be damaged due to the emergence of the scale 4 or 5 strong typhoons, resulting in shortage and instability of power supply, power outages (which may be over 4 hours) or planned power restrictions (which may vary from 5-15% for large power users). As a result, TWM needs its own generators or backup generators provided by the manufacturers for computer rooms. What's more, it will lead to operation disruption (data centers, computer rooms, stores, base stations), resulting into network instability and customers' complaints which could affect the Company's brand image.

→ Operating costs

→ Asset appreciation

Entity Risks

Extreme

Increase in frequency and severity of typhoons/hurricanes

IPCC AR5

According to the data from the latest IPCC 1.5DC report in 2018, under 2DS Scenario, there will be additional 1.2 scale 4 typhoons (wind speed above 58m/s, scale 17 gusts) and 1.2 scale 5 typhoons (wind speed above 70m/s, scale 17 gusts) in the world every year in the future.

Impact and effect on TWM

Logistics

The frequency increase in the scale 4 or 5 strong typhoons will probably lead to road interruption or port closure, which will affect the logistics traffic, reduce the service quality of most TWM services, and slightly affect the future revenue. Greenhouse gas laws and regulations may also have an impact on logistics suppliers, requiring them to purchase vehicles with low carbon emissions, such as electric vehicles, which will indirectly increase TWM logistics cost.

→ Operating revenue

→ Operating costs

NDC Scenario (Correspond to RCP4.5)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM	Financial Impact Projects

Transition Risks

Laws, regulations and policies

Increased requirement and regulation of sustainability
Increased requirement and regulation of sustainability

Renewable Energy Development Ordinance

In response to the energy structure adjustment to "a power generation structure with 20% renewable energy, 50% natural gas and 30% fire coal in 2025, and stable power supply", the Renewable Energy Development Ordinance stipulates that businesses with a contracted capacity of more than 800 kWh must install renewable energy equipment or purchase green electricity certificates. In addition, it also includes reviewing and setting renewable energy promotion targets year by year for the next two years, and revising the “total promotion target” to 17 million kWh

Telecommunications operations

At present, Taiwan Mobile has three telecom operating bases with contracted capacity of more than 800 kWh, and most of the carbon emissions come from electricity (98%). No matter the renewable energy regulations or the Company's low-carbon transformation demand, more renewable energy construction or renewable energy certificate purchase may be required, which could result in increased operating costs.

→ Operating costs

Telecommunications operations | **General Operations**

The National Communications Commission (NCC) will take telecom computer room and building energy use as its main guidance actions. In the current Taiwan Mobile operation, the electricity consumption of computer room and office accounts for 92% of the total electricity consumption. Replacing telecom equipment with high power consumption and upgrading office energy efficiency will increase the operating cost, and also cause the loss of the asset value of existing equipment

→ Operating costs
→ Asset appreciation

Store sales

At the same time, NCC takes the store energy use as one of the ways to achieve the greenhouse gas reduction goal. Currently, 4% of Taiwan Mobile's electricity consumption comes from direct stores. It is estimated that this will impact the store operation, resulting in operating cost increase, such as early replacement of low-efficiency lamps and air-conditioning equipment in the stores.

→ Operating costs

Transition Risks

Laws, regulations and policies

Increased in the costs of greenhouse gas emissions

Greenhouse Gas Reduction and Management Act

The "Greenhouse Gas Reduction and Management Act" promulgated on July 1, 2015 sets the national goal of greenhouse gas emission reduction in 2050
to less than 50% in 2005.
NCC, the competent authority of the telecommunications companies, will promote the independent emission reduction of telecommunications companies, with the goal of 14,000 metric tons of CO_2e in 2020.
In the future carbon trading system, every metric ton of excess carbon emissions will be fined three times the carbon market price, with the upper limit of NT$ 1,500/ton.

Telecommunications operations

If the TWM carbon emission reduction rate fails to meet the state reduction goal, it may be fined by relevant carbon trading, carbon tax and other carbon pricing systems, which will increase the operating costs. (At present, the carbon trading system rarely regulates the ICT industry, and it is estimated that this impact is less possible in the future)

→ Operating costs

General Operations | **Telecommunications operations** | **Store sales**

The purchase and introduction of new management tools and equipment, in addition to the purchase cost, also includes the expenditure required for research and development of new technologies and processes, and the transitional operational impact.

→ Operating costs

Transition Risks

Information technology

Increase in cost to transition to lower carbon emissions technology

IIASA NDC Model

According to the research report released by International Institute for Applied Systems Analysis (IIASA) in 2018, to achieve the NDC requests, the annual average global investment in energy transformation needs to reach $2.544 trillion (US$ 2015) from now until 2050, including investment in energy storage, carbon capture, nuclear energy, renewable energy and energy efficiency improvement.

General Operations | **Telecommunications operations** | **Store sales**

The increase of the frequency of the scale 4 or 5 strong typhoon will probably lead to the damage or operation interruption of TWM's own operating base, data center and base station equipment due to strong winds and flooding, which will increase the maintenance and renewal costs, and even cause customer complaints due to the unstable network, and will affect the Company's brand image. As for the stores, there should not have high financial loss as all stores

→ Operating costs
→ Asset appreciation

Telecommunications operations

The frequency increase in scale 4 or 5 strong typhoons may affect the safety of outdoor workers (emergency workers in typhoon days), increase the injury rate of employees and increase the Company's operating costs

→ Operating costs

Electricity suppliers

Taiwan's power facilities, such as towers and poles, may be damaged due to the emergence of the scale 4 or 5 strong typhoons, resulting in shortage and instability of power supply, power outages (which may be over 4 hours) or planned power restrictions (which may vary from 5-15% for large power users). As a result, TWM needs its own generators or backup generators provided by the manufacturers for computer rooms. What's more, it will lead to operation disruption (data centers, computer rooms, stores, base stations), resulting into network instability and customers’ complaints which could affect the Company’s brand image.

→ Operating costs
→ Asset appreciation

Entity Risks

Extreme

Increase in frequency and severity of typhoons/hurricanes

IPCC AR5

Basis
The wind (tropical cyclone) frequency will decrease, but the frequency of strong typhoons (scale 4 or 5) in the northwest Pacific will increase.

Logistics

The frequency increase in the scale 4 or 5 strong typhoons will probably lead to road interruption or port closure, which will affect the logistics traffic, reduce the service quality of most TWM services, and slightly affect the future revenue. Greenhouse gas laws and regulations may also have an impact on logistics suppliers, requiring them to purchase vehicles with low carbon emissions, such as electric vehicles, which will indirectly increase TWM logistics cost.

→ Operating revenue
→ Operating costs

2DS scenario (Correspond to RCP2.6)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM	Financial Impact Projects

Transition Risks

Laws, regulations and policies

Increased sustainability requirements and regulations

2DS Renewable Energy Development of IEA and CCPI

According to the "2017 Energy Technology Outlook" published by the International Energy Agency (IEA) in the latest issue, in the RTS scenario, the global average temperature will rise by 2.7℃ by 2100. However, under the 2DS scenario, CO_2 emissions will peak before 2020, and then fall to about a quarter of that in 2014 in 2060

To achieve the above goal, the global power sector must achieve net zero emissions in 2060. At that time, renewable energy will account for 74%, nuclear energy accounts for 15%, and natural gas accounts for the rest.

In addition, according to Climate Change Performance Index (CCPI) Result 2019 released by Germanwatch in 2018, under the 2DS path, the proportion of renewable energy supply in Taiwan should reach 50% in 2030.

Telecommunications operations

According to the information of IEA Energy Technology Outlook, to achieve the goal, the low carbon policy would include developing a low-carbon power generation system based on renewable energy. Taiwan Mobile has set a target 1.2% for the total renewable energy consumption in 2018. Under 2DS scenario, renewable energy will become the main energy source, so that it should invest more in renewable energy building or renewable energy certificate purchase,

- Operating costs
- Operating revenue
- Asset appreciation

NDC Scenario (Correspond to RCP4.5)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM	Financial Impact Projects

Transition Risks

Laws, regulations and policies

Increased sustainability requirements and regulations

Renewable Energy

In April, 2017, the Ministry of Economic Affairs issued the "Energy Development Program (approved version)", pointing out that in order to meet the Greenhouse Gas Reduction and Management Act and other related norms, it is necessary to conform to the energy transformation wave. According to the Energy Policy Report of the Executive Yuan in May 2018, the medium- and long-term energy ratio is "a power generation structure with 20% renewable energy, 50% natural gas and 30% fire coal in 2025, and stable power supply".
In response to the above-mentioned energy structure adjustment, in the “Renewable Energy Development Ordinance" amended by the Legislative Yuan, there is a relevant provision that businesses with a contracted capacity of more than 800 kWh must install renewable energy equipment or purchase green electricity certificates. In addition, according to the "General Notes on the Revised Draft of Renewable Energy Development Ordinance" issued by the Energy Bureau of the Ministry of Economic Affairs, the renewable energy promotion targets for the next two years will be reviewed and set year by year within 20 years from the implementation date of the ordinance, and the total promotion targets will be revised to more than 17 million kWh.

Telecommunications operations

Under the Renewable Energy Development Ordinance, Taiwan Mobile currently has three telecom operating bases with contracted capacity of more than 800 kWh, which may lead to additional expenses for building additional renewable energy generating devices or purchasing and purchasing renewable energy certificates according to regulations

- Operating costs
- Operating revenue
- Asset appreciation

2DS scenario (Correspond to RCP2.6)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM	Financial Impact Projects

Transition Risks

Laws, regulations and policies

Increased in the costs of greenhouse gas emissions

Greenhouse gas emissions under 2DS

According to the "2017 Energy Technology Outlook" published by the International Energy Agency (IEA) in the latest issue, in the RTS scenario, the global average temperature will rise by 2.7℃ by 2100. However, under the 2DS scenario, CO_2 emissions will peak before 2020,

and then fall to about a quarter of that in 2014 in 2060.

From the time point of 2014, as the global energy CO_2 emissions mainly come from power, industry, transportation and construction industries. To achieve the above goals, the building-related CO_2 emissions in 2060 need to be reduced by 85% compared with RTS, while the CO_2 emissions in transportation system need to reduce to 9GtCO_2

Estimation of High Level Commission on Carbon Prices: In order to achieve the goal of Paris Agreement, the carbon price should be raised to $40~80 tCO2e in 2020

Telecommunications operations **General Operations**

In the current operation, Taiwan Mobile's computer room has the highest proportion of electricity consumption, including 83% of base station computer room, 4% of IDC and 2% of information computer room, and even 3% of office. In the future 2℃ scenario, Taiwan Mobile's replacement of telecom equipment with high power consumption and upgrading of office energy efficiency will increase the operating costs, and also lead to value decrease in the existing equipment assets. In addition, if failing to meet the 2℃ reduction path, TWM may be fined by related carbon trading and carbon tax system, which will increase the operating cost.

General Operations **Telecommunications operations**

According to the information of IEA Energy Technology Outlook, the measures of building energy conservation and carbon reduction include efficient lighting, air conditioning and appliances, as well as the transfer of energy supply to renewable energy and integrated solutions. At present, the electricity consumption of TWM office buildings accounts for 3% of the total electricity consumption, which mainly uses non-renewable energy. If renewable energy equipment is introduced and the energy use mode is changed, the operating cost will rise, which includes the purchase of renewable energy certificates, replacement of hardware equipment or the adoption of energy-efficient integrated energy management system.

Telecommunications operations

According to the information of IEA Energy Technology Outlook, the transportation sector will contribute to decarbonization through the energy use structure transformation, such as the adoption electric vehicles and other low-carbon vehicles. At present, about 1% of the TWM greenhouse gas emission comes from official vehicles. If it is changed to low-carbon vehicles, such as electric vehicles, it will directly impact TWM and increase operating expenses.

Logistics

Greenhouse gas laws and regulations may also have an impact on logistics suppliers, requiring them to purchase vehicles with low carbon emissions, such as electric vehicles, which will indirectly increase TWM logistics cost.

Financial Impact Projects

- Operating costs
- Operating revenue
- Asset appreciation

NDC Scenario (Correspond to RCP4.5)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM	Financial Impact Projects

Transition Risks

Laws, regulations and policies

Increased in the costs of greenhouse gas emissions

Greenhouse Gas

According to the "Greenhouse Gas Reduction and Management Act" promulgated on July 1, 2015:

1. Article 4 specifies the 2050 goal of reducing the greenhouse gas emissions to less than 50% of 2005.

2. According to Article 9, the central competent authority of the target industry shall formulate the action plan for greenhouse gas emission control of its subordinate departments. The content of its action plan must include the greenhouse gas emission control target of this sector. Therefore, by consulting the approved version of the "Greenhouse Gas Emission Control Action Plan (Phase I) of the Residential and Commercial Sector" published by the Ministry of the Interior in September 2018, which also covers the telecommunications industry, the emission control target of the residential and commercial sector is to reduce the emissions by 2.5% from the base year

3. According to the action plan listed in the above-mentioned approved version, the National Communication Commission, the competent authority of the telecommunication companies, needs to instruct the telecommunication companies to independently reduce carbon, with the 2020 goal of reducing CO_2e by 14,000 metric tons

4. The carbon emission trading system is planned and implemented. In the future, if the greenhouse gas emissions exceed the approved quota, the excess amount can be deducted and offset through carbon trading, and a fine of three times the market price of carbon per metric ton will be imposed, with the upper limit of NT$1,500/ton

Telecommunications operations / General Operations

The National Communications Commission will take the replacement of telecommunication equipment, power supply and air-conditioning equipment in the telecommunication computer rooms as the main instruction action, and the improvement of office energy efficiency as the auxiliary instruction action. In the current operation, Taiwan Mobile's computer room has the highest proportion of electricity consumption, including 83% of base station computer room, 4% of IDC and 2% of information computer room, and even 3% of office. As such, the replacement of telecom equipment with high power consumption and upgrading of office energy efficiency will increase the operating costs, and also lead to value decrease in the existing equipment assets. In addition, if failing to meet the EPA's reduction plan, TWM may be fined by subsequent carbon trading system, which will increase the operating cost

Store sales

At the same time, NCC takes the management of store energy use as one of the ways to achieve the greenhouse gas reduction goal, and focus on improving energy use efficiency. Currently, 4% of Taiwan Mobile's electricity consumption comes from direct stores. It is estimated that this will impact the store operation, resulting in operating cost increase, such as early replacement of low-efficiency lamps and air-conditioning equipment in the stores.

Financial Impact Projects

- Operating costs
- Operating revenue
- Asset appreciation

2DS scenario (Correspond to RCP2.6)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM	Financial Impact Projects

Transition Risks

Information technology

Technology upgrades or innovations that do not support low-carbon transformation

IIASA model lower

According to the research report released by International Institute for Applied Systems Analysis (IIASA) in 2018, if the global temperature rise is not more than 2℃, the annual average global investment in energy transformation needs to reach $2.978 trillion (US$ 2015) from now until 2050, including investment in energy storage, carbon capture, nuclear energy, renewable energy and energy efficiency improvement.

The investment in Asia will be $1.034 trillion per year (US$ 2015), of which the renewable energy and energy efficiency increase will be $0.278 trillion and $0.157 trillion.

GeSI SmartER 2030

According to the GeSI SmartER 2030 report, the ICT industry will get $2 trillion revenue at the current status in 2030. It is one of the keys to help other industries reduce carbon emissions by considering the ICT intelligent services and solutions. If below 2DS scenario, it is reasonable to assume that all industries would rely more on ICT solutions, and their revenue would be greater than $2 trillion.

First-tier suppliers | **Store sales** | **Telecommunications operations**

Loss of revenue due to failure to take the lead in developing low-carbon substitutes for existing products and services. In addition, in order to make existing products competitive with low-carbon alternatives, additional marketing expenses are needed.

Store sales | **General Operations** | **Telecommunications operations**

Because it did not support the technological upgrading or innovation of low-carbon transformation, Taiwan Mobile got bad results from DJSI and other sustainable development appraisals at home and abroad, which would affect the Company's reputation and image, investors' willingness to invest and consumers' willingness to consume.

- Operating costs
- Operating revenue
- Asset appreciation

NDC Scenario (Correspond to RCP4.5)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM	Financial Impact Projects

Transition Risks

Information technology

Technology upgrades or innovations that do not support low-carbon transformation

IIASA NDC Model

According to the research report released by International Institute for Applied Systems Analysis (IIASA) in 2018, to achieve the NDC requests, the annual average global investment in energy transformation needs to reach $2.544 trillion (US$ 2015) from now until 2050, including investment in energy storage, carbon capture, nuclear energy, renewable energy and energy efficiency improvement.

The investment in Asia will be $0.754 trillion per year (US$ 2015), of which the renewable energy and energy efficiency increase will be $0.181 trillion and $0.026 trillion.

GeSI SmartER 2030

According to the GeSI SmartER 2030 report, the ICT industry will get $2 trillion revenue in 2030.

Store sales — Telecommunications operations

Loss of revenue due to failure to take the lead in developing low-carbon substitutes for existing products and services. In addition, in order to make existing products competitive with low-carbon alternatives, additional marketing expenses are needed.

→ Operating costs

→ Operating revenue

Store sales — General Operations — Telecommunications operations

Because it did not support the technological upgrading or innovation of low-carbon transformation, Taiwan Mobile got bad results from DJSI and other sustainable development appraisals at home and abroad, which would affect the Company's reputation and image, investors' willingness to invest and consumers' willingness to consume.

→ Asset appreciation

2DS scenario (Correspond to RCP2.6)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM	Financial Impact Projects

Transition Risks

Information technology

Increase in cost to transition to lower carbon emissions technology

IIASA below 2DS model

According to the research report released by International Institute for Applied Systems Analysis (IIASA) in 2018, if the global temperature rise is not more than 2℃, the annual average global investment in energy transformation needs to reach $2.978 trillion (US$ 2015) from now until 2050, including investment in energy storage, carbon capture, nuclear energy, renewable energy and energy efficiency improvement.

The investment in Asia will be $1.034 trillion per year (US$ 2015), of which the renewable energy and energy efficiency increase will be $0.278 trillion and $0.157 trillion.

Telecommunications operations

For Taiwan Mobile, the energy consumption of the computer rooms accounts for the largest proportion (83%), so the operating equipment must be of high energy efficiency, which may have higher unit price. The hardware equipment with poor energy efficiency may have to be replaced before the useful years, which would affect depreciation expenses.

General Operations **Telecommunications operations** **Store sales**

It is necessary to purchase and introduce new management tools and equipment. Apart from the purchase cost, there is also the transitional operational impact during the introduction and transition. For example, low-carbon management reduces the use of air-conditioning systems in computer rooms/base stations,
which may increase the failure rate of some equipment, resulting in an increase in maintenance manpower and costs.

General Operations **Telecommunications operations** **Store sales**

As most of the greenhouse gas emissions of Taiwan Mobile come from electricity (98%), it is necessary to introduce green electricity through setting up its own power generation facilities, purchasing foreign green electricity, or investing in renewable energy manufacturers to ensure the supply of green electricity. At present, Taiwan Mobile has assessed and confirmed that there is no suitable place for setting up renewable energy facilities on its own land, so it will prefer to buy foreign green electricity, or obtain green electricity by investing in renewable energy manufacturers and renting roof erection systems.

Product/services R&D **General Operations**

Expenditure required for R&D of new technologies or processes

Financial Impact Projects

- Operating costs
- Operating revenue
- Asset appreciation

NDC Scenario (Correspond to RCP4.5)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM	Financial Impact Projects

Transition Risks

Information technology

Increase in cost to transition to lower carbon emissions technology

IIASA NDC fire Model

According to the research report released by International Institute for Applied Systems Analysis (IIASA) in 2018, to achieve the NDC requests, the annual average global investment in energy transformation needs to reach $2.544 trillion (US$ 2015) from now until 2050, including investment in energy storage, carbon capture, nuclear energy, renewable energy and energy efficiency improvement.

The investment in Asia will be $0.754 trillion per year (US$ 2015), of which the renewable energy and energy efficiency increase will be $0.181 trillion and $0.026 trillion.

Telecommunications operations

For Taiwan Mobile, the energy consumption of the computer rooms accounts for the largest proportion (83%), so the operating equipment must be of high energy efficiency, which may have higher unit price. The hardware equipment with poor energy efficiency may have to be replaced before the useful years, which would affect depreciation expenses.

General Operations **Telecommunications operations** **Store sales**

It is necessary to purchase and introduce new management tools and equipment. Apart from the purchase cost, there is also the transitional operational impact during the introduction and transition. For example, low-carbon management reduces the use of air-conditioning systems in computer rooms/base stations,
which may increase the failure rate of some equipment, resulting in an increase in maintenance manpower and costs.

General Operations **Telecommunications operations** **Store sales**

As most of the greenhouse gas emissions of Taiwan Mobile come from electricity (98%), it is necessary to introduce green electricity through setting up its own power generation facilities, purchasing foreign green electricity, or investing in renewable energy manufacturers to ensure the supply of green electricity. At present, Taiwan Mobile has assessed and confirmed that there is no suitable place for setting up renewable energy facilities on its own land, so it will prefer to buy foreign green electricity, or obtain green electricity by investing in renewable energy manufacturers and renting roof erection systems.

Product/services R&D **General Operations**

Expenditure required for R&D of new technologies or processes

Financial Impact Projects

- Operating costs
- Operating revenue
- Asset appreciation

2DS scenario (Correspond to RCP2.6)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM	Financial Impact Projects

Transition Risks

Information technology

Replacement of existing products and services with low-carbon alternatives

IIASA model lower than 2℃

According to the research report released by International Institute for Applied Systems Analysis (IIASA) in 2018, if the global temperature rise is not more than 2℃, the annual average global investment in energy transformation needs to reach $2.978 trillion (US$ 2015) from now until 2050, including investment in energy storage, carbon capture, nuclear energy, renewable energy and energy efficiency improvement.

The investment in Asia will be $1.034 trillion per year (US$ 2015), of which the renewable energy and energy efficiency increase will be $0.278 trillion and $0.157 trillion.

GeSI Smarter 2030

According to the GeSI SmartER 2030 report, the ICT industry will get $2 trillion revenue at the current status in 2030. It is one of the keys to help other industries reduce carbon emissions by considering the ICT intelligent services and solutions. If below 2DS scenario, it is reasonable to assume that all industries would rely more on ICT solutions, and their revenue would be greater than $2 trillion.

Product/services R&D **General Operations** **Telecommunications operations**

There are many low-carbon services among Taiwan Mobile's existing services and products, such as myfone, myBook, myMusic, myVideo, but intelligent services and solutions are gradually becoming one of the keys to help other industries reduce carbon. If Taiwan Mobile continues to invest in the development of new ICT services, such as IoT, smart agricultural services, vehicle management, smart production, security system, e-commerce system, remote office, smart energy system, digital finance and other products and services, it will need to invest in R&D.

Product/services R&D **Telecommunications operations**

Smart ICT services and solutions are one of the keys to help other industries reduce carbon. Taiwan Mobile provides a low-carbon version of existing services through equipment carbon reduction, so there will be expenses for new equipment, and phasing out old facilities and services will also cause financial impact.

Store sales **Telecommunications operations**

Loss of revenue due to failure to take the lead in developing low-carbon substitutes for existing products and services. In addition, in order to make existing products competitive with low-carbon alternatives, additional marketing expenses are needed.

- Operating costs
- Operating revenue
- Asset appreciation

NDC Scenario (Correspond to RCP4.5)

Climate Risk Path

Name → **Corresponding Climate Change Scenarios** → **Impact and effect on TWM**

Financial Impact Projects

Transition Risks

Information technology

Replacement of existing products and services with low-carbon alternatives

IIASA NDC Model

According to the research report released by International Institute for Applied Systems Analysis (IIASA) in 2018, to achieve the NDC requests, the annual average global investment in energy transformation needs to reach $2.544 trillion (US$ 2015) from now until 2050, including investment in energy storage, carbon capture, nuclear energy, renewable energy and energy efficiency improvement.

The investment in Asia will be $0.754 trillion per year (US$ 2015), of which the renewable energy and energy efficiency increase will be $0.181 trillion and $0.026 trillion.

GeSI Smarter 2030

According to the GeSI SmarTER 2030 report, the ICT industry will get $2 trillion revenue in 2030.

Product/services R&D | **General Operations** | **Telecommunications operations**

There are many low-carbon services among Taiwan Mobile's existing services and products, such as myfone, myBook, myMusic, myVideo, but intelligent services and solutions are gradually becoming one of the keys to help other industries reduce carbon. If Taiwan Mobile continues to invest in the development of new ICT services, such as IoT, smart agricultural services, vehicle management, smart production, security system, e-commerce system, remote office, smart energy system, digital finance and other products and services, it will need to invest in R&D. However, the sales of the services and products will also increase revenue

Product/services R&D | **Equipment discard** | **Telecommunications operations**

Smart ICT services and solutions are one of the keys to help other industries reduce carbon. Taiwan Mobile provides a low-carbon version of existing services through equipment carbon reduction, so there will be expenses for new equipment, and phasing out old facilities and services will also cause financial impact.

Store sales | **Telecommunications operations**

Loss of revenue due to failure to take the lead in developing low-carbon substitutes for existing products and services. In addition, in order to make existing products competitive with low-carbon alternatives, additional marketing expenses are needed.

- Operating costs
- Operating revenue
- Asset appreciation

2DS scenario (Correspond to RCP2.6)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM

Financial Impact Projects

Transition Risks

Information technology

New technology investment failure

IIASA model lower than 2℃

According to the research report released by International Institute for Applied Systems Analysis (IIASA) in 2018, if the global temperature rise is not more than 2℃, the annual average global investment in energy transformation needs to reach $2.978 trillion (US$ 2015) from now until 2050, including investment in energy storage, carbon capture, nuclear energy, renewable energy and energy efficiency improvement.

The investment in Asia will be $1.034 trillion per year (US$ 2015), of which the renewable energy and energy efficiency increase will be $0.278 trillion and $0.157 trillion.

GeSI Smarter 2030

According to the GeSI SmartER 2030 report, the ICT industry will get $2 trillion revenue at the current status in 2030. It is one of the keys to help other industries reduce carbon emissions by considering the ICT intelligent services and solutions. If below 2DS scenario, it is reasonable to assume that all industries would rely more on ICT solutions, and their revenue would be greater than $2 trillion.

First-tier suppliers | Product/services R&D | Telecommunications operations

The invested new technology is replaced by other low-carbon technologies due to high carbon emissions, or other partners' change of their R&D direction to low-carbon technologies, resulting in the failure of the original R&D investment in new technology, which will lead to the decrease of revenue due to the R&D expenses and lack of opportunities.

For Taiwan Mobile, the key to most low-carbon transformation lies in the provision of telecommunication services, which mainly depends on equipment vendors, so it has a greater relationship with suppliers. In addition, if the purchased equipment becomes non-mainstream, it will affect the value of equipment, and also the value of assets.

- Operating costs
- Operating revenue
- Asset appreciation

NDC Scenario (Correspond to RCP4.5)

Climate Risk Path

Name → **Corresponding Climate Change Scenarios** → **Impact and effect on TWM**

Financial Impact Projects

Transition Risks

Information technology

New technology investment failure

IIASA NDC Model

According to the research report released by International Institute for Applied Systems Analysis (IIASA) in 2018, to achieve the NDC requests, the annual average global investment in energy transformation needs to reach $2.544 trillion (US$ 2015) from now until 2050, including investment in energy storage, carbon capture, nuclear energy, renewable energy and energy efficiency improvement.

The investment in Asia will be $0.754 trillion per year (US$ 2015), of which the renewable energy and energy efficiency increase will be $0.181 trillion and $0.026 trillion.

GeSI Smarter 2030

According to the GeSI SmartER 2030 report, the ICT industry will get $2 trillion revenue in 2030.

First-tier suppliers | **Product/services R&D** | **Telecommunications operations**

The invested new technology is replaced by other low-carbon technologies due to high carbon emissions, or other partners' change of their R&D direction to low-carbon technologies, resulting in the failure of the original R&D investment in new technology, which will lead to the decrease of revenue due to the R&D expenses and lack of opportunities.

For Taiwan Mobile, the key to most low-carbon transformation lies in the provision of telecommunication services, which mainly depends on equipment vendors, so it has a greater relationship with suppliers. In addition, if the purchased equipment becomes non-mainstream, it will affect the value of equipment, and also the value of assets.

- Operating costs
- Operating revenue
- Asset appreciation

2DS scenario (Correspond to RCP2.6)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM	Financial Impact Projects

Transition Risks

Market

Changing customer behavior

2DS scenario description

According to the "2017 Energy Technology Outlook" issued by the International Energy Agency (IEA) in the latest issue, if we want to move from RTS scenario (including energy saving and carbon reduction measures planned by various countries nowadays, and NDC promised in Paris Agreement) to 2DS scenario, the carbon emission will reach its peak before 2020, and will decrease to a quarter of that of 2014 around 2060, of which the carbon reduction contribution from energy efficiency improvement will account for about 40%.

According to Nielsen's survey, in 2015 (after the Paris Agreement), **66%** of consumers are willing to pay more for sustainable products (lower impact on the environment, including low-carbon footprint), which is 11 percentage points higher than 55% in 2014. Although this market survey focuses on general consumer goods, it can clearly indicate that consumers will change their purchasing behavior. It is reasonable to assume that the proportion of consumers who are willing to pay more for lower impact products in the future under the 2DS scenario would be at least 66%

According to Nielsen's survey, in 2018, 75% of American young people (21-24 years old) firmly believe that they will change their consumption behavior to reduce the impact on the environment,
and it is reasonably assumed that the proportion of young people who will change their consumption behavior in the future under 2DS scenario will reach at least 75%.

Telecommunications Operation | **Product/services R&D**

Under 2DS Scenario, customers would increase their demand for low-carbon products and services, and TWM needs to invest some resources in the development of new low-carbon products and services, so as to respond to the trend of customers' consumption of more sustainable products and services. It is expected that TWM would invest more in R&D, or a certain amount to purchase/replace low-carbon equipment, so as to reduce the carbon emissions of its own telecommunications services.

Telecommunications operations

After the Paris Agreement in 2015, consumers are more inclined to use low-carbon products or services, and change their purchasing behavior. Some customers may be lost because the products and services provided by Taiwan Mobile are not low in carbon. For the telecom services, as Taiwan Mobile has lower environmental impact and low carbon emissions compared with the current peers, there would be less loss of these customers. Instead, the revenue may increase because the low-carbon operation is favored by consumers. For TWM's online services, as they are relatively low-carbon in nature, there should be no change in purchasing behavior, with little impact on revenue.

- Operating costs
- Operating revenue
- Asset appreciation

NDC Scenario (Correspond to RCP4.5)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM	Financial Impact Projects

Entity Risks

Market

Changing customer behavior

INDC scenario description

According to the "2017 Energy Technology Outlook" issued by the International Energy Agency (IEA) in the latest issue, under the RTS scenario (including the energy saving and carbon reduction measures planned by various countries today, and the NDC promised in the Paris Agreement), the global carbon emissions will peak around 2050, and will be about 16% higher than that in 2014 by 2060. The average global temperature will rise by 2.7℃ by 2100, and it will continue to rise and not be able to stabilize.

According to Nielsen's survey, in 2015 (after the Paris Agreement), **66%** of consumers are willing to pay more for sustainable products (lower impact on the environment, including low-carbon footprint), which is 11 percentage points higher than 55% in 2014. Although this market survey focuses on general consumer goods, it can clearly indicate that consumers will change their purchasing behavior. It is reasonable to assume that under the future **INDC** Scenario, consumers would have deeper feeling on the intensified loss caused by climate change and the percentage of consumers who are willing to pay more for lower impact products in the future would be higher than 66% in the 2015 survey.

According to Nielsen's survey, in 2018, 75% of American young people (21-24 years old) firmly believe that they will change their consumption behavior to reduce the impact on the environment,
and it is reasonably assumed that under the future **INDC** Scenario, consumers would have deeper feeling on the intensified loss caused by climate change and the percentage of young consumers who are willing to change their purchasing behavior would be higher than 75%

Telecommunications Operation **Product/services R&D**

Under NDC Scenario, customers would greatly increase their demand for low-carbon products and services, and TWM needs to invest a great deal of resources in the development of new low-carbon products and services, so as to respond to the trend of customers' consumption of more sustainable products and services. It is expected that TWM would invest more in R&D, or a large amount to purchase/replace low-carbon equipment, so as to reduce the carbon emissions of its own telecommunications services.

Telecommunications operations

Under NDC scenario, consumers feel the intensified impact of climate change, prefer to use low-carbon products or services, and change their purchasing behavior. Some customers may be lost because the products and services provided by Taiwan Mobile are not low in carbon. For the telecom services, as Taiwan Mobile has lower environmental impact and low carbon emissions compared with the current peers, there would be less loss of these customers. Instead, the revenue may increase because the low-carbon operation is favored by consumers. For TWM's online services, as they are relatively low-carbon in nature, there should be no change in purchasing behavior, with little impact on revenue.

- Operating costs
- Operating revenue
- Asset appreciation

2DS scenario (Correspond to RCP2.6)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM

Financial Impact Projects

Transition Risks

Business reputation

Shifts in consumer preferences

Measures taken by

According to the "2017 Energy Technology Outlook" published by the International Energy Agency (IEA) in the latest issue, in the RTS scenario, the global average temperature will rise by 2.7℃ by 2100. However, under the 2DS scenario, CO_2 emissions will peak before 2020,

and then fall to about a quarter of that in 2014 in 2060. In addition, according to Climate Change Performance Index (CCPI) Result 2019 released by Germanwatch in 2018, under the 2DS path, the proportion of Greenhouse Gas Emissions in Taiwan should be below $5tCO_2eq$/capita in 2030.

According to The Paris Agreement, a report jointly published by We Mean Business and Business for Social Responsibility (BSR): It was pointed out in What it Means for Business that, after the Paris Agreement, enterprises should take bold measures to address climate change, and one of the rewards of taking measures is reflected in the business reputation. On the contrary, if no action is taken, the cost would gradually increase.

According to the 2017 research report of Shelton Group, which has been observing consumer behavior for a long time, 65% of consumers regard corporate reputation as a consideration when deciding product purchase.

Telecommunications operations

Under 2DS scenario, customers have a high degree of environmental awareness, and TWM must take more active climate-related response actions to maintain its outstanding sustainability performance. On the contrary, if no aggressive actions are taken on climate-related issues, customers' preference would change, and this would have a negative impact on the revenue, which would be more significant than under INDC scenario.

- Operating costs
- Operating revenue
- Asset appreciation

NDC Scenario (Correspond to RCP4.5)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM	Financial Impact Projects

Transition Risks

Business reputation

Shifts in consumer preferences

Enterprise GHG reduction performance

According to Greenhouse Gas Reduction and Management Act, INDC's goal is to "reduce the greenhouse gas emissions in 2050 to less than 50% of the 2005 level", while the phase I goal is to "reduce the greenhouse gas emissions in 2020 by 2% compared with the 2005 level". Under this scenario, six sectors, including telecom industry, will be promoted to implement the greenhouse gas emission control action plan, and enterprises will be led by their competent authorities to achieve the reduction target. According to previous research (Juan PineiroChousa et al., 2017), it is pointed out that the transparent disclosure of environmental management and its performance results will effectively slow down the business reputation risk, showing that there is a high correlation between environmental performance and business reputation.

According to the 2017 research report of Shelton Group, which has been observing consumer behavior for a long time, 65% of consumers regard corporate reputation as a consideration when deciding product purchase.

Telecommunications operations

The environmental performance of enterprises, including climate-related performance, has a positive correlation with enterprise evaluation, which could affect customers' consumption decisions. Taiwan Mobile's current sustainability performance has maintained excellent results according to relevant sustainability appraisal or awards at home and abroad, and it is supervised by external sustainability-related NGOs. If TWM has bad climate-related performance results, it will lead to negative brand reputation, which may change customers' consumption preferences, and negatively impact the revenue

- Operating costs
- Operating revenue
- Asset appreciation

2DS scenario (Correspond to RCP2.6)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM	Financial Impact Projects

Entity Risks

Long term

Rising mean Temperature

IPCC AR5 - RCP 2.6

North Taiwan

From 2021 to 2040, the average (scenario) will increase by 0.64℃, and the highest scenario will increase by 1.64℃. From 2081 to 2100, the average (scenario) will increase by 0.77℃, and the highest scenario will increase by 2.29℃

Central Taiwan

From 2021 to 2040, the average (scenario) will increase by 0.64℃, and the highest scenario will increase by 1.61℃. From 2081 to 2100, the average (scenario) will increase by 0.78℃, and the highest scenario will increase by 2.29℃

South Taiwan

From 2021 to 2040, the average (scenario) will increase by 0.62℃, and the highest scenario will increase by 1.56℃. From 2081 to 2100, the average (scenario) will increase by 0.76℃, and the highest scenario will increase by 2.24℃

East Taiwan

From 2021 to 2040, the average (scenario) will increase by 0.62℃, and the highest scenario will increase by 1.59℃. From 2081 to 2100, the average (scenario) will increase by 0.76℃, and the highest scenario will increase by 2.28℃

Telecommunications operations **General Operations**

According to the information of the Bureau of Energy, every one degree drop in the air-conditioning temperature would need to increase the electricity consumption by 6%. As TWM's computer rooms/base stations and offices are all over Taiwan, assuming the same electricity consumption, the electricity cost of air-conditioning rooms will gradually increase in 2021-2040 due to the temperature rise in the North, Central, South and East Taiwan, up by about 9.4% at the highest. In 2081-2100, the electricity cost will increase by about 13.5% at the highest, and the operating cost will be greatly increased.

Telecommunications operations **General Operations**

The average temperature rise will lead to an increase in the load of power units (especially in summer days), which may lead to power restriction or even power trip of some units, causing power outage. This would impact the quality and reliability of TWM telecom services in the whole Taiwan (such as interruption of store operations, service in computer rooms and base stations, etc.). As a result, TWM needs to spend more resources on the maintenance of power supply stability (purchasing generators), and even the customer number and revenue would decrease due to the decrease in service satisfaction.

Product/services R&D **Store sales**

The average temperature rise will affect consumers' overall consumption and purchase patterns, such as a sharp drop in the number of consumers in TWM stores during the hot days, and a shift in service mode to on-site service during summer. This will impact TWM's current operation mode, which mainly focuses on store service, and require TWM to invest a certain amount to change its business model. In the meantime, the change of consumption mode may also reduce TWM's revenue

- Operating costs
- Operating revenue
- Asset appreciation

NDC Scenario (Correspond to RCP4.5)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM	Financial Impact Projects

Entity Risks

Long term

Rising mean Temperature

IPCC AR5 - RCP 4.5

North Taiwan

From 2021 to 2040, the average (scenario) will increase by 0.68℃, and the highest scenario will increase by 1.66℃. From 2081 to 2100, the average (scenario) will increase by 1.57℃, and the highest scenario will increase by 3.23℃

Central Taiwan

From 2021 to 2040, the average (scenario) will increase by 0.68℃, and the highest scenario will increase by 1.63℃. From 2081 to 2100, the average (scenario) will increase by 1.56℃, and the highest scenario will increase by 3.2℃

South Taiwan

From 2021 to 2040, the average (scenario) will increase by 0.66℃, and the highest scenario will increase by 1.59℃. From 2081 to 2100, the average (scenario) will increase by 1.52℃, and the highest scenario will increase by 3.15℃

East Taiwan

From 2021 to 2040, the average (scenario) will increase by 0.65℃, and the highest scenario will increase by 1.61℃. From 2081 to 2100, the average (scenario) will increase by 1.52℃, and the highest scenario will increase by 3.19℃

Telecommunications operations — **General Operations**

According to the information of the Bureau of Energy, every one degree drop in the air-conditioning temperature would need to increase the electricity consumption by 6%. As TWM's computer rooms/base stations and offices are all over Taiwan, assuming the same electricity consumption, the electricity cost of air-conditioning rooms will gradually increase in 2021-2040 due to the temperature rise in the North, Central, South and East Taiwan, up by about 9.6% at the highest. In 2081-2100, the electricity cost will increase by about 19% at the highest, and the operating cost will be greatly.

Telecommunications operations — **General Operations**

The average temperature rise will lead to an increase in the load of power units (especially in summer days), which may lead to power restriction or even power trip of some units, causing power outage. This would impact the quality and reliability of TWM telecom services in the whole Taiwan (such as interruption of store operations, service in computer rooms and base stations, etc.). As a result, TWM needs to spend more resources on the maintenance of power supply stability (purchasing generators), and even the customer number and revenue would decrease due to the decrease in service satisfaction.

Product/services R&D — **Store sales**

The average temperature rise will affect consumers' overall consumption and purchase patterns, such as a sharp drop in the number of consumers in TWM stores during the hot days, and a shift in service mode to on-site service during summer. This will impact TWM's current operation mode, which mainly focuses on store service, and require TWM to invest a certain amount to change its business model. In the meantime, the change of consumption mode may also reduce TWM’s revenue

- Operating costs
- Operating revenue
- Asset appreciation

2DS scenario (Correspond to RCP2.6)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM	Financial Impact Projects

Entity

Long term

Changes in precipitation patterns and extreme variability in weather patterns

IPCC AR5 - RCP 2.6

Changes in precipitation patterns lead to drought

North Taiwan

At the end of this century, the average annual maximum continuous non-rainfall days will increase by 26.5%. Based on the previous 46 days of maximum continuous non-rainfall period in Taipei (2000), it is estimated that there may be about 58 continuous non-rainfall days in the future.

Central Taiwan

At the end of this century, the average annual maximum continuous non-rainfall days will increase by 28.9%. Based on the previous 150 days of maximum continuous non-rainfall period in Taichung (2003), it is estimated that there may be about 193 continuous non-rainfall days in the future.

South Taiwan

At the end of this century, the average annual maximum continuous non-rainfall days will increase by 26.5%. Based on the previous 132 days of maximum continuous non-rainfall period in Kaohsiung (2000), it is estimated that there may be about 166 continuous non-rainfall days in the future.

East Taiwan

At the end of this century, the average annual maximum continuous non-rainfall days will increase by 23.7%. Based on the previous 57 days of maximum continuous non-rainfall period in Taipei (2000), it is estimated that there may be about 70 continuous non-rainfall days in the future.

Telecommunications operations

Long-term drought caused by the change of rainfall pattern will probably cause the cooling water supply of TWM data centers all over Taiwan to be interrupted, resulting in business interruption and affecting customer service. Based on the data of each part of Taiwan and the analysis of water restriction situation in the past, TWM faces a higher risk of drought in central and south Taiwan, where water restriction measures have been implemented in stages in the past. For example, the users whose water consumption exceeds 1000 tons in the second stage would have its water supply reduced by 5-20%, and the measure of “supply for five days and stop for two days" is implemented in the third stage, which would all affect the water stability of TWMs computer rooms.

IPCC AR5 - RCP 2.6

Weather Change - Increase in the Number of Extremely Hot Days

At the end of this century, the number of days with the highest temperature exceeding 35℃ for three consecutive days in Taiwan will increase by 579%. Based on the average 10 hot days in 1986-2005, it is estimated that the number of days with the highest temperature exceeding 35℃ for three consecutive days in the next year will increase to 58 days.

Product/services R&D **Store sales**

Under the NDC scenario, nearly two months in a year will have temperature more than 35℃, which will affect consumers' overall consumption and purchase patterns, sharply reduce the number of customers in the stores, and shift the service mode to on-site service. This will have an impact on TWM/s operation mode which focuses on store services, so that TWM may need to have some investment to change its business model, and the change of consumption pattern may also reduce its revenue.

Financial Impact Projects

- Operating costs
- Operating revenue
- Asset appreciation

NDC Scenario (Correspond to RCP4.5)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM	Financial Impact Projects

Entity Risks

Long term

Changes in precipitation patterns and extreme variability in weather patterns

IPCC AR5 - RCP 4.5

Changes in precipitation patterns lead to drought

North Taiwan

At the end of this century, the average annual maximum continuous non-rainfall days will increase by 51.7%. Based on the previous 46 days of maximum continuous non-rainfall period in Taipei (2000), it is estimated that there may be about 70 continuous non-rainfall days in the future.

Central Taiwan

At the end of this century, the average annual maximum continuous non-rainfall days will increase by 46.1%. Based on the previous 150 days of maximum continuous non-rainfall period in Taichuang (2003), it is estimated that there may be about 219 continuous non-rainfall days in the future.

South Taiwan

At the end of this century, the average annual maximum continuous non-rainfall days will increase by 37.1%. Based on the previous 132 days of maximum continuous non-rainfall period in Kaohsiung (2002), it is estimated that there may be about 181 continuous non-rainfall days in the future.

East Taiwan

At the end of this century, the average annual maximum continuous non-rainfall days will increase by 57.4%. Based on the previous 57 days of maximum continuous non-rainfall period in Kaohsiung (2000), it is estimated that there may be about 90 continuous non-rainfall days in the future.

Telecommunications operations

Long-term drought caused by the change of rainfall pattern will probably cause the cooling water supply of TWM data centers all over Taiwan to be interrupted, resulting in business interruption and affecting customer service. Based on the data of each part of Taiwan and the analysis of water restriction situation in the past, TWM faces a higher risk of drought in central and south Taiwan, where water restriction measures have been implemented in stages in the past. For example, the users whose water consumption exceeds 1000 tons in the second stage would have its water supply reduced by 5-20%, and the measure of “supply for five days and stop for two days" is implemented in the third stage, which would all affect the water stability of TWMs computer rooms.

Telecommunications operations

Under the NDC scenario, the number of continuous non-rainfall days is higher. If TWM wants to avoid the impact of business interruption caused by long-term drought, it needs to draw up relevant budget, reduce water consumption, increase recycled water or develop other available water sources, so as to solve the problem of insufficient or even restricted water sources.

IPCC AR5 - RCP 4.5

Weather Change - Increase in the Number of Extremely Hot Days

At the end of this century, the number of days with the highest temperature exceeding 35℃ for three consecutive days in Taiwan will increase by 847%. Based on the average number of 10 hot days in 1986-2005, it is estimated that the number of days with the highest temperature exceeding 35℃ for three consecutive days in the next year will increase to 85 days.

Product/services R&D Store sales

Under the NDC scenario, nearly three months in a year will be extremely hot days, which will greatly affect consumers' overall consumption and purchase patterns, sharply reduce the number of customers in the stores, and shift the service mode to on-site service. TWM may need to have some investment to change its business model, and the change of consumption pattern may also reduce its revenue.

- Operating costs
- Operating revenue
- Asset appreciation

2DS scenario (Correspond to RCP2.6)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM

Financial Impact Projects

Entity

Extreme

Increase in frequency and severity of typhoons/hurricanes

IPCC AR5 & IPCC 1.5DC

According to the data from the latest IPCC 1.5DC report in 2018, under 2DS Scenario, there will be additional 1.2 scale 4 typhoons (wind speed above 58m/s, scale 17 gusts) and 1.2 scale 5 typhoons (wind speed above 70m/s, scale 17 gusts) in the world every year in the future.

Store sales | **Telecommunications operations** | **General Operations**

Under 2DS scenario, the increase of the frequency of the scale 4 or 5 strong typhoon will probably lead to the damage or operation interruption of TWM's own operating base, data center and base station equipment (generally the base stations can resist scale 15 winds), which will increase the maintenance and renewal costs, and even cause customer complaints due to the unstable network, and will affect the Company's brand image. As for the stores, there should not have high financial loss as all stores have been insured against natural disasters.

Store sales | **Telecommunications operations** | **General Operations**

Under the 2DS scenario, due to the increase of rainfall caused by typhoon, the flood potential forecast by the National Science and Technology Center for Disaster Reduction indicates that, different levels of flooding (0.5m to 3m) may occur in all parts of Taiwan, which will interrupt TWM operation (flooding in its stores and computer rooms), resulting in the increase of operating costs and the loss of some assets.

Telecommunications operations

Under the 2DS scenario, the frequency increase in scale 4 or 5 strong typhoons may affect the safety of outdoor workers (emergency workers in typhoon days), increase the injury rate of employees and increase the Company's operating costs.

Electricity suppliers

Under 2DS scenario, the related Taiwan power facilities, such as electric towers and poles (currently can resist about scale 14 winds), may be damaged due to the occurrence of scale 4 or 5 strong typhoons, resulting in power supply shortage and instability, power outage (which may reach more than 4 hours) or planned power cut (the power cut of large power users may vary between 5-15%), so that TWM needs its own generators or backup generators provided by the manufacturers for the computer rooms. What's more, it will lead to the interruption of operations (in data centers, computer rooms, stores and base stations), resulting in network instability and customer complaints which could affect the Company's brand image.

Logistics

Under 2DS scenario, the frequency increase in the scale 4 or 5 strong typhoons will probably lead to road interruption or port closure, which will affect the logistics traffic, reduce the service quality of most TWM services, and slightly affect the future revenue.

- Operating costs
- Operating revenue
- Asset appreciation

NDC Scenario (Correspond to RCP4.5)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM

Financial Impact Projects

Entity

Extreme

Increase in frequency and severity of typhoons/hurricanes

IPCC AR5 & IPCC 1.5DC

According to the data in the IPCC AR5 and 1.5DC reports, if the temperature increases to the INDC scenario (corresponding to RCP4.5), there is no significant evidence that the number of strong typhoons will increase more compared with the 2DS scenario.

According to the IPCC AR5 data, although the frequency of typhoons (tropical cyclones) in the northwest Pacific will decrease in the future, the frequency of strong typhoons (scale 4 or 5) in the region will increase, and the scale of typhoons will increase under RCP8.5 (temperature rise 4℃).

Conservatively, it is assumed that the number of strong typhoons in the future will be at least equal to the 2DS scenario, that is there will be additional 1.2 scale 4 typhoons (wind speed above 58m/s, scale 17 gusts) and 1.2 scale 5 typhoons (wind speed above 70m/s, scale 17 gusts) in the world every year in the future.

Store sales | **Telecommunications operations** | **General Operations**

Under NDC Scenario, the frequency increase of the scale 4 or 5 strong typhoons will probably lead to the damage of TWM's own operating bases, data centers and base station equipment (generally the base stations can resist scale 15 winds), which will increase the maintenance and renewal costs, and even cause customer complaints due to the unstable network, and will affect the Company's brand image. As for the stores, there should not have high financial loss as all stores have been insured against natural disasters.

Store sales | **Telecommunications operations** | **General Operations**

Under the NDC scenario, due to the increase of rainfall caused by typhoon, the flood potential forecast by the National Science and Technology Center for Disaster Reduction indicates that, different levels of flooding(0.5m to 3m) may occur in all parts of Taiwan, which will interrupt TWM operation (flooding in its stores and computer rooms), resulting in the increase of operating costs and the loss of some assets.

Telecommunications operations

Under the NDC scenario, the frequency increase in scale 4 or 5 strong typhoons may affect the safety of outdoor workers (emergency workers in typhoon days), increase the injury rate of employees and increase the Company's operating costs.

Electricity suppliers

Under the NDC scenario, the related Taiwan power facilities, such as electric towers and poles (currently can resist about scale 14 winds), may be damaged due to the occurrence of scale 4 or 5 strong typhoons, resulting in power supply shortage and instability, power outage (which may reach more than 4 hours) or planned power cut (the power cut of large power users may vary between 5-15%), so that TWM needs its own generators or backup generators provided by the manufacturers for the computer rooms. What's more, it will lead to the interruption of operations (in data centers, computer rooms, stores and base stations), resulting in network instability and customer complaints which could affect the Company's brand image

Logistics

Under NDC Scenario, the frequency increase in the scale 4 or 5 strong typhoons will probably lead to road interruption or port closure, which will affect the logistics traffic, reduce the service quality of most TWM services, and slightly affect the future revenue.

- Operating costs
- Operating revenue
- Asset appreciation

2DS scenario (Correspond to RCP2.6)

Climate Risk Path

Name	Corresponding Climate Change Scenarios	Impact and effect on TWM	Financial Impact Projects

Entity

Extreme

Increase in frequency and severity of rainstorms Heavy Downpours

IPCC AR5 - RCP 2.6

North Taiwan

From 2021 to 2040, the maximum summer rainfall increase in Taipei will be in August, and the maximum rainfall will increase by 51.64%. It is estimated that the single-day rainfall could reach 465.08mm/day

Central Taiwan

From 2021 to 2040, the maximum summer rainfall increase in Taichung will be in May, and the maximum rainfall will increase by 44.72%. It is estimated that the single-day rainfall could reach 319mm/day

South Taiwan

From 2021 to 2040, the maximum summer rainfall increase in Kaohsiung will be in August, and the maximum rainfall will increase by 45.49%. It is estimated that the single-day rainfall could reach 457.57mm/day

East Taiwan

From 2021 to 2040, the maximum summer rainfall increase in Hualien will be in October, and the maximum rainfall will increase by 76.89%. It is estimated that the single-day rainfall could reach 474.95mm/day

Store sales | **Telecommunications operations** | **General Operations**

Under the 2DS scenario, the frequency and severity of extreme rainfall in each part will increase.

According to the flood potential forecast of National Science and Technology Center for Disaster Reduction, under the current estimated single-day rainfall in all parts of Taiwan, the single-day rainfall in the north, south and east parts will all exceed 450mm, and there is a high probability of flooding with different depths (0.5m to 3m), which may interrupt the TWM operation (flooding in stores and computer rooms), resulting in the operating cost increases and some asset losses

Electricity suppliers

Under 2DS scenario, the single-day rainfall in north, south and east parts of Taiwan all exceed 450mm, resulting in possible power supply shortage and instability due to the flood, leading to power outage (which may reach more than 4 hours) or planned power cut (the power cut of large power users may vary between 5-15%), so that TWM needs its own generators or backup generators provided by the manufacturers for the computer rooms. What's more, it will lead to the interruption of operations (in data centers, computer rooms, stores and base stations), resulting in network instability and customer complaints which could affect the Company's brand image

Logistics

Under 2DS scenario, the single-day rainfall in north, south and east parts of Taiwan all exceed 450mm, which could lead to road interruption or port closure, affect the logistics traffic, reduce the service quality of most TWM services, and slightly affect the revenue.

- Operating costs
- Operating revenue
- Asset appreciation

NDC Scenario (Correspond to RCP4.5)

Climate Risk Path

Name → **Corresponding Climate Change Scenarios** → **Impact and effect on TWM**

Financial Impact Projects

Entity

Extreme

Increase in frequency and severity of rainstorms Heavy Downpours

IPCC AR5 - RCP 4.5

North Taiwan

From 2021 to 2040, the maximum summer rainfall increase in Taipei will be in August, and the maximum rainfall will increase by 75.19%. It is estimated that the single-day rainfall could reach 537.31mm/day

Central Taiwan

From 2021 to 2040, the maximum summer rainfall increase in Taichung will be in May, and the maximum rainfall will increase by 49.81%. It is estimated that the single-day rainfall could reach 330.18mm/day

South Taiwan

From 2021 to 2040, the maximum summer rainfall increase in Kaohsiung will be in August, and the maximum rainfall will increase by 66.87%. It is estimated that the single-day rainfall could reach 524.81mm/day

East Taiwan

From 2021 to 2040, the maximum summer rainfall increase in Hualien will be in October, and the maximum rainfall will increase by 73%. It is estimated that the single-day rainfall could reach 464.51mm/day

Store sales | **Telecommunications operations** | **General Operations**

Under NDC scenario, the frequency and severity of extreme rainfall in each part of Taiwan increases, and the north and south Taiwan could have the single-day rainfall of more than 500mm, which is more serious than that under 2DS scenario. According to the flooding potential prediction of National Science and Technology Center for Disaster Reduction, more serious flooding (0.5m to 3m) will occur, which may interrupt TWM's operation (flood in the stores and computer rooms), resulting in the increase of operating costs and some asset losses

Electricity suppliers

Under NDC scenario, the frequency and severity of extreme rainfall increase in each part of Taiwan, and the single-day rainfall of more than 500mm is more likely to occur in the north and south parts, which is more serious than that in the 2DS scenario. This would result in possible power supply shortage and instability due to the flood, lead to power outage (which may reach more than 4 hours) or planned power cut (the power cut of large power users may vary between 5-15%), so that TWM needs its own generators or backup generators provided by the manufacturers for the computer rooms. What's more, it will lead to the interruption of operations (in data centers, computer rooms, stores and base stations), resulting in network instability and customer complaints which could affect the Company's brand image

Logistics

Under NDC Scenario, the north and south Taiwan would be more likely to have single-day rainfall of over 500mm, the extreme rainfall would be more likely to lead to road interruption or port closure than under 2DS scenario, which will affect the logistics traffic, reduce the quality of most TWM services, and slightly affect the revenue.

- Operating costs
- Operating revenue
- Asset appreciation