TCC
THE FUTURE IS WORTH IT

THE TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES

2023

/ 2023 TCC GROUP HOLDINGS /

THE TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES

Message from the Chairman 01

Climate Milestones at TCC Group Holdings 02

01 - Foresight of Climate-related Risks

1.1 Identification of Climate-related Risks and Opportunities 05

1.2 Climate Scenario Analysis 11

02 - Laying the Foundation for Achieving Net-zero Emissions

2.1 Total Climate Commitment at TCC Group Holdings 16

2.2 Net-zero Pathway for the Cement and Concrete Business Units and External Influence of Carbon Reduction from TCC Group Holdings 16

03 - Creating New Age of Climate

3.1 Low-carbon Circular Production 25

3.2 Industry-leading Low-carbon Construction Materials 27

3.3 Low-carbon and Carbon Negative Technical Innovations 30

3.4 Smart New Energy Business 32

3.5 Low-carbon Supply Chain 40

3.6 Climate and Natural Disaster Adaptation 41

04 - Establishing A Solid Management Framework 43

05 - Planning Green and Sustainable Finance 50

06 - Climate Metrics and Targets 61

Appendix 70

(1) Reference sources

(2) TCC Sustainability and Climate Related Policies, Reports and Publications

(3) TCFD Disclosure Comparison Table

(4) Cross-Industry Climate-Related Indicators

(5) Editorial Team

(6) Conformity Statement

We are living in a time of unprecedented challenges, as climate change and its devastating impacts become ever more apparent. But we are also witnessing a global awakening, a recognition that we must transition towards a sustainable and decarbonized future.

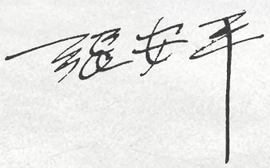
TCC Group Holdings stands at the forefront of this global revolution. Our company is dedicated to developing and deploying cutting-edge technologies that enable the integration of low carbon construction materials, renewable energy sources, energy storage, and e-mobility solutions. We are committed to providing our customers with reliable, efficient, and environmentally friendly construction and energy solutions that meet world's ever-evolving needs.

The world is experiencing extreme weather events on all five continents with increasing frequency and intensity, underscoring the urgency of our mission. TCC is not merely responding to this crisis; we are proactively shaping a new low carbon construction material and energy paradigm. Our innovative solutions are empowering communities to generate their own low carbon building and clean energy, to reduce their dependence on fossil fuels thus mitigating their carbon footprint.

We are partnering with businesses to optimize their energy consumption, enhance their operational efficiency, and achieve their sustainability goals. And we are working with governments and institutions to build resilient infrastructure that can withstand the challenges of a changing climate.

This what TCC stands for and working hard to achieve, A New Horizons ahead for the 21st century.

Chairman, TCC



Climate Milestones at TCC

● International Ratings ▲Initiatives & Recognitions ★Low-carbon Products/Energy Services

2024

Mar.	★	Completed the closing procedures for expanding investment in low-carbon cement in Europe, officially becoming one of the main suppliers of low-carbon cement in Europe
	★	Called for climate action talents, launched the AI Avatars, and expanded the generative AI team to help integrate technologies across 11 industries in 13 countries
Jan.	★	Cooperating with tkPOL in Germany developed a new generation of pure oxygen carbon capture technology, aiming to capture 100,000 metric tons of CO_2 per year by 2030
	★	Fire-proof and fire-extinguishing EnergyArk Energy Storage Cabinet of TCC passed the test for the strictest international safety standard of UL 9540 and made its debut at CES in USA
	▲	Became one of the world's first TNFD Early Adopters, and the only large construction material supplier invited from Taiwan

2023

Nov.	★	TCC announced its partnership with the Turkish OYAK Group to expand investment in the low-carbon cement markets in Europe, Asia, and Africa, with a plan to increase its stake in OYAK from 40% to 60% and that in Portuguese Cimpor from 40% to 100%
	★	TCC launched Taiwan's largest 100-MW E-dReg energy storage system in Hualien, as the No.1 by the market share in the energy trading platform, generating an estimated revenue of NT$1 billion per year, with a total trading capacity across ETP of Taipower, project sites, and aggregated energy trading management services of 169.2 MW
	★	Molicel's battery cell plant in Vancouver, expected to receive NT$4.8 billion in funding from the Canadian government to be the world's first 100% green-powered, low-carbon, high-power battery cell plant, with a projected production capacity of 2.8 GWh and an estimated annual output of 135 million cylindrical ternary lithium batteries
Oct.	★	TCC launched the Total Climate Series of low-carbon construction materials
	★	TCC showcased the patented fire-proof and fire-extinguishing EnergyArk UHPC Energy Storage Cabinet at Energy Taiwan and Net-Zero Taiwan
Sep.	★	Published the "Green Financing Framework", with the Second-party Opinion (SPO) from Sustainalytics, an international ESG ratings agency, verifying the alignment with green standards; completed a US$420 million international fundraising for green ECB on October 18th
	★	The European ATLANTE S.R.L (ATLANTE), under TCC subsidiary NHOA, qualified for the EU's transport infrastructure funding program and received the grant of an estimated amount of €49.9 million from the EU's CEF Fund in 2023
	★	Energy Helper TCC Corporation, a subsidiary of TCC, assisted Decathlon's five suppliers in the APPA, helping the SMEs on their way to RE100
Aug.	★	The Yingde Plant of TCC inaugurated the largest 43.2-MW/107.3MWh energy storage system in the cement industry of Mainland China, realizing energy transition through solar energy and energy storage
May	★	Taiwan Transport & Storage Corp. introduced the first electric heavy-duty truck into Taiwan to support IKEA to kick off its zero-carbon green logistics and establish support services of charging station
	▲	Golden Award, Profit-seeking Enterprise Category, Taiwan Biodiversity Awards, 2023TCSA
Feb.	●	Top 10% in the 2023 S&P Sustainability Yearbook

2022

Dec.	▲	A founding partner of BCSD Nature Positive Initiative
	▲	Member of TNFD Pilot Program
	▲	The first TCFD Report on Climate-Related Financial Disclosures issued, with the highest rating of BSI Level 5+
	●	CDP Carbon Disclosure Questionnaire Rating "A-" & Water Disclosure Questionnaire Management Rating "B"
	●	MSCI ESG Ratings "A," upgraded for 4 consecutive years from 2019 to 2022
Nov.	●	Top 5 in "Construction Materials," 2023 S&P Global CSA
	★	NHOA.TCC launched the "Energy Helper TCC Corporation Green Energy Trading Platform" to enter the green energy trading market
Oct.	▲	Signatory to the Statement of Make it Mandatory, Business for Nature, for COP15
Sep.	★	Atlante, under the TCC subsidiary NHOA, sponsored by the EU Fund for the plan to build 215 100% green-powered charging stations in Europe
Aug.	▲	EP 100 Member, with the commitment to a 50% energy productivity improvement by 2040 compared with the base year of 2016
Jul.	●	ESG Top-Rated Company, Construction Materials, Sustainalytics, an ESG rating institution
	★	NHOA.TCC launched the world's first charging station with UHPC energy storage cabinet used: TCC Tainan Yawan Station
	★	E-One Moli Energy Corp. under TCC involved in the eVTOL aircraft field, signaling the official debut of lithium ternary batteries in the market of electric air transportation
Feb.	●	Supplier Engagement Leader "A" in the Supplier Engagement Rating (SER), CDP Carbon Disclosure Questionnaire

CHAPTER 1

Foresight of Climate-related Risks

Climate change has caused severe damage to the environments and ecosystems on Earth, leading to potentially catastrophic impacts on industries and economies, much like the biblical story of Noah's Ark, in which people were unaware of the imminent danger. Recognizing the potential impacts of climate change on its operations and business, TCC proactively identifies the risks posed by climate change and take proactive measures to address these risks, rather than taking action after the strike of disasters.

1.1_Identification of Climate-related Risks and Opportunities

Management Processes for Climate-related Risks and Opportunities

"TCC Risk Management Policy and Principles" and "TCC Risk Management Committee Charter" have been adopted at TCC. Meetings are called on a regular basis to track outcomes of climate actions, contain the risks potentially arising from various businesses to a tolerable extent, and establish sound risk management operating principles.

STEP 1

RISK AND OPPORTUNITY IDENTIFICATION

Update climate risk and opportunity issues in accordance with the results of the previous climate risk and opportunity identification, international scientific and technological reports, industry trends in local laws and regulations where TCC operates, etc.

OUTCOME | 13 key climate risks and 8 climate opportunities listed per the TCFD taxonomy

STEP 2

RISK AND OPPORTUNITY ASSESSMENT

- Conduct cross-departmental workshops to probe into the actual impacts, timing, sources, and expected financial impact of various risks/opportunities at TCC.
- Analyze and assess questionnaire results, incorporating the perspectives of external experts and executives, to identify key risks/opportunities.

OUTCOME | 16 internal assessment questionnaires sent, with 11 key risks and 7 opportunities identified in the end

STEP 3

RESPONSE AND ADAPTATION

Link the climate policy, operation and production, products and services, and external communication to the existing climate mitigation and adaptation strategies to formulate and execute six climate action plans.

OUTCOME | Six Climate Actions

STEP 4

Management and Supervision

Call meetings on a regular basis to track the progresses of the Six Climate Actions in response to risks and opportunities, track the carbon reduced by each plant via the Carbon Reduction Management Platform, and present the risk control report to the Board of Directors by the Risk Management Committee.

OUTCOME | Performances against the management indicators and non-financial performance indicators of the Six Climate Actions

Climate Risk and Opportunity Identification and Assessment Methodology

In response to the rapid policy and market changes and the high uncertainty of climate, TCC identifies and assesses climate-related risks to capture and evaluate the potential impacts of climate scenarios on TCC, followed by the Six Climate Actions formulated for active responses. As the highest risk decision-making body, TCC Board of Directors undertakes risk identification and analysis on seven aspects, i.e., operation, finance, states, legal compliance, ESG, human resources, and information security, in line with the respective business scope of each department, among which the risks associated with climate change have been integrated into the overall risk management process at TCC.

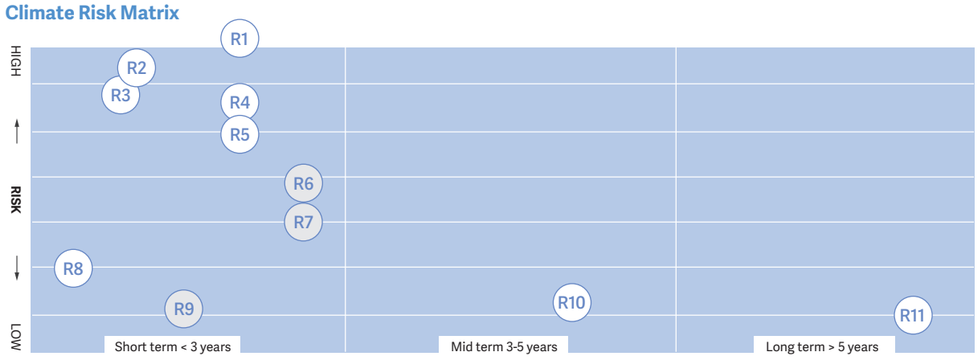
Pursuant to the Task Force on Climate-related Financial Disclosures(TCFD)framework, TCC assesses climate-related risks and opportunities every other year. The aforementioned assessment scope covers the cement businesses in Taiwan and Mainland China, with the facts that the carbon emissions of TCC Group Holdings are concentrated in the cement business and that Taiwan and Mainland China are the main sources of revenue for the cement business of TCC Group Holdings mainly taken into account. Through discussions with senior managers of various departments, TCC identifies the climate-related transition risks and physical risks as well as climate-related opportunities based on the external changes and trends in policies/regulations, markets, and climate disasters, along with the internal directions for operational strategies.

Climate Risk Matrix & Climate Opportunity Matrix

Short-, Medium-, and Long-Term Climate-related Risks and Opportunities

In the face of the potential operational impacts stemming from extreme weather events caused by climate change and from net-zero transition, TCC has integrated climate risks into its overall risk management policy. Also, according to the TCFD framework, 11 key climate-related risks and 7 derivative opportunities have been identified. In addition to inventory of the existing response strategies and adaptation measures, TCC has also formulated Six Climate Actions based on the scopes and time horizons of impacts from the risks and opportunities—Low-Carbon Circular Production, Industry-Leading Low-Carbon Construction Materials, Low-Carbon and Carbon Negative Technology Innovation, Smart New Energy Business, Low-Carbon Supply Chain, and Climate Disaster Adaptation—aiming to enhance the resiliency and adaptability of the Company in the net-zero transition, thereby initiating transformational deployment and strengthening the operational resilience of the Company.

Climate Risk Matrix



Transition Risk

- R 1 Carbon trading/carbon fee/carbon tax for Cap and Trade
- R 2 Costs in the low-carbon technologies, equipment and management
- R 3 Rising prices of raw materials and energy
- R 4 Impacts to corporate reputation
- R 5 Impacts on the strength of supports from financial institutions in investment, financing, and insurance
- R 8 Regulations and procurement of renewable energy
- R10 Transformation of the coal-fired Hoping Plant
- R11 Transition Risk – Breakthrough in the advanced technology of carbon capture and storage (CCS)

Physical Risk

- R 6 Drought (Production)
- R 7 Flood (Production)
- R 9 Changes in precipitation patterns and extreme changes in climate patterns (Transportation)

Climate Risks Faced at TCC

R1 Transition Risk – Carbon trading/carbon fee/carbon tax for Cap and Trade

Implementation of carbon trading, and levy of carbon taxes or carbon fees, to limit GHG emissions leads to increased costs.

Introduction of carbon trading, and levy of carbon taxes or carbon fees, due to emerging regulations will increase costs, which will inevitably be reflected in selling prices and in turn lead to a risk of declining profits should these costs fail to fully pass through.

If the CBAM is not enforced, or imported goods are not subject to carbon costs, the resulting unfair competition will pose risks to business operations.

Actions in Response |

Low-Carbon Circular Production; Smart New Energy Business

R2 Transition Risk – Costs in the low-carbon technologies, equipment and management

Since most of the existing equipment energy consumption conditions in the cement and concrete plants are better than the regulatory energy consumption requirements, actively replacing and upgrading production equipment will incur additional capital costs; on the other hand, most peers on the market only meet the minimum regulatory standards, leading to differences in production costs that is unfavorable for TCC in cost competition.

Actions in Response | Low-Carbon Circular Production; Industry-Leading Low-Carbon Construction Materials; Low-Carbon Supply Chain

R3 Transition Risk – Rising prices of raw materials and energy

The primary source of thermal energy for clinker production in cement plants is coal. With the overall trend towards net-zero emissions, the supply of coal is likely to decrease year by year, which is expected to drive the prices of coal and alternative fuels, resulting in pressure on operations.

Actions in Response | Low-Carbon Circular Production; Industry-Leading Low-Carbon Construction Materials; Low-Carbon Supply Chain

R4 Transition Risk – Impacts on corporate reputation

If the CO_2 emissions fail to meet standards, or the carbon reduction targets are not ambitious enough, the investors, governments, and environmental groups, would decrease the valuation on TCC thereby rendering negative impacts on the corporate reputation.

Actions in Response | Low-Carbon Circular Production; Industry-Leading Low-Carbon Construction Materials; Low-Carbon and Carbon Negative Technology Innovation; Smart New Energy Business

R5 Transition Risk – Impacts on the strength of supports from financial institutions in connection with investment, financing, and insurance

Belonging to an industry of high carbon emissions, TCC's failure to plan relevant low-carbon transition strategies, or failure in transition, will severely impact the willingness of financial institutions to conduct business with TCC, including reduced interest from potential investors, difficulties in financing and insurance, etc., resulting in a significant impact on the organization's operations.

Actions in Response | Low-Carbon Circular Production; Industry-Leading Low-Carbon Construction Materials; Low-Carbon and Carbon Negative Technology Innovation; Smart New Energy Business

R6 Physical Risk – Drought (Production)

- Since the operation of power generation by waste heat recovery system demands a large amount of cooling water, water shortage will render power generation by waste heat recovery unable to operate, resulting in a significant increase in electricity costs.
- As water is an essential raw material for concrete plants, drought and water shortage will seriously affect the normal production and sales of concrete, impacting the productions and operations of TCC.

Actions in Response | Climate Disaster Adaptation

R7 Physical Risk – Flood (Production)

The occurrence of floods may affect the production of concrete and the supply quality of raw materials, resulting in shortages of raw materials and impacts on production.

Actions in Response | Climate Disaster Adaptation

R8 Transition Risk – Regulations and procurement of renewable energy

The regulations in force require large electricity consumers with a contract capacity of 5,000 kW or more to install 10% renewable energy within five years and achieve an annual energy saving rate of 1%, or failure to do so may result in government penalties.

Actions in Response | Low-Carbon Circular Production; Smart New Energy Business

R9 Physical Risk – Changes in precipitation patterns and extreme changes in climate patterns (Transportation)

Extreme climate patterns or changes in precipitation patterns may impact product delivery, or cause delivery delays or inability in shipping, resulting in operational impacts.

Actions in Response | Climate Disaster Adaptation

R10 Transition Risk – Transformation of the coal-fired Hoping Plant

In line with the international trend of a global "transition away" from fossil fuels called by COP28, the Hoping Power Plant is facing a transitional crisis. Its current power purchase agreement with Taipower will expire in 2027. The failure in contract renewal and operation that after will render impact on the revenue and profit of TCC Group Holdings.

The transition of the Hoping Power Plant may directly impact certain supplies of raw materials (fly ash, bottom ash, and gypsum) for the cement plant, requiring additionally external procurement and raising the operating costs of the Hoping Cement Plant.

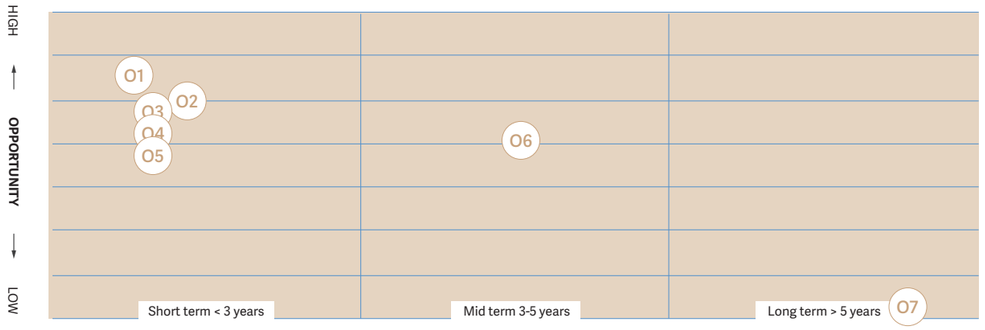
Actions in Response | Smart New Energy Business

R11 Transition Risk – Breakthrough in the advanced technology of carbon capture and storage (CCS)

In 2011, the calcium looping carbon capture project was initiated in collaboration with the ITRI and the Bureau of Energy. Nonetheless, due to the current lack of a scaled capture process, the thermal efficiency is poor, and the carbon dioxide concentration under a negative pressure operation is relatively low, resulting in high costs in purification after capture.

Actions in Response | Carbon Negative Technology Innovation

Climate Opportunity Matrix



O1 Smart low-carbon production and waste co-processing
O2 Securing investors' willingness for long-term investment
O3 Involvement in the electricity trading market
O4 Involvement in the carbon trading market
O5 Installation of new energy projects
O6 Exploration of the market for low-carbon products
O7 Application of the oxygen enriched combustion and oxy-fuel combustion technologies to carbon capture and reuse

Climate Opportunities Grasped by TCC

O1 Smart low-carbon production and waste co-processing

▲Industry-leading low-carbon production models to increase competitiveness
▲Waste co-processing to reduce coal consumption

O2 Securing investors' willingness for long-term investment

▲Increased investor willingness with investment in low-carbon transition
▲Green products receiving government subsidies

O3 Involvement in the electricity trading market

▲Capturing business opportunities in the renewable energy market
▲Energy storage systems involved in the ancillary services of energy trading platforms

O4 Involvement in the carbon trading market

▲Outstanding carbon reduction performance to earn free carbon allowance

O5 Installation of new energy projects

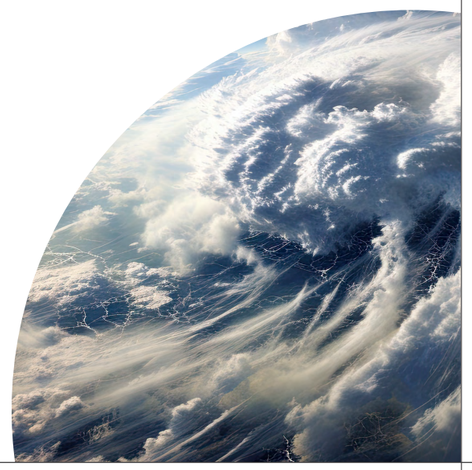
▲Self-generation for self-consumption and self-developed renewable energy
▲Combination with energy storage system for peak shaving and valley filling to meet power demands

O6 Exploration of the market for low-carbon products

▲Increased demand for low-carbon products from enhanced carbon reduction awareness

O7 Application of the oxygen enriched combustion and oxy-fuel combustion technologies to carbon capture and reuse

▲Use of oxygen enriched combustion for calcination in cement kilns to raise combustion efficiency and reduce carbon emissions
▲Development of pure oxygen combustion technology to enhance carbon capture efficiency



1.2_Climate Scenario Analysis

In line with the assessment of transition and physical risks associated with climate change, TCC analyzed the level and time horizons of the financial impacts arising from the climate risks. To further address the impacts of climate risks, TCC conducts future scenario analyses for specific transition and physical risks, probing into the potential financial impacts on TCC Group Holdings under different global warming scenarios and policy environments in the future. The results are incorporated into the future resilience strategies so as to achieve the net-zero targets.

In consideration of the potential impacts of different future climate scenarios, TCC has selected multiple scenarios for both physical and transition risks to develop corresponding climate response strategies accordingly. Among the transition risk scenarios, "Carbon Trading/Carbon Fee/Carbon Tax for Cap and Trade" that presents the highest impact on TCC is taken as the primary item in the assessment. With reference to the GHG management directions, the Stated Policies Scenario(STEPS), Announced Pledges Scenario (APS), and Net Zero Emissions by 2050 Scenario(NZE)of the International Energy Agency (IEA) are employed to assess the financial impacts of carbon pricing trends on TCC operations in Taiwan and Mainland China in the future.

On the other hand, regarding the physical risks, the geographical locations of TCC in Taiwan and Mainland China, and the potential impacts of future climate disasters(droughts and floods), are taken into account. Hence, TCC has selected the low GHG emissions scenario(SSP1-2.6)and the high GHG emissions scenario(SSP5-8.5) released by the Intergovernmental Panel on Climate Change(IPCC). The multi-scenario assessment of the physical and transition risks enables TCC to plan future strategies to mitigate financial and operational risks and grasp future climate trends.

	Scenario Description	Key Parameters	Impact Description	Estimated Temperature Increase	
Risk Category Transition Risks	STEPS-The climate change response measures in force and concrete policies enacted by governments around the world	Carbon price variation across regions [1]	Additional costs in 5-10 years due to carbon fees or carbon trading	2.5°C	Source of Scenario IEA[2]
	APS-The latest climate commitments of countries, including the NDCs and long-term net-zero goals.			1.7°C	
	NZE 2050-Realization of net-zero CO_2 emissions of the global energy sector by 2050			1.5°C	
Risk Category Physical Risks	SSP1-2.6-The low emissions scenario with a global effort to achieve sustainability goals, but in a slow progress	Droughts and precipitation changes caused by extreme weather events [3]	Operational disruption and asset impairment due to drought and flooding	1.8°C	Source of Scenario IPCC[4]
	SSP5-8.5-The extremely high emissions scenario with ultra-high emissions brought by the extensive use of fossil fuels in the absence of climate policies globally			4.4°C	

Note 1 References from the IEA World Energy Outlook (WEO) 2023; Carbon Pricing Options for Taiwan (2020)
Note 2 Reference from World Energy Outlook (WEO) 2023, International Energy Agency (IEA)
Note 3 Reference from the Central Weather Administration, Ministry of Transportation and Communications
Note 4 Reference from the Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC) in 2021

Transition Risk: Carbon Price Impacts – the Carbon Fee in Taiwan & the Carbon Trading in Mainland China

The cement sector is a sector of high carbon emissions. As such, it is necessary for TCC to pay a close attention to the regulations over GHG emissions in operations at where it operates. In 2023, the "Climate Change Response Act" was adopted in Taiwan. In April 2024, the "Regulations Governing the Collection of Carbon Fees (Draft)" was promulgated, which is scheduled to come into force in 2024-2025. The cement sector is considered as a sector at a high risk of carbon leakage. The risk coefficient of carbon leakage may apply if the voluntary emission reduction plan of the Company is approved, helping mitigate the financial impact from the carbon fee. In addition, the carbon emissions trading market was established in China in 2021. At present, it only mandates the power sector to participate in the trading. In the future, it may not rule out the inclusion of seven high-emitting industries such as steel and construction materials (cement). Mainland China will also relaunch its voluntary carbon trading market in 2024, suggesting that Mainland China is to strengthen its carbon trading mechanism. To capture the impacts of carbon pricing on the operations of TCC, different baseline (Business as Usual, BAU) scenarios and the corporate target scenarios are taken into consideration at TCC to estimate the future carbon emissions of the Company. Then, through the transition scenarios released by the IEA, including the Stated Policies Scenario (STEPS), Announced Pledges Scenario (APS), and Net Zero Emissions by 2050 Scenario (NZE), the carbon pricing scenarios in Taiwan and Mainland China are analyzed. Finally, the financial impacts of carbon fee and carbon trading faced in Taiwan and Mainland China are calculated.

Primary parameters in consideration		Response Strategies	
Yield of Cementitious Materials Yield of Clinker Energy Transition Plan in Taiwan Carbon Leakage Risk Coefficient in Taiwan Carbon Prices in Taiwan and Mainland China Preferential rates in Taiwan and Mainland China	IEA STEPS Carbon Price in Existing Policy Scenario IEA APS Carbon Price in Committed Targets Scenario IEA NZE 2050 Carbon Price in Net-Zero Emissions Scenario	Alternative Clinker Alternative Raw Materials Alternative Fuels Equipment &Process Enhancements Power Generation by Waste Heat Recovery Renewable Energy Carbon Capture Carbon Sink	Reduced financial impact from carbon pricing by approx. NT$3.4 billion Reduced financial impact from carbon pricing by approx. NT$5.1 billion Reduced financial impact from carbon pricing by approx. NT$11.6 billion

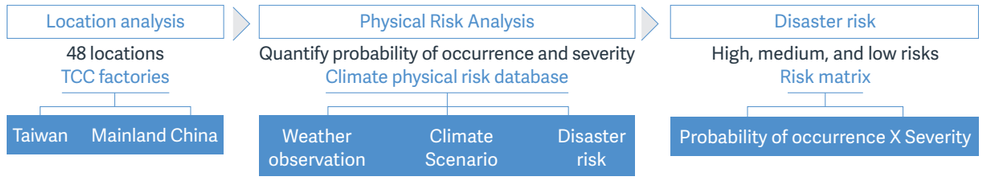
Note1 The financial impacts are comparison results against the failure in adoption of mitigation measures.

The analysis results reveal that regardless of the climate transition scenario, the BAU scenarios incur higher carbon costs than any of the corporate target scenarios. The NZE scenario requires even higher carbon costs compared to the SPS and the APS scenarios. Pursuant to the carbon reduction pathway of TCC, if the operation sites in Taiwan and Mainland China can achieve the internal targets of the Company, the expenditures on carbon fee and carbon credit purchases can be lowered, thereby saving an estimated NT$ 11.6 billion.

Either for the operation sites in Taiwan or Mainland China, without carbon reduction management efforts, there will be great financial impacts in the future. Hence, carbon reduction targets have been formulated actively at TCC in recent years. Through its Carbon Reduction Strategies, TCC shall continue to march towards the goal of net-zero emissions, endeavoring to effectively mitigate the risks arising from regulatory carbon pricing.

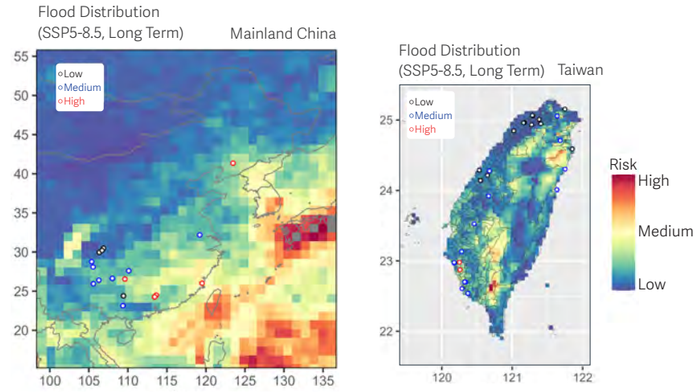
Physical Risks: Flood and Drought Risks

The physical risks brought by climate change have been emphasized at TCC. TCC has long conducted regular reviews of the impact of climate-related physical risks on its operations. First, there are 48 operation sites in Taiwan and Mainland China covered in the analysis of TCC. Then, with reference to climate-related physical risk databases, including the national meteorological observations, climate scenarios (IPCC SSP1-2.6 low emissions and SSP5-8.5 extremely high emissions scenarios), disaster risks, and so forth, the likelihood and level of impact from the physical risks are quantified. Finally, a matrix of physical risks is mapped out based on the likelihood and level of impact in the analysis to classify risks into high, medium, and low risks. In 2023, two significant risks, "flood" and "drought," were identified in the end. The impact of extreme weather events on the net asset value and operating revenue of each plant were assessed, and the results of which were incorporated into the future climate adaptation strategies to strengthen the operational resilience of respective plant.



Flood Risk

In the SSP5-8.5 scenario, the operation sites of TCC in Taiwan and Mainland China often experience heavy rainfalls such as plum rains and typhoons from April to September each year, potentially resulting in damage to production equipment at operation sites. According to the analysis in the assessment, there are 2 sites in Taiwan, located in Tainan City and Kaohsiung City, as well as 6 operation sites in Mainland China, located in Guangdong Province, Liaoning Province, Hunan Province, Fujian Province and so on, at a high flood risk. The remaining 40 sites are at medium to low flood risk. Over the long term, flood will lead to operational disruption and asset impairment, rendering a financial impact of NT$ 180 million. To reduce the potential disaster damage and operational risks, flood disaster simulations shall be performed for the above-mentioned sites regularly at TCC in the future to strengthen the adaptation measures of the plants.



Special Column | Impact and Damage of Flood due to Heavy Rainfall in Guangdong

▲ Yingde Plant

Since mid-April 2024, owing to the torrential rain and strong winds in the southern region of Mainland China, the rapid rising water level of the Bei River has led to flooding of wharfs and damages to wharf fences and walls, rendering impacts on the plant operations. The damage includes roof tiles blown off, damage to the driveway isolation gates and photovoltaic power station inverters by flooding. The loss incurred from this incident is estimated at approximately RMB 1.17 million.

In addition, due to the prolonged shipping control, coal required for production could not be transported via the Bei River, resulting in a decrease in inventory. The plant immediately initiated truck transport as an emergency alternative to shipping. However, the higher costs incurred from the truck transportation rendered additional procurement costs by approximately RMB 1.16 million. The plant subsequently planned to increase the coal inventory on the plant prior to periods prone to torrential rain or typhoons to lower transportation costs.

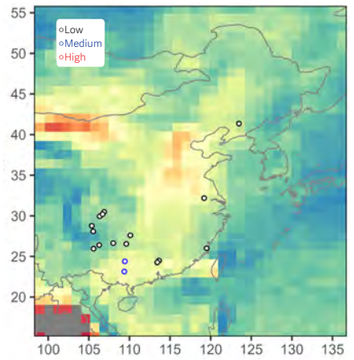
▲ Shaoguan Plant

In mid-April 2024, the Shaoguan plant experienced thunderstorms and heavy rainfalls, leading to 3 power outages on the plant and up to 32 hours of kiln shutdown. Additionally, landslide and damage occurred on the hillside roads and drainages in the mine as well as by the walls of the plant, resulting in a loss of approximately RMB 985,000.

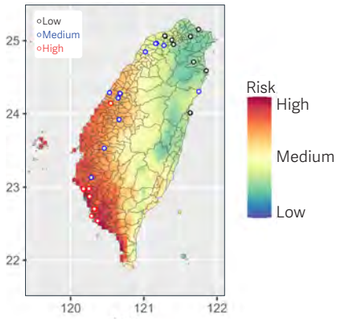
Drought Risk

In the SSP8.5 scenario, the operation sites of TCC in Taiwan and Mainland China will see an increased frequency of droughts, affecting the water use at the production sites and impacting the production schedules and operating revenue. According to the assessment, 9 operation sites in Taiwan are at a high drought risk, while the remaining 39 sites are at medium to low risk. Over the long term, droughts are projected to cause operational disruptions with a financial impact of NT$ 120 million. The high-risk sites in Taiwan are concentrated in Tainan City and Kaohsiung City. Moving forward, the water use management at these sites shall be reviewed on a regular basis, along with measures for adaptation to drought.

Distribution (SSP5-8.5, Long Term) Mainland China



Distribution (SSP5-8.5, Long Term) Taiwan



CHAPTER 2

Laying the Foundation for Achieving Net-zero Emissions

TCC incessantly promotes climate transition plans in business development and has mapped out the blueprint for marching towards net-zero emissions to address the foreseeable impacts of future climate change. With such foresight and proactive measures, TCC can better respond to the challenges posed by climate change while protecting its business, stakeholders, and the environment.

2.1_Total Climate Commitment at TCC

The Philosophy of In Service of Life

The Global Risks Report 2024 published by the World Economic Forum (WEF) suggests that "extreme weather events" are among the top two risks in the next two years and the next decade, meaning that companies must pick up their speed in actions to address climate change in order to effectively respond to imminent challenges. In response to the high uncertainty of climate change, TCC identified major climate risks and opportunities in 2023, and strengthened the climate scenario analyses of carbon pricing, carbon emission control, and extreme weather events. Based on the scenario parameters announced in the latest international scientific and technical reports, the financial impact of carbon pricing and carbon emission control have been analyzed. In addition, TCC also assessed the impact of flood and drought on various operating sites to capture the climate change and market dynamics of the external environment as well as to more comprehensively consider the overall operational strategy planning.

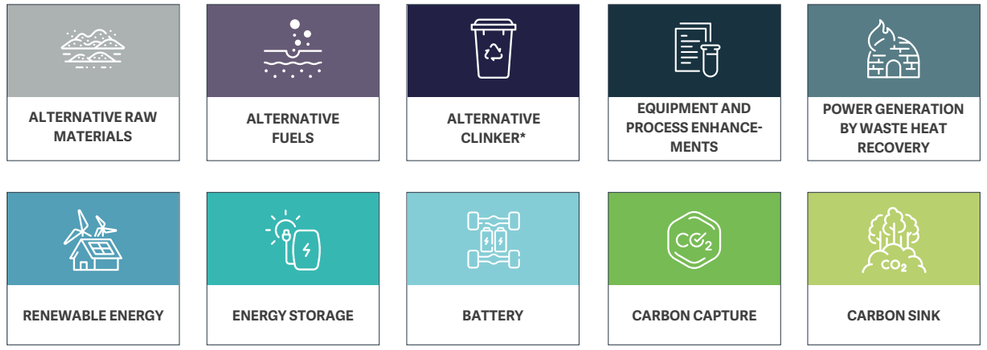
As a member of the global industry, TCC has clearly declared its commitment to carbon neutral concrete by 2050. Through the advancements on three key corporate pillars, i.e., low-carbon construction materials, resource recycling, and green energy, TCC is engaging in carbon reduction strategies based on Science Based Targets (SBTs), including equipment & process enhancements, power generation by waste heat recovery, alternative raw materials, alternative clinker, alternative fuels, renewable energy, energy storage, battery, and charging services, as well as carbon negative technologies like carbon capture and carbon sink, dedicated to reducing greenhouse gas emissions and improving energy efficiency.

TCC continuously communicates and interacts with various associations on climate issues, such as participating in discussions on net-zero emission pathways and low-carbon product R&D in the cement and concrete sector with the Global Cement and Concrete Association (GCCA). In addition, TCC also communicates with government agencies on laws and regulations, responds to international trends, actively participates in initiatives related to biodiversity, which is closely related to climate change, and speaks out on biodiversity issues with other industry leaders. In the face of extreme weather, TCC strives to establish a future development. We respond to nature with actions, uphold the philosophy of In Service of Life, and conform to the law of sustainable survival that is inseparable between enterprise and life, aspiring for the inclusion and co-prosperity with the society.

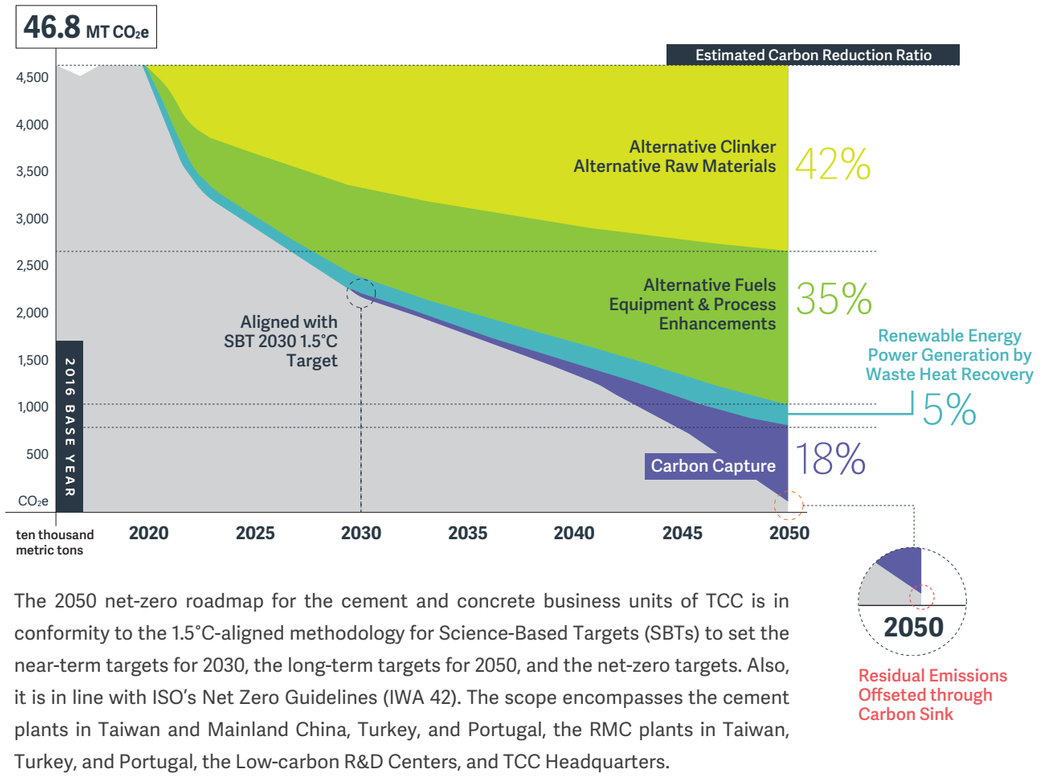
2.2_Net-zero Pathway for the Cement and Concrete Business Units and External Influence of Carbon

Carbon Reduction & Greening Strategy

Since the launch of transformation in 2018, TCC has been steadily marching on the path of carbon revolution and globalization towards the goal of Net Zero by 2050. In alignment with the carbon reduction and greening strategy formulated at TCC Group Holdings, a new TCC Roadmap to Net-zero Carbon Reduction shall be released in 2024. The net-zero pathway for the cement and concrete business units worldwide and the avoided emissions of TCC Group Holdings will be presented respectively. The results of the global green transformation of TCC Group Holdings in phases as well as the future prospects thereof will be quantified, with the roadmap reviewed and updated annually. In the meantime, the results of external influence of carbon reduction from TCC will be disclosed yearly to demonstrate the outcomes of the net-zero transition by TCC.



The 2050 Net-zero Pathway for the cement and concrete business units of TCC



The 2050 net-zero roadmap for the cement and concrete business units of TCC is in conformity to the 1.5°C-aligned methodology for Science-Based Targets (SBTs) to set the near-term targets for 2030, the long-term targets for 2050, and the net-zero targets. Also, it is in line with ISO's Net Zero Guidelines (IWA 42). The scope encompasses the cement plants in Taiwan and Mainland China, Turkey, and Portugal, the RMC plants in Taiwan, Turkey, and Portugal, the Low-carbon R&D Centers, and TCC Headquarters.

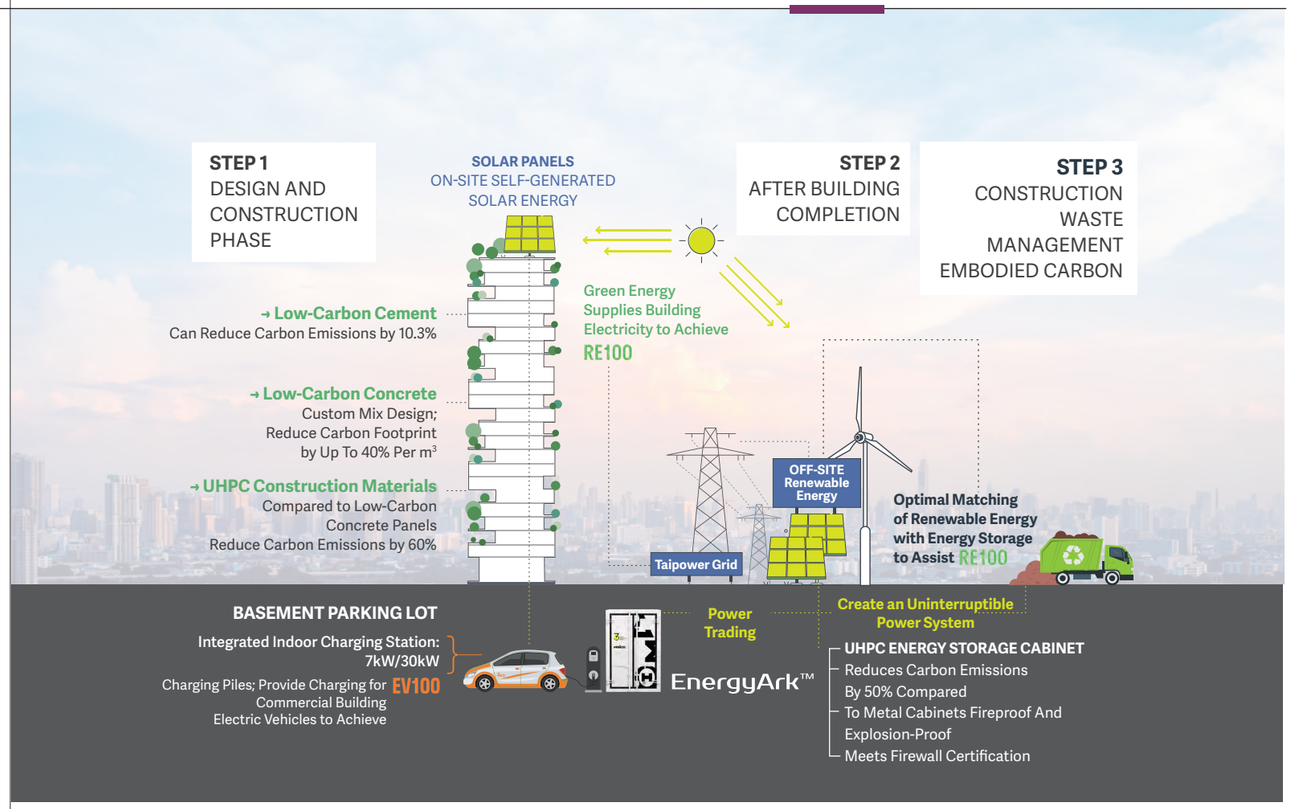
Net-zero Pathway Methodologies:

- SBTi's Sectoral Decarbonisation Approach (SDA) for the cement sector's 1.5°C-aligned and net-zero SBTs
- ISO Net Zero Guidelines (IWA 42); ISO 14064-1
- MIT En-ROADS net-zero simulator's open-source formulas
- International Energy Agency (IEA) Global Energy and Climate Model (GEC Model) logic and NZE Scenario parameters

The alternative clinkers and alternative raw materials key to the cement and concrete manufacturing processes, alternative fuels, power generation by waste heat recovery, equipment and process enhancements, renewable energy generation for self-consumption, and carbon capture are adopted for strategic applications. As for carbon sink, starting from the launch of forest and soil surveys in 2023, it has been used as a viable option for net-zero carbon removal. In addition, a UN report against greenwashing recommends that corporate net-zero should be aligned with the NZE scenario in the IPCC and IEA models. Therefore, with reference to the 2023 Net Zero Roadmap report and the World Energy Outlook 2023 of IEA, coupled with the historical production data and carbon reduction performance from the corporate carbon reduction management platform, the pathway to Net Zero by 2050 for the cement and concrete business unit is modeled.

Climate Solutions at TCC

The era of global carbon pricing has arrived, and carbon reduction has become the carbon competitiveness of countries and enterprises. Aiming at the global trend and business opportunities of carbon reduction in construction, TCC spearheaded the development of a full range of low-carbon products in the domestic cement sector and launched the comprehensive "Total Solution: Low-Carbon New Energy Building Solution." From design and construction, completion and operation to the end of the life cycle of buildings, TCC offers the most comprehensive low-carbon strategy assessment and recommendations with its own expertise and services for carbon reduction across all phases.



Design and Construction Phase

▲The "Low-Carbon Building and Engineering Carbon Emission Calculation System" developed by TCC helps clients with the initial calculation of their carbon reduction performance by using the low-carbon construction materials of TCC based on the floor area and the estimated amount of cement and concrete used, along with assistance in the assessment and planning of renewable energy, energy storage equipment, and charging piles to optimize the energy use model.

Building Operation Phase

▲With the green power wheeling after buildings are completed and put into operation, combined with the planning for charging station integrated with solar, charging and storage applications, as well as Online Green Energy Consultant and aggregated energy storage and trading management of Energy Helper TCC Corporation, the optimal power use curve is identified for buildings.

Construction Waste Phase

▲At the end of a building's life cycle, construction waste from demolition is processed and recycled into renewable resources as alternative raw materials for cement and concrete.

The impact of carbon issues on businesses is no longer a future concern, but a present reality. TCC endeavors to join hands with construction partners to enhance carbon competitiveness in the era of carbon pricing.

Green Revitalization of Land Assets

TCC ongoingly promotes the use of low-carbon construction materials, starting with the revitalization of its own non-operational land assets. For example, the development of TCC Accommodations and the old plant of TCC in Zhudong Township were all planned to use the low-carbon concrete of TCC. Furthermore, TCC has collaborated with numerous partners on the value chain to jointly work to reduce GHG emissions from buildings in response to the idea of Reducing Carbon without Reducing Strength.

Constructing a Low-Carbon Living Sphere in Zhudong | JUT Land Development Co., Ltd.

TCC and JUT Land Development Co., Ltd. have officially signed a contract, announcing that the two parties will jointly create a new generation of low-carbon sphere of happy living combining low-carbon construction materials on the approximately 6,508-ping land of the old TCC plant in Zhudong Township, Hsinchu County, for the friendly symbiosis of housing with the environment. This development project will adopt the lowest carbon concrete in Taiwan - TCC Total Climate Series limestone cement concrete, which is estimated to achieve a 34% carbon reduction in the use of concrete. JUT Land Development Co., Ltd. shares the same philosophy with TCC, striving to coexist harmoniously with the ecological environment and work hard for the sustainable development of Earth while engaging in economic activities and development. The JUT Group actively introduces Japanese construction methods, continues to collaborate with international teams, and carefully manages the architecture, culture, and art in the city to enrich life experiences of all. The partnership between TCC and JUT Land Development Co. Ltd. will further live up to the "friendly symbiosis of humanity and the environment" and write an important chapter in the sustainable development of the residential industry in the future.

Construction of the Headquarter Building Using the Lowest Carbon Concrete | Fubon Insurance Co., Ltd.

In 2023, TCC held the "TCC Total Climate Series_Low-carbon Construction Materials Launch Press Conference" to launch the low-carbon cement brand with the lowest carbon in Taiwan—Portland Limestone Cement, TCC Portland Limestone Cement Concrete, and UHPC low-carbon high-quality construction materials—as the collective response to the goal of promoting carbon reduction in construction and moving towards low-carbon cities. TCC took the lead in the domestic cement industry and launched a full range of low-carbon products. The first wave targeted the listed companies, construction companies, and builders among the clientele that value ESG, with the warranty of "TCC Low-carbon Cement, Reducing Carbon without Reducing Strength." The launch event also unveiled the low-carbon product partner of TCC—Fubon Land Development Co., Ltd., a subsidiary of Fubon Group. Their project of Fubon Insurance Headquarter Building in Taipei City shall be constructed using the lowest carbon concrete in Taiwan—TCC Portland Limestone Cement Concrete.

Responses from Representative Construction Companies and Builders in Northern, Central, and Southern Taiwan

TCC Total Climate Series of low-carbon products have received responses from representative construction companies and builders in northern, central, and southern Taiwan, including Kuensun Construction and Guangying Construction in Hsinchu, Huiguo Construction and Fuying Construction in Taichung, Young Der Construction and Zhengde Construction in Kaohsiung, Be Young Construction, Lian Tai Real Estate, and Seeyond Construction in Tainan. These companies have decided to employ TCC Portland Limestone Cement Concrete, which significantly reduces carbon reduction, for the main structures of their construction projects. In terms of the life cycle of a building, the carbon emissions from cement and concrete account for 20%, and in the life cycle of public works, the carbon emissions from cement and concrete even account for more than 50%. Compared with traditional cement, TCC low-carbon products offer the same performance strength, reducing carbon without reducing strength, delivering both concrete performance and on-site workability.

台泥 減碳 不減強度 Total Climate 系列

Five Energy Businesses

Energy Creation | **Diversified Green Power of Wind, Solar, Geothermal, and Marine Energy (solar energy, wind energy, aquavoltaics, solar grazing, geothermal energy, OTEC, and small hydropower)**

In response to the global demand for renewable energy, TCC is actively building diverse renewable energy sources on both sides of the Taiwan Strait to reduce the use of high-carbon-emitting grey energy. Investment has been made at TCC in a variety of renewable energy sources, including solar, wind, geothermal, and tidal energies, all of which have been actively developed by TCC in recent years. In 2023, its solar and wind power projects have been installed across Changhua, Chiayi, Taitung, Hualien, and multiple provinces in Mainland China. Meanwhile, the lands of the project sites have been revitalized, including aquavoltaics and solar grazing as well as Green Energy Vision Pavilion. TCC unceasingly cooperates with various parties in the research and development of forward-looking energy sources such as geothermal energy and ocean thermal energy conversion (OTEC), seeking to create diversified renewable energy sources and increase the baseload power to stabilize the grid.

Energy Storage | **The Key to A Stable Energy Supply (NHOA energy storage project site deployment and EnergyArk)**

For the stable use of renewable energy in the future, TCC is proactively developing energy storage business and integrating technical resources at home and abroad to deliver peak shaving and valley filling and power grid stabilization through energy trading platforms. All-round integrated new energy services have now made available at TCC, including EnergyArk Energy Storage Cabinets, integrated charging stations with solar, charging and storage applications, energy management systems, energy trading, city-level microgrid integrated services, and business portfolios. Through various constructions and tests, TCC sustainably provides stable and safe energy storage services, helping enterprises solve energy problems in the process of net-zero transition.

Energy Supply | **New Energy, New Lifestyle (deployment of charging stations, off-peak charging for Earth, EVPASS, and electric trucks)**

To offer comprehensive energy supply services, TCC has expanded into the charging life of consumers and businesses, giving birth to the EV charging stations "integrated with solar, charging and storage applications," planning low-carbon and energy-saving charging solutions for clientele, and building zero-carbon green logistic ecospheres in Taiwan. With system design and charging station construction, it provides charging services. Coupled with photovoltaic and energy storage management services, it offers low-carbon and stable energy. Moving forward, TCC shall continue to explore the markets of consumers and businesses so as to jointly create living spheres of green transportation.

Energy Solution | **Green Energy Helper for SMEs (Energy Helper TCC Corporation Green Energy Trading Platform and joining the Energy Trading Platform of Taipower)**

The renewable energy project sites of TCC are located throughout Taiwan and Mainland China. To vitalize the use of renewable energy, TCC engages in renewable energy trading services as well as offers Unbundled RECs and online consulting services through Energy Helper TCC Corporation. In addition, Energy Helper TCC Corporation aggregates energy storage projects under TCC to partake in the energy trading services of Taipower, offering services of Regulation Reserve (sReg & dReg), Energy-shifting with Dynamic Regulating Function Reserve (E-dReg), Spinning Reserve, and Supplemental Reserve. Through the self-developed AI-powered big data system of clustering algorithms developed by itself, Energy Helper TCC Corporation, a TCC subsidiary, matches renewable energy sources under TCC with green electricity consumers, delivering renewable energy with high efficiency.

Energy Transmission | **Advanced Ultra-High Power Cells (the 1st 100% green-powered low-carbon battery cell plant in the world)**

To meet the future demand for energy supply, Molicel, a subsidiary of TCC, is devoted to developing "next-generation high-performance ternary lithium-ion batteries" with high energy density and high discharge power to supply the batteries needed for various electric vehicles in the future. Moving forward, apart from stabilizing battery production and improving safety, it shall collaborate with raw material suppliers to develop and improve quality. In the meantime, Molicel will partner with clients to expand business plans and introduce its products into electric vehicle markets.

CHAPTER 3

Creating New Age of Climate

The climate transition plan is the commitment to reducing carbon emissions and promotion of sustainable development at TCC. By implementing this plan, TCC not only helps mitigate the impacts of global warming and climate change, but also advances towards the goals of sustainable development, rendering positive impacts on the society as a whole and the ecosystems on Earth, giving birth to a brighter future.

3.1_Low-carbon Circular Production

Key Performances

Target |
Proportion of alternative raw materials

Performance in 2023 |
Taiwan and Mainland China
19%

Target |
Power generation by waste heat recovery

Performance in 2023 |
cement plants in Taiwan
63.55 million kWh

cement plants in Mainland China
737.63 million kWh

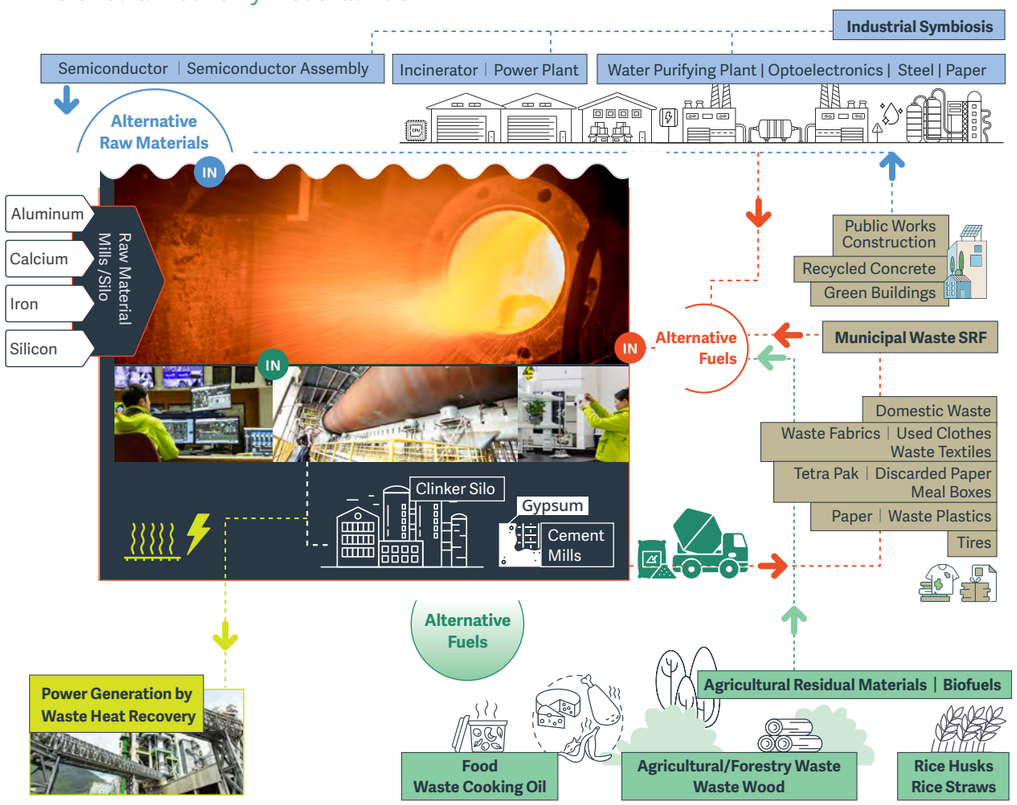
Target |
Total amount of waste treated for various industries in Taiwan

Performance in 2023 |
1,155,684 metric tons

Target |
Reduced purchased electricity due to upgrade and retrofit for energy-saving measures at the plants in Taiwan in 2023

Performance in 2023 |
4,936,974 kWh

The Circular Economy Model at TCC



The co-processing with cement kiln, which is the core competence of the cement industry, is hailed as the venous industry of circular economy. It can achieve innocuous treatment and resources reuse of wastes. The Global Cement and Concrete Association (GCCA) pointed out that alternative fuels and raw materials are vital to the sustainable transition of the cement industry. By establishing a production model of resource recycling, we not only harness the advantages of low-carbon emissions and reduce natural resource exploitation, but also further treat wastes for society and industries, fulfilling the purpose of resource recycling.

Alternative Fuels

Alternative Fuels

A diverse range of alternative fuels have been utilized at TCC. In 2023, TCC continued to develop sources of waste wood, waste plastics, waste textiles, and non-hazardous oily sludge. Due to the varied characteristics, heating values, and moisture contents of different alternative fuels, extensive testing is required to achieve stable utilization. Considering the geographical characteristics and industrial structure of the areas its plants operated, TCC joined hands with local governments and enterprises to conduct trials and develop alternative fuel sources suitable for local application with stable supply. In October 2023, TCC and the Industrial Technology Research Institute (ITRI) jointly completed the construction of the "SRF with high heating value co-firing and clean integration system for cement kiln" to work on the development of materials of SRF with high heating value and co-firing technology. The system performance verification is currently underway. The outcome of the project is also expected to be applied to raise the efficiency of alternative fuels in the future.

Alternative Raw Materials

Alternative Raw Materials

Developing alternative raw materials to reduce the use of natural raw materials is a crucial key to lowering carbon emissions in cement production. TCC is actively engaged in developing alternative raw materials, collaborating with industrial associations and business entities to recover and reuse waste as alternative raw materials, helping to reduce the GHG emissions from limestone calcination. The ferrosilicon and aluminum among the alternative raw materials currently used at TCC can also be extracted from the wastes from other industries. In addition, alternative raw material sources, such as calcium silicate boards and construction waste, are developed continuously to exercise a circular economy, effectively reduce carbon emissions, and lower the use of raw materials.

Alternative Clinkers

Alternative Clinkers

Pursuant to the recommendations of the International Energy Agency (IEA) on the key area for reducing carbon emissions in the cement industry, which is to lower the proportion of clinker in cement, including the use of blended cement. Aside from investing in alternative raw materials or limestone to produce clinker, TCC is also ceaselessly searching for new materials for testing and development into clinker substitutes. Auxiliary materials such as slag powder can all be used as alternatives to clinker.

UHPC for High-strength Construction Material and 3D Printing Technology

Ultra-High Performance Concrete (UHPC) is an innovative basic engineering material developed by TCC. Compared to traditional concrete, it offers ultra-high durability, compressive strength, and mechanical properties. UHPC construction materials can effectively reduce the area of structural sections and increase the interior structural space. The buildings with UHPC have a life cycle of 100-120 years or more. Compared to traditional concrete, it can cut carbon emissions by up to 60%. In addition, the high-quality UHPC materials of TCC can be applied to 3D printing technology, with the features of high strength, adjustable color, and large-scale printing. In 2023, to better the UHPC research and development, the largest Process Center of Ultra-High Performance Concrete (UHPC) Materials was established at the Hoping Plant in Hualien. At present, products such as UHPC EnergyArk Energy Storage Cabinet, UHPC mosaic wall panels, KT slabs, grass pavers, and paving bricks have been launched. Moving forward, we plan to develop cement or UHPC permeable panels in combination with the reuse of construction waste.

UHPC Applications

UHPC EnergyArk Energy Storage Cabinet

Developed by TCC, EnergyArk Energy Storage Cabinet made of UHPC comes with the features of low carbon, fire-proof, fire-extinguishing, compression resistant, and weather resistant, ensuring the safety of energy storage system.

UHPC Panel

The UHPC mosaic wall panels developed by TCC are used for exterior walls and curtain walls, featuring high strength, lightweight, and low carbon.

UHPC KT Slab

The UHPC KT slab developed by TCC leverage the high-strength property of UHPC to significantly reduce the weight of KT slab. It not only decreases the net structural capacity but also shortens construction time, effectively reducing overall carbon emissions.

UHPC Bricks

The UHPC paving bricks feature high compressive and flexural strengths; the UHPC grass pavers with resistance to heavy pressure and high durability further allow the land to breathe.

3.2_Industry-leading Low-carbon Construction Materials

Key Performances

Targets |

The Type I Portland Cement manufactured by TCC is the only cement product in the cement sector in Taiwan that is certified to the "Product Carbon-Footprint Reduction Label" of the Ministry of Environment.

Cement types PII, PO, and PC manufactured by the plants in Mainland China have obtained low-carbon product certifications, accounting for approximately 80% of overall revenue.

All the RMC plants in Taiwan have obtained the carbon labels from the Ministry of Environment for concrete strength specifications of 210 kgf/cm^2, 280 kgf/cm2, 350 kgf/cm^2, and 420 kgf/cm^2. Also, the 210 kgf/cm^2 specification has also obtained the Product Carbon-Footprint Reduction Label.

Low-carbon Portland Limestone Cement & Low-carbon Portland Limestone Cement Concrete

TCC is dedicated to developing low-carbon products, establishing a Low-Carbon Building Materials Research and Development Center, and developing low-carbon Portland Limestone Cement (IL) and low-carbon concrete. The low-carbon Portland Limestone Cement (IL) features a low carbon footprint due to the reduction of clinker content and lower carbon emissions during production. Additionally, when using Portland Limestone Cement (IL) in concrete, it demonstrates high early strength, excellent workability, and durability in slump and compressive strength tests. It can completely replace the traditional Type I Portland cement, suitable for general construction and engineering projects with the advantage of being low-carbon.

Low-carbon Portland Limestone Cement (Type IL)

Portland Limestone Cement (Type IL), by adding limestone to replace clinker, can reduce carbon by 15.4% compared to the traditional Portland Type I cement, without reducing strength. With a stable production at present, the application scenarios of Portland Limestone Cement will be extensively expanded in the future.

Low-carbon Portland Limestone Low-carbon Concrete

Low-carbon Portland Limestone Cement Concrete will utilize Portland Limestone Cement(Type IL) developed by TCC featuring excellent durability and low carbon characteristics. In addition to conducting low-carbon concrete performance tests in accordance with standards, TCC will continue to work on the research and development of low-carbon concrete mix designs.

Carbon Label/Carbon Reduction Label and Green Building Material Label

Aside from developing low-carbon cement and concrete, TCC keeps obtaining the latest product certifications in line with domestic environmental trends. The products of TCC have obtained Green Marks, Carbon Footprint Labels, Carbon Reduction Labels, and certifications of carbon footprint and recycled green construction materials. In 2023, TCC became one of the first companies to pass the trial implementation of Low-carbon Recycled Materials Certification (LCR). Its Portland Cement Type I and II (MH) and Ready-Mixed Concrete 280 kgf/cm2, 350 kgf/cm2, and 420 kgf/cm2 have been reviewed and found to comply with the standards in the "Manual of Low Embodied-carbon Building Rating System" that qualify as low-carbon recycled materials. The certification process for low-carbon building materials will proceed once the relevant authorities have refined the operational guidelines for certification, highlighting the emphasis of TCC on a healthy environment to provide the construction industry with more eco-friendly materials. TCC takes excellent quality management as its foundation and is unceasingly obtaining various management certifications in an attempt to deliver the best quality.

Low Carbon Product Certifications

Cement

- Ministry of Environment-Gold-level Green Mark
- Ministry of Environment-Carbon Footprint Label
- Ministry of Environment-Carbon Footprint Reduction Label
- ISO 14067 Carbon Footprint of Products

Concrete

- Ministry of Environment-Carbon Footprint Label
- Ministry of Environment-Carbon Footprint Reduction Label
- Taiwan Architecture & Building Center-Recycling Green Building Material Label
- ISO 14067 Carbon Footprint of Products

AI-powered Carbon Management Platform

To probe into the carbon reduction performances of its cement and concrete products, TCC started to build an AI-powered carbon reduction management platform in 2019 to calculate the carbon emissions of cement and concrete by means of Cradle-to-Gate using the life cycle assessment (LCA) approach. With the production data of the plants fed back on a daily basis, the platform automatically calculates the carbon emissions from raw materials and energy use. Meanwhile, combined with target achievement and alerts, it presents carbon management statuses, offering optimal carbon reduction recommendations and decisions for respective plants. Also, the SBTs for carbon reduction and the KPIs for the alternative fuels in the plants are tracked. Coupled with the variable compensations, quarterly bonuses, and annual bonus factors, it presents target achievement rates visually. In 2023, the alternative fuel indicators are added to the platform. In 2024, it is planned to add an environmental technology company and Taiwan Cement's DAKA Recycling Resource Utilization Center to the platform, comprehensively enhancing Taiwan Cement's management and control of carbon emissions.

Internal Carbon Pricing

To drive low-carbon investments, improve energy use efficiency, and incentivize the carbon reducing actions internally, an internal carbon pricing system has been set up at TCC. Pursuant to the carbon pricing policy, laws, regulations, and directions at where the cement business of TCC operates, like the "Carbon pricing options for Taiwan" released by the London School of Economics and Political Science as the reference for Taiwan, NT$300/ton-CO2e is set as the internal carbon pricing basis for 2023 and 2024. As for Mainland China, it is assumed that the carbon credit trading will include the cement industry, with the reference of the actual carbon price in Mainland China in 2023 and the World Energy Outlook released by IEA, the carbon price level of Mainland China shall rise to USD 28/ton-CO2e in 2030. Hence, the internal carbon price for 2024 is calculated and set at RMB101/ton-CO2e as a basis to calculate the impacts on capital investments and operations. As a result, in preparing budgets for capital expenditures, maintenance projects, equipment improvement, and energy-saving projects, etc., in addition to the consideration of existing costs, carbon impacts must also be considered in the calculation of internal rate of return, which boosts the motivation for carbon reduction in business decisions of all departments.

SPECIAL COLUMN | The Expanded Investments in OYAK and Cimpor for the Lowest Carbon Cement in the World

TCC continuously expands its global green energy and low carbon products development. The Company partnered with OYAK Group in Turkey to expand its investment in the low-carbon cement market across Europe, Asia, and Africa as well as increased its stake in the joint venture subsidiary with OYAK in Turkey from 40% to 60%, and owned its stake in the subsidiary with Cimpor in Portugal from 40% to 100%. The relevant transaction procedures were completed in the first quarter of 2024.

In the European cement market, imported cement has long taken up a certain share. With the Carbon Border Adjustment Mechanism (CBAM) to come into force in the EU in the future, low-carbon cement will become the main competitive edge for both domestic and imported cement entering the European market. OYAK and Cimpor possess world-leading low-carbon cement research, development, and production technologies. Also, Cimpor has accumulated 2.37 million tons of carbon credits in Europe. By increas-

ing investment, TCC is expected to become one of the few major suppliers in the world capable of supplying the lowest carbon cement, which strengthens the carbon competitiveness of TCC.

TCC established a joint venture with OYAK in Turkey in 2018 and invested in Cimpor, a cement company in Portugal, through the joint venture. The joint venture between TCC and OYAK is the first cement company in Turkey to declare its net-zero commitment. In recent years, it has successfully secured the ultra-low carbon alternative raw materials and fuels in Africa through Cimpor. Its ultra-low carbon cement technology, which employs calcined clay to replace clinker in the manufacturing process, is leading the global cement industry, delivering the lowest carbon cement production in the world.

▲OYAK
the Cement Company in Turkey

OYAK owns 7 cement plants, 11 clinker production lines, 2 white cement production lines, 67 concrete plants, 50 distribution stations, and 1 port in Turkey. In recent years, it has been actively developing technologies of alternative fuel and alternative clinker applications, striving to reduce carbon emissions. The Aslan plant in Turkey has even achieved a TSR as much as 61%, fully realizing the goal of fossil fuel use reduction.

▲CIMPOR
the Cement Company in Portugal

Cimpor, the Portuguese cement company owned by TCC, has established one of the two commercial cement plants in the world that use 90% biofuel for production. The cement plant of Cimpor in Côte d'Ivoire (Ivory Coast), West Africa has established the world's first large-scale cement base for calcined clay production. The calcined clay, when mixed with clinker, reduces carbon emissions by at least 40% compared to the traditional cement.

3.3_ Low-carbon and Carbon Negative Technical Innovations

TCC is committed to carbon reduction, particularly in carbon capture technology. Since carbon capture is a forward-looking climate technology in the world, TCC has been collaborating with the Industrial Technology Research Institute (ITRI) since 2011 to develop calcium-looping CO2 capture technology and microalgae carbon fixation technology, which have been verified and accumulated substantial operational experiences. In the future, aside from the application of the CO2 captured in cross-sectoral services such as industrial welding, chemical engineering, and food processing, the feasibility of carbon storage and use as carbon credits for carbon offset in accordance with government policies, or value-added utilization, shall be assessed, which are all potential directions for future planning.

Oxygen-enriched Combustion

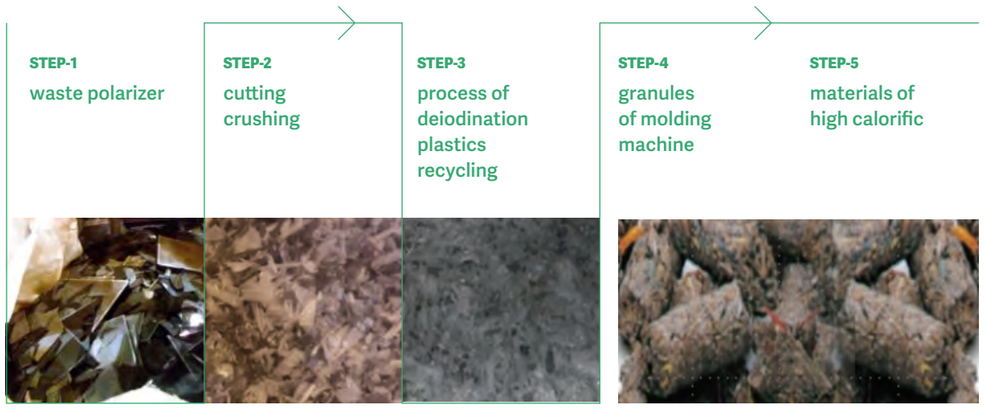
The Suao Plant of TCC commenced the installation of an oxygen-enriched combustion system in 2022. The system aims to reduce carbon monoxide generated at the kiln end, thereby enhancing combustion efficiency and increasing the intake of alternative fuels for the benefits of coal reduction and carbon reduction. The kiln head combustion tests and evaluation have been engaged at the Suao Plant since December 2023. Tests and evaluations are also underway for the kiln head at the Hoping Plant.

Oxy-fuel Combustion

TCC has been collaborating with ITRI since 2011 to develop and verify the research and experimentation of calcium looping carbon capture technology. In 2022, ITRI completed a summary report of the results of the joint research on calcium looping technology development. Based on the practical verification and solid operational experience gained, and in response to the carbon reduction strategy, TCC shall lead the development of the next-generation carbon capture technology—oxy-fuel combustion. At the end of January 2024, TCC signed an MOU with thyssenkrupp Polysius (tkPOL), a subsidiary of the German thyssenkrupp AG, for a carbon capture project. The No.1 Kiln at the Hoping Plant in Hualien will be used for testing of carbon capture technology. Together, they are to jointly develop the third-generation oxy-fuel combustion process and technology. The project is expected to complete in 2026, aiming to master the core technology for commercial operation by 2030 and capture 100,000 metric tons of carbon dioxide per year.

Co-firing and Clean Integration System Development Plan for High Calorific Value SRF in Cement Kilns

The plan has successfully developed a deiodination process for waste polarizer recycling, separating the mixed plastics (TAC, PVA, PE, PP, etc.) from waste polarizers into SRF materials of high calorific value. The test result of deiodination rate is 100%, and the calorific value of the SRF materials of high calorific value from waste polarizer recycling and deiodination is tested to be ≥7,000 kcal/kg. At this stage, the design of the SRF of mixed woodchip fuel conveying system has completed. The stability of the operation system will be continuously tested moving forward.



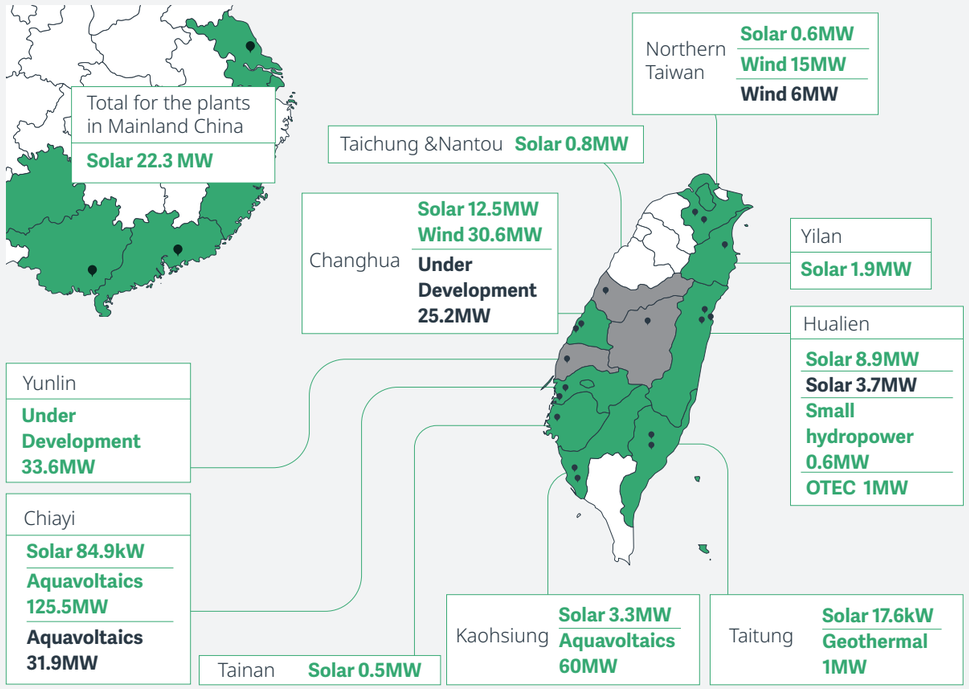
3.4_ Smart New Energy Business

Development of Renewable Energy Sources

According to the International Energy Agency (IEA), to achieve the 1.5°C goal, the installed capacity of global renewable energy should triple by 2030. In addition to renewable energy generation for self-consumption, TCC has installed PV panels at its operation sites on both sides of the Taiwan Strait to reduce the use of grey energy. In the meantime, through the active investment in developing diversified renewable energy sources, including wind, solar, geothermal, and marine energy, by TCC Green Energy Corporation, a subsidiary of TCC Group Holdings, TCC supports the energy transition in Taiwan. From 2021 to 2023, TCC has generated over 315 million kWh of green electricity in Taiwan, equivalent to reducing carbon by 155,659 metric tons. Also, with the AI-powered digital management introduced, it monitors the power generation status of project sites in real time. Combined with weather information, equipment maintenance and repair recommendations are available using big data analytics. In view of the intermittency challenges with solar and wind energy, TCC is further devoted to the R&D of forward-looking energy sources, including geothermal energy and OTEC that can be used as baseload energy sources. In 2023, the renewable energy generated for self-consumption in Taiwan and Mainland China totaled 18,979,592 kWh.

Installed capacity of renewable energy project sites of TCC

■ In Production/Under Construction ■ Under Development



SPECIAL COLUMN | Transformation Plan for the Hoping Plant

Energy Plan for the Hoping Power Plant

Taiwan suffers from insufficient natural resources, sluggish renewable energy progress, and rising power demand year by year. The Hoping Power Plant, a subsidiary of TCC Group Holdings, is the only large power plant in Eastern Taiwan. It supplies two major cities in Northern Taiwan—95% of the power needs of Yilan, and 20% of New Taipei City. Also, it ensures a stable power supply in accordance with government contract provisions. The power plant is expected to be decommissioned in 2040 per its design lifespan. TCC has assessed actively relevant renewable energy installation plans.

▲**Biomass Energy Feasibility Study**: The Hoping Power Plant initiated a feasibility study on wood pellets and Solid Recovered Fuel (SRF) in 2024, encompassing the facets of unloading, transportation, and storage, along with an impact assessment of boiler operations.

▲**Renewable Energy Generation for Self-Consumption—Rooftop PV, Small Hydropower and Wind Turbine**:

Photovoltaic—The Hoping Power Plant has planned installing renewable energy generation equipment for self-consumption to provide power for auxiliary equipment in the plant. Solar panels are comprehensively installed over the roof, with the power generation efficiency higher than the average in Hualien County.

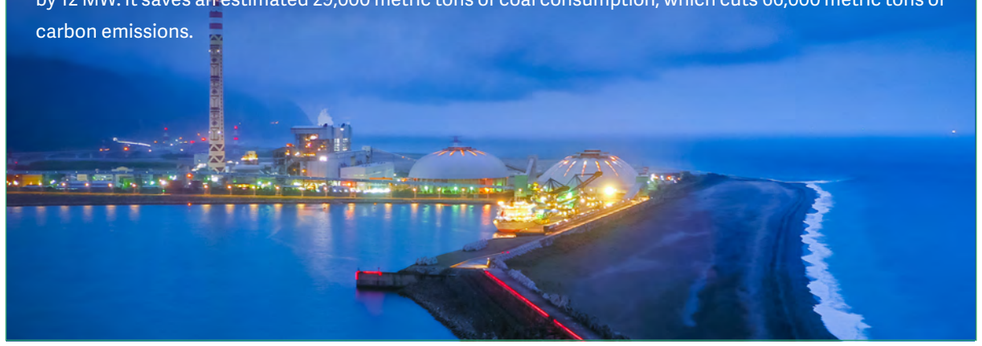
Small hydropower—To cool the power plant generators, a large amount of seawater is introduced for heat exchange. Since the cooling water does not come into contact with the process, it is the same as general seawater and is usually discharged directly into the sea through dedicated channels. In order to increase the benefits in use, the Hoping Power Plant has planned a composite renewable energy generation system. Since the cooling water flow can reach up to 22 cm, it planned to install generators on the existing channels to tap into the potential difference for small hydropower generation and connect such to the high-voltage system of the plant. The feasibility assessment was completed in 2023, with an installed capacity of 572 kW and an estimated annual power generation of 3.9 million kWh.

SPECIAL COLUMN | Transformation Plan for the Hoping Plant

Wind turbine—Meanwhile, the idle space on the plant is revitalized with the plan to install a 10.8-kW wind turbine that will be connected to the low-voltage system of the plant, which is expected to be completed in the first half of 2024 with an annual power generation of 1,183 kWh.

▲**Ocean Thermal Energy Conversion (OTEC):** The Hoping Power Plant is located nearby the waters of Eastern Taiwan, enabling it to leverage the temperature difference between the power plant's cooling water and the deep seawater to drive turbines for power generation. The Hoping Power Plant is to apply to the government for OTEC-related review procedures in 2024. It plans to utilize the power talents and teams of the Hoping Power Plant to build the world's first MW-class OTEC power plant at where it operates.

▲**Low-pressure Steam Turbine Retrofit Project:** In 2021 and 2023, the low-pressure steam turbines of units 1 and 2 were respectively retrofit to enhance the efficient utilization of thermal energy, reducing the heat consumption of the units by 1.66%, which is equivalent to an increase of power generation capacity by 12 MW. It saves an estimated 29,000 metric tons of coal consumption, which cuts 66,000 metric tons of carbon emissions.



The Only Large Power Plant in Eastern Taiwan to Support 4% of Stable Electricity Supply around Taiwan

TCC supports the COP28 resolution: the transition away from fossil fuels for the world. According to the energy transition goal in the Summary of Taiwan's Pathway to Net-Zero Emissions in 2050 and Strategies released by the National Development Council, Taiwan will still need at least 20-27% of coal-fired power generation combined with CCUS applications in the energy mix by 2050. It can be said that in the foreseeable decade, there is no alternative energy sources for Taiwan.

Shouldering the significance and social responsibility for the social operation in Taiwan, the Hoping Power Plant sells all the electricity generated to Taiwan Power Company (Taipower). It helps Taipower significantly improve the power supply in Eastern Taiwan and alleviate the transmission burden on the 345 kV ultra-high voltage (UHV) north-south trunk line in Western Taiwan. As the sole large power plant in Eastern Taiwan, the Hoping Power Plant cares for the environmental and energy needs in Taiwan, elevating the stability of the power supply system in Taiwan.

Energy Helper TCC Corporation

Energy Helper TCC Corporation, under TCC Group Holdings, develops flexible renewable energy mix for trading, offering the Unbundled RECs rarely available on the market. Also, the pioneering Online Green Energy Consultant enables clients to obtain optimal green power solutions via big data computing. The Green Energy Trading Platform has been built to deliver a convenience-store-like trading experience for power producers to access a convenient green energy trading platform. In addition, combined with the resources of TCC Group Holdings, Energy Helper TCC Corporation aggregates energy storage projects under TCC and manages energy storage sites of clients for energy trading, involved in all operational items on the Energy Trading Platform of Taiwan Power Company. In December 2023, the largest energy storage project site in Taiwan, the 100-MW E-dReg Energy Storage System at Hoping, Hualien, was operational with a 200-MWh capacity of off-peak/peak load regulation daily for Taipower's power grid in the northeast region.

Echoing with the SDG7, Energy Helper TCC Corporation is committed to providing a certain percentage of green energy annually to export-oriented SMEs in Taiwan to support them in achieving RE100. Utilizing the AI-powered big data clustering algorithm developed by itself, Energy Helper TCC Corporation matches renewable energy sources under TCC with green electricity consumers, leveraging smart energy management to monitor the energy used, green energy matched, and energy use curve in real time. In 2023, it helped five Taiwanese suppliers of Decathlon procure nearly one million kilowatt-hours of green electricity, enabling Decathlon's supply chain to meet the annual carbon reduction targets. Hence, it became the first case in Taiwan for enterprises to successfully procure green electricity by means of Aggregated Power Purchase Agreement (APPA).

Energy Storage Equipment & Charging Stations

Cumulative Installed Capacity of Large Energy Storage Projects:
Taiwan & Mainland China covered

2021	2022	2023	2024
Operational	Operational	Operational	Installed (operational included)
5.2MWh	8.8MWh	507.2MWh	796.6MWh

Through NHOA.TCC's energy management system, the charging stations connecting charging with energy storage systems (DC-DC), capable of supply energy to chargers during peak hours on the power grid with the energy stored, reducing the required grid load by nearly 90%. Also, with the PV system and energy storage equipment combined, the charging services were directly powered by green energy, or the pure green power charging services via power wheeling.

The EnergyArk Energy Storage BTM Energy Storage System Rental Plans were further rolled out in 2023, offering enterprises with a circular procurement model of Rent to Own and lowering the entry barrier for owning an energy storage system. Also, with a plan to expand the promotion of the energy storage cabinets from Taiwan and Mainland China to the European and American markets, it is expected to partner with Atlante, a subsidiary of TCC, to build the first charging station integrated with EnergyArk Energy Storage Cabinets in Europe in Italy in Q3 2024. As of 2023, NHOA.TCC has been managing 9 energy storage project sites in Taiwan. With these projects scheduled to be fully operational in 2024, the installed capacity will reach 217.3 MW/655 MWh.

TCC shall continue to increase the number of electric trucks and charging stations as well as to work with other clients to help them achieve Scope 3 emissions reduction in the GHG inventory. Also, in the first half of 2024, TCC will introduce electric RMC mixers and build three "electric truck charging stations" integrated with energy storage system to charge the electric RMC mixer trucks. It is planned to deploy a 180-KW fast charger and EnergyArk 1000 Energy Storage Cabinet at the Taipei Plant and Taoyuan Plant of TCC as well as the Suao Plant of Taiwan Transport & Storage Corp.

EnergyArk Energy Storage Cabinet

TCC combines its core business of low-carbon construction materials with the innovative product of new energy "Ultra-High Performance Concrete (UHPC) Energy Storage Cabinet—EnergyArk." In 2023, the product made its debut at the International Consumer Electronics Show (CES) in the United States and passed the tests of two of the most important international safety standards. Presenting a safe and stable energy storage solution to the world, we have received enthusiastic inquiries from domestic and international companies . During the exhibition, the NHOA.TCC team received feedback from European and American clients that the current energy equipment can no longer meet their needs, and the future surge in energy demand will put a tremendous burden on the grid. Therefore, provision of energy storage systems and stabilization of microgrids are the keys to future energy. The charging station with EnergyArk Energy Storage Cabinet combined makes a solution to various problems. In addition to delivery of stable ultra-high-power charging, it can also protect the grid and ensure safety. TCC also pioneered the industry by employing EnergyArk Energy Storage Cabinet as the core, in combination with the complete energy industry chain presence in energy creation (renewable energy), energy transmission (lithium batteries), and energy storage of TCC Group Holdings, to provide charging stations integrated with green energy charging and energy storage system, green energy matching services, and aggregated energy trading, offering clients with Total Solution of city-level microgrids.

Fire Proof & Extinguishing Guarantee

- Up to 2 hours of protection under 1,050°C heating with excellent fire resistance and flame retardant properties
- Multi-Stage Anomaly Detection in the system design, capable of injecting 9,000 liters of water in 5 minutes to prevent battery thermal runaway upon any thermal runaway detected

Thermal Insulation & Weather Resistance

- Corrosion-resistant, leak-proof, salt-resistant, and highly weather-resistant cabinet
- Up to 10 times of a lifespan, reducing carbon emissions by 50%, compared to traditional metal cabinet
- A 25-35% lower thermal conductivity compared to traditional metal cabinets

Flexibility & Tenacity

- Single/Flexible modular design with spatial flexibility to accommodate multiple application scenarios
- Various PCS configurations, along with modular design of cabinet combination, for optimal battery capacity allocation

Comprehensive Protection

- 24/7 EMS system monitoring & optimal depth of discharge (DOD), extending the lifespan of batteries
- The 1st energy storage cabinet with product liability insurance policy in Taiwan, reducing operational risks
- Comprehensive after-sales service & comprehensive remote anomaly monitoring with Automatic Monitoring Center

RE100 CLIMATE GROUP

Fire-Proof & Extinguishing Guarantee EnergyArk Energy Storage Cabinet Introduced into Commercial Building

In 2023, NHOA.TCC partnered with Cathay United Bank to establish the first low-carbon fast-charging station that integrates EnergyArk Energy Storage Cabinets and T-RECs at the Building of the Ruihu Branch of Cathay United Bank in Taipei. All it takes is only one-third of the electricity of a typical slow-charging station at commercial building to provide fast-charging services without compromising the building's power supply, thereby ensuring the safety. Supporting clients on their path to RE100, the facility helps reduce the Scope 3 emissions from the bank's company cars as well as enables the bank employees and the building's tenants to reduce the costs in the transition to low-carbon transportation.

Ultra-high Power Cells

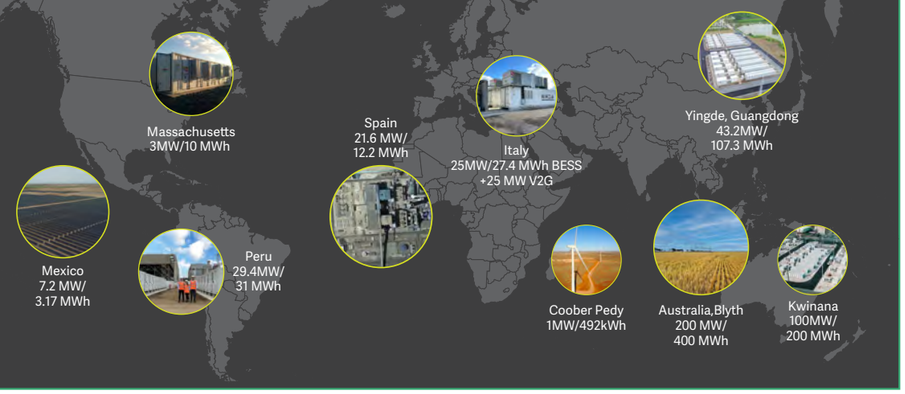
Molicel, a subsidiary of TCC Group Holdings, is devoted to developing "next-generation high-performance ternary lithium-ion batteries" with high energy density and high discharge power. Targeting high-end clients in the areas of electric vertical take-off and landing (eVTOL) aircraft, electric supercars, and electric motorcycles, Molicel has become a world-class leader in high power cells. With the Xiaogang Plant in Kaohsiung put into operation in 2023, Molicel reached an annual production capacity of 3.3 GWh, actively developing and seizing the emerging niche market in the low-carbon economy.

In November 2023, Molicel announced the construction of the world's largest high-performance ternary lithium-ion battery cell plant in Vancouver, Canada, with the firm support from the Canadian Government. The plant is expected to break ground in 2024 and be operational in 2028. With the capability to manufacture 135 million cylindrical ternary lithium batteries per year, it shall be the first low-carbon, ultra-high power battery cell plant in the world using "100% green electricity." This plant construction project is expected to attract Molicel's raw material suppliers (e.g., those of positive electrode powder and steel cans) to set up their factories in Canada as well, forming the ecosystem and cluster of the lithium battery industry. The clustering of the upstream and downstream players over the supply chain can also reduce the carbon footprints brought by transportation, jointly create a win-win prosperity, and promote a low-carbon logistics circle.

SPECIAL COLUMN | Global New Energy Development of NHOA

Energy Storage Solutions – Stabilize Power Supply & Better Grid Resilience

NHOA Energy is one of the global leaders in energy storage system integration, offering advanced energy storage solutions to convert intermittent renewable energy sources into an energy supply 24/7. It also provides grid stabilization services and promotes more renewable energy integration into the grids. TCC unceasingly expands its international charging and energy storage businesses to meet the energy demands of tomorrow. The development of NHOA Energy spans five continents, including solar energy and energy storage systems, utility-scale storage systems, and industrial microgrids. At present, there are 46 sites worldwide, with a total installed capacity of 1,900 MWh online or under construction. It is estimated that more than 1 GWh of capacity will be connected to the grid by 2030.



▲Planned and designed by NHOA, and constructed by NHOA.TCC, the 100-MW E-dReg energy storage project sites at Hoping, Hualien, as well as the 35-MW project site at Suao, Yilan, came online over the Energy Trading Platform (ETP) of Taipower in December 2023 and April 2024, respectively, with a 200-MWh capacity of off-peak/peak load regulation capability daily for Taipower's power grid in the northeast region. Working with the Italian team of NHOA, NHOA.TCC learned about project site construction and regulation, while NHOA gained experience in the electricity regulations, system requirements, and circuit design in Taiwan, achieving a synergy of 1+1>2.

▲Enhanced Dynamic Regulation Reserve (E-dReg) is a hybrid energy storage system, capable of regulating grid frequency over a long-term and supplying electricity to the grid per the needs of Taipower's dispatch. With 2.5 times the number of batteries required compared to Dynamic Regulation (dReg), it presents higher technical barriers and costs. However, it can effectively deliver "peak shaving and valley filling," reducing waste of national grid resources. As of April 2024, the E-dReg energy storage of TCC accounted for 72% of the total capacity on the Energy Trading Platform (ETP) of Taiwan Power Company.

Comprehensive Fastcharging Networks

Free2Move eSolutions under NHOA specializes the development of EV chargers, offering charging equipment for residential, commercial, industrial, and public applications, as well as development of bidirectionalfast-charging vehicle-to-grid (V2G) power grids.

▲Weekly production capacity: 2,750 charging devices

In addition, Atlante, a subsidiary of NHOA specializing in fast and ultra-fast charging infrastructure for electric vehicles (EVs), is developing the largest fast and ultra-fast charging network in Southern Europe, fully powered by renewable energy, energy storage, and vehicle-grid integration (VGI).

▲Install 35,000 fast and ultra-fast charging points by 2030.

▲Install and operate 5,000 fast and ultra-fast

charging points in Italy, France, Spain and Portugal by 2025.

Atlante Supported from the European Union Again

Under the CEF 2 Transport - Alternative Fuel Infrastructure Facility (AFIF), the funding program was committed to a grant of approximately €49.9 million awarded to Atlante in 2023, following the €23 million received in 2022, totaling approximately €73 million in funding.

Atlante has proposed a project, codenamed "Atlante4All," to install 1,800 charging points in four European countries, with over 1,000 fast chargers installed across 407 charging stations, of which 153 located in Italy, 126 in France, 95 in Spain, and 33 in Portugal.

The Atlante4All project will also secure the financial support of France's Groupe Caisse des Dépôts (CDC), which is to provide additional funding for approximately €20 million.

3.5_Low-carbon Supply Chain

Enhanced Supplier Carbon Management

Demanding suppliers to conduct carbon data inventory
Strengthening supplier exchange at the Supplier Convention
Holding greenhouse gas workshops to assist RMC transporters

Green Logistics and Transportation

Installation of chargers at operating sites
Replacement of companyl vehicles
Electrification of transport vehicles
Use of AMP in berthing
Purchase of eco-friendly cement carriers

Key Performances

95.7%
of the Critical Tier-1 Suppliers in Taiwan with valid carbon data

77
more fuel-efficient Phase 5 trucks adopted by outsourced transporters

79%
of RMC trucks replaced with Phase 5 trucks
(leased ones included)

Supplier Carbon Management

The significance of climate change in the supplier selection and evaluation process at TCC has been increasing year by year. Climate adaptation relies on a resilient supply chain. To enhance the resilience of its supply chain to climate change, since 2021, TCC has been requesting its suppliers to fill out carbon questionnaires, collecting data on their carbon emissions, and conducting on-site audits to 10 suppliers per year, with reference to the Scope 3 emissions for SBTs. TCC also provides consultation to the supply chain to reduce carbon emissions, gradually strengthening the low-carbon supply chain. Any supplier that fails to cooperate will be evaluated and reported for "termination of cooperation."

The 2023 Supplier Convention was attended by 150 domestic and foreign suppliers. During the convention, TCC elaborated its sustainable management policies to suppliers as well as the results of supplier evaluations and supplier carbon management plans, so that suppliers could get a better picture of the expectations and directions of TCC. Outstanding suppliers with an excellent performance and those with a significant progress achieved were recognized by TCC. The outstanding suppliers were invited to share their experiences in sustainable development and carbon reduction practices with other suppliers, leading the entire supply chain to march onward together.

TCC organized the GHG Workshop to share innovative carbon reduction actions of the transportation industry and methods and tools for collecting carbon data worldwide, improving the quality of carbon data from RMC transporters. In 2023, 77 Phase 5 trucks were replaced by the outsourced transporters on the plants.

Green Transportation

The supply chain of TCC mainly relies on maritime and land freight. In terms of maritime transportation, the subsidiary Ta-Ho Maritime Corporation has phased out old vessels and purchased two eco-friendly cement carriers, improving the energy efficiency and transportation capacity. In addition, TCC has introduced the Alternative Maritime Power (AMP) system at ports and on ships, which can reduce the fuel consumption and pollution during berthing. In 2023, its CO2 emissions were reduced by 710.3 metric tons. With the third new eco-friendly cement carrier purchased from a renowned Japanese shipbuilder scheduled to join the fleet in 2025, it is expected to reduce carbon emissions by 24.2%.

In terms of land transportation, 384 RMC trucks (leased ones included) have been replaced with those meeting a minimum of Phase 5 environmental standards for emissions, accounting for 83% of the RMC truck fleet. In the future, the plan is to gradually increase the number of eco-friendly RMC trucks and continue to evaluate the feasibility of introducing electric mixer trucks based on the market and technological developments, while accelerating the low-carbon painting of mixer trucks. In addition, the subsidiary Taiwan Transport & Storage Corp. had two electric trucks in 2023. It planned to purchase 5 electric trucks in 2024. Meanwhile it shall successively replace the traditional fuel company cars with electric counterparts and add three charging stations dedicated to electric trucks at operating sites. In response to net-zero action, TCC shall continue to evaluate the feasibility of electrification of mixer trucks and tractors.

3.6_Climate and Natural Disaster Adaptation

Water Resources Management

TCC cherishes water resources and upholds the principle of maintaining product quality with an aim to manage water resources while ensuring a normal operation of production lines. By exploring diversified water resources, implementing reclamation and reuse, TCC comprehensively improves its water use efficiency and continues to introduce innovative water conservation solutions. TCC assesses future water supply based on the WRI's Aqueduct Water Risk Atlas. The results indicated that all the operating sites in Taiwan are not located in water-stressed regions. In Mainland China, except for the Guangan, Huaying, and Anshun Plants, which are located in high water-stressed regions, the remaining sites are also not in water-stressed regions.

TCC ceaselessly strengthens the verification of its management systems, including conducting certifications for ISO 14046 Water Footprint and ISO 46001 Water Efficiency Management Systems, as well as enhances the water resources management within the cement and RMC plants to reduce water consumption. In 2023, TCC began the introduction of the Alliance for Water Stewardship (AWS), an international sustainable water resource management standard. Also, combined with the installation of systematic water footprint management platform internally, TCC is enabled to accurately capture water use and impacts thereof and achieve sustainable water resources management. The first third-party verification audit was completed in September 2023.

The water conservation measures in force on the cement and RMC plants include introduction of rainwater into the mixing system, conveyor belt washing water reclamation, use of rainwater for tire cleaning, increase of water stored in sedimentary ponds, maintenance to the pipelines of water systems, addition of sewage deslimer machine, addition of rainwater harvesting ponds, retrofit of water-using equipment, and employee education and training to reduce water consumption. In addition, TCC continuously communicates with its supply chain on issues of water resources to jointly reduce water use. To strengthen the communication with competent authorities on the issue of water scarcity, TCC holds water supervision meetings with the Industrial Development Administration, Ministry of Economic Affairs on a quarterly basis.

Physical Risk Adaptation

2023 was the hottest year on record. In the face of climate change, TCC is actively addressing the risks posed by extreme weather events, establishing mechanisms for real-time information tracking, prevention, and response. Also, TCC formulated adaptation measures for climate-related disasters to enhance the climate resilience of its plants and mitigate the physical risks posed by disasters, such as disruptions of operations or supply chain. The measures in force are to monitor changes to the local water resources at where TCC production sites operate through the up-to-date water information on government websites and coordinate for optimal inventory levels and transportation flexibility. Hence, TCC puts climate adaptability into practice and strengthens its operational resiliency.

Physical Risk | **Flood**

Risk Description |

Production delay and disruption due to equipment damage

Response Measures |

- **Stipulate directions for emergency response to climate disasters for the RMC plants**
- **Formulate response plans for typhoon and flood prevention for the cement plants**
- **Strengthen the flood prevention facilities at the plants**
- **Ensure safe stocks of raw materials and products prior to the flood season**
- **Purchase natural disaster insurance for high-risk critical equipment.**

Physical Risk | **Drought**

Risk Description |

Production delay and disruption due to water shortage in production

Response Measures |

- **Continuously reduce the water withdrawal intensity in the cement production process**
- **Establish water storage facilities in medium and high-risk plants**
- **Introduce ISO 14046 Water Footprint and ISO 46001 Water Efficiency Management Systems**
- **Install rainwater and process water reclamation and purification equipment to all RMC plants**
- **Establish a water footprint management platform to monitor the water use of the plants in real time**

Risk Description |

Product transportation and coordination failure due to interruptions of river transportation

Response Measures |

- **Plan to transport raw materials by rail for the Guigang Plant**
- **Enhance transportation capacity with the canal infrastructure of the local government in Mainland China**
- **Actively coordinate the production of different plants to prevent any obstruction in material or product transportation**

CHAPTER 4

Establishing A Solid Management Framework

If companies act alone in the absence of a proper governance structure and collaboration, it may lead to more chaos. A sound climate risk governance framework has been established at TCC, integrating climate actions among businesses to ensure the success of climate actions and promote the entire group to work jointly towards the goals of mitigating carbon emissions and climate change.

4.1_Climate Governance

As the highest governing body on climate issues at TCC, the Board of Directors is responsible for supervising and overseeing all economic, environmental, and social risks, with climate risks and opportunities taken into consideration. The Corporate Sustainable Development Committee and the Risk Management Committee have been established at TCC to support the corporate climate strategy development. The Corporate Sustainability Committee is in charge of approving and directing the sustainable development strategies and performance at TCC, including climate governance and low-carbon transition planning. It convenes at least twice a year and reports the results to the Board of Directors. The Board of Directors may monitor and review the execution status and development direction through the report thereof to ensure the alignment with the sustainable development strategies of the Company. In 2022, the Office of Responsibility and Sustainability was established to facilitate cross-departmental communication and coordination, integrate resources of TCC Group Holdings for more effective sustainability project promotion, as well as propose improvement recommendations.

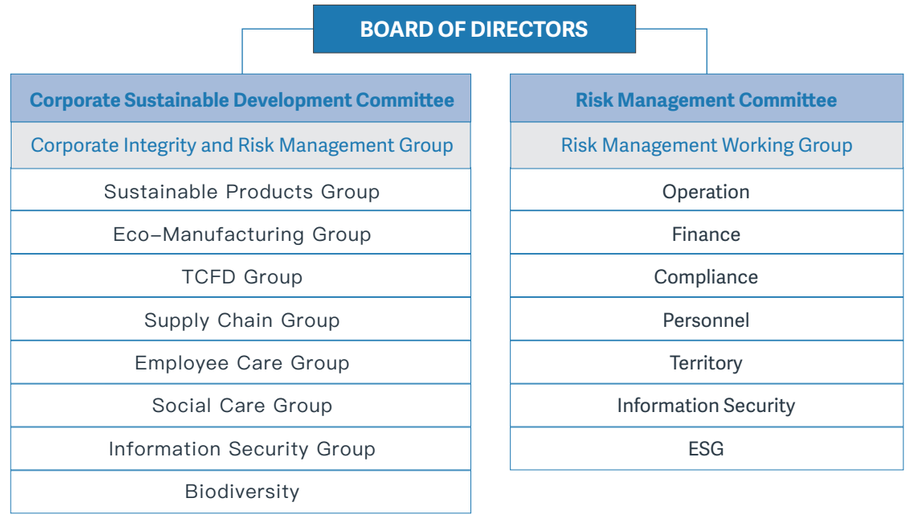
The Risk Management Committee is responsible for risk control and risk governance enhancement. With the President as the highest person in charge in risk management-related issues, the committee conducts operational risk identification and management of the Company, including climate-related physical and transition risks. It leads the planning of risk-related response measures. The committee reports to the Board of Directors at least once a year on the management team's performance and risk control results and is responsible for supervision and follow-up thereof. In 2023, the climate-related performance indicators and targets were formulated and adopted by the Board of Directors. The relevant progresses shall be tracked continuously and reported to the Board of Directors on a regular basis moving forward.

Board of Directors and Functional Committees Attendance:
Attendance rate in 2023 98.97%
*Attendance by proxy included

Professional Development of the Board of Directors on Climate Issues
The total hours of courses on climate and sustainability-related for the Board of Directors in 2023: 48 hours

Governance and Management Structures and Responsibilities

The Sustainable Development Working Group has been established under the Corporate Sustainable Development Committee, encompassing functional groups of seven key sustainability areas. These groups are composed of first-level supervisors and senior personnel from various departments, in charge of promoting sustainability tasks related to their functions. The Working Group assesses the progresses on climate and other sustainability issues, as well as future plan directions, through annual meetings and written reports, in order to fine tune strategies and practices. The Chief Sustainability Officer reports the results to the Corporate Sustainable Development Committee on a regular basis. The Risk Management Working Group has been established under the Risk Management Committee, which is also composed of first-level supervisors from various departments. They communicate and formulate strategies based on seven aspects of risk to ensure that strategies are put into practice as well as report the results and plans to the Risk Management Committee.



Major climate change issues discussed by various bodies within the climate management framework.

Body	Responsibilities and scope on climate issues	Members	Important Results in 2023
Board of Directors Meetings convened: 4	The highest decision-making body for approving and overseeing the climate change strategies of the Company	Convener Nelson An-ping Chang, Chairman 14 Directors 9 Juristic Person Director Representatives 5 Independent Directors	**FSC Sustainable Development Pathway Planning:** GHG inventory progress tracking from Q4 2022 to Q2 2023 **IFRS S1 & S2:** TCC's responses to risks and recommendations and invited to the initiative to advance the adoption or use of the ISSB's Climate Standard as the climate global baseline **Sustainability Trends Assessment:** The plan in response to the Ministry of Environment's carbon fee collection in 2025 and the EU's new battery regulations to demand disclosure of the carbon footprint of electric vehicle batteries **Low-carbon and Green Products:** Analysis of the development opportunities for the low-carbon cement of Cimpor; description of the development direction of net-zero buildings and low-carbon construction materials of GCCA; application status of the low-carbon certification progress for sustainable products **Biodiversity:** "TCC Nature & Biodiversity Report-TNFD Pilot Program" published; the Biodiversity Group established

Body	Responsibilities and scope on climate issues	Members	Important Results in 2023
Corporate Sustainable Development Committee Meetings convened: 2	Supervision of the execution of climate strategies and project performance at TCC and approval of relevant indicators and targets proposed by the Sustainable Development Working Group	Convener: Nelson An-ping Chang, Chairman 2 Members: Independent Director Victor Wang and President Roman Cheng	▎The carbon reduction pathway of TCC replanned to align with the SBTs for 1.5°C ▎Low-carbon cement development and certification status tracking and confirmation of the GCCA's focused goals in alignment with the development directions of TCC Group Holdings ▎Discussion the changes to the 2023 annual report with the application of IFRS S1 and S2
Risk Management Committee Meetings convened: 2	Review and assessment of risk management and improvement recommendation proposal, including climate risks, to ensure that the risk management framework remains aligned with corporate strategies	Convenor: Independent Director Sherry S. L. Lin 2 Members: Independent Director Victor Wang and Independent Directors Lynette Ling-Tai Chou	▎Annual update on the matrix of major risks identified on seven aspects ▎Report on "climate-related performance indicators and targets" and progresses thereof ▎Impact from the carbon fee levy in Taiwan

Regarding various climate-related issues, TCC regularly communicates and coordinates across departments, including the Works Department, Finance Department, Sales Department, Procurement Department, Low-carbon R&D Center, Human Resources Department, cement plants, RMC plants, etc. Meetings are called at least biweekly or monthly to track the execution of departments' emission reduction projects and climate strategies. To keep tabs on the development on climate issues, the Chairman also holds meetings with the President and Vice Presidents from functional units from time to time to oversee the climate actions on the ground.

Meeting	Department/Personnel Involved	Agenda Items	Key Matters Adopted in 2023
Cross-departmental Monthly Meeting Report	Senior managers from the Works Department, Finance Department, Sales Department, Procurement Department, Human Resources Department, cement plants, and RMC plants	Market operations, monthly profit and loss, material procurement, use of alternative raw materials/fuels, carbon emission status, and project progresses	▎Use of construction waste as resources ▎Research and development of calcined clay ▎Development of oxy-fuel combustion technology ▎Development of limestone cement
Biweekly Meeting on Environmental Protection	Managers from the President Office, Works Department, Low-carbon R&D Center, Finance Department, the cement plants in Mainland China, the Suao Plant, and the Hoping Plant	Survey on the types, sources and quantities of alternative raw materials/fuels, setting of disposal prices and mechanisms, use of alternative raw materials/fuels, and construction of waste disposal projects Ultra-High Performance Concrete (UHPC) Test Progress Report	▎Development of low-carbon products
SBT Meeting	Middle and senior managers of cement plants, managers of the Works Department, and managers of the Low-carbon R&D Center	Tracking and analysis of carbon emission intensity of cement plants Tracking of progress in carbon reduction projects at cement plants Tracking of alternative materials/fuels use at cement plants Planning for alternative fuel intake, storage, and feeding processes	▎Investment in PV and energy storage systems & testing of ultrafine limestone powder at the Yingde Plant and the Guigang Plant ▎Investment in the supporting facilities for alternative fuel use ▎Investment in cooler upgrade projects to increase production and reduce consumption at the Yingde, Guigang, and Hoping Plants ▎Investment in the cement mill upgrade projects to increase production and reduce consumption at the Yingde plant ▎Coal injection pipe replacement and technical transformation at the Suao plant ▎Testing of oxygen enriched combustion in the kiln head at the Suao Plant ▎Investment in bypass venting system

4.2_Climate Remuneration Linkage

TCC puts its climate strategies into practice by continuously tracking medium- and long-term targets and the performance on various non-financial indicators, incorporating the results into the appraisal for executive remuneration. In addition, the performance of corporate governance, green finance, social inclusion, and environmental protection are included in the personal performance appraisal of the President as well. The Remuneration Committee aggregates the contributions of these factors to the operations of the Company and the reasonableness of the remuneration for the deliberation and adoption by the Board of Directors. Additionally, TCC promotes low-carbon transition via the accountability mechanism for all employees. The achievement rate of internal

management targets for carbon reduction of each plant is also linked to the performance appraisal, remuneration, and bonuses for the managers of respective plant, so as to implement the medium- and long-term targets and actively track the performance on climate-related indicators. Starting from 2019, carbon reduction targets are set at TCC each year for the cement plants in Taiwan and Mainland China. For the plants in Mainland China, various KPIs are set during the annual budget preparation by the Finance Department. The progresses are checked through an AI-powered Carbon Reduction Management Platform. The platform presents real-time daily data and progresses against targets, including emission intensity, carbon reduction project progresses, and the use of alternative raw materials/fuels. The performance tracking of each plant is explored on the biweekly SBT Meeting. In 2023, TCC continued to improve the internal carbon trading mechanism promotion and relevant indicator assessment system establishment. The binding force of allowance trading among plants and the linkage of plant performance to the compensations and bonuses of all employees on the plants served as the driver for the collective efforts of internal carbon reduction to advance at full thrust on the net-zero pathway of TCC Group Holdings.

4.3_Climate Awareness & Education/Training

TCC proactively cultivates climate change awareness and carbon management capabilities among employees at all levels in the Company. It has launched a series of diversified education and training programs for courses like climate awareness. Thus, it not only strengthens the internal understanding of climate risks but also better implements sustainable strategies. The training courses cover a wide range of personnel, from executive board members to frontline staff. The contents encompass crucial climate areas such as climate change risk trends, GHG inventory, and low-carbon transition strategies, demonstrating the collective determination and efforts at TCC to promote low-carbon transition throughout the Company.

Professional Development Program for Directors

Trends of Risks under Climate Change - Nature, Water, and Human Rights
2023 Cathay Sustainable Finance and Climate Change Summit
Sustainable Transformation Series 4-1: Challenges and Opportunities in Global Net-Zero Transition
Open Path to International Carbon Trading: Carbon Risk and Carbon Asset Management
Cultural Intergration and Social Innovation in Contemporary Architecture; Development and Implications of the International Carbon Border Adjustment Mechanism

Content |

Climate-related emerging risks, climate change trends and experience sharing platform, net-zero transition pathways, introduction to global carbon trading mechanisms, carbon credits, carbon asset management, as well as the CBAM development and response

Participants | Directors and Independent Directors Total hours of professional development: 51 hours

2023 TCC Carbon Academy

GHG Inventory Talent Development Program	Management Sustainability Consensus Camp	Low-carbon Product Consensus Camp
The low-carbon transition strategies at TCC, ISO 14064 Standard, inventory techniques, internal audits and external verifications, practices sharing from colleagues, case studies and discussions, and post-course tests	International sustainable management trends and corporate carbon talent development, sustainability challenges and competitiveness of TCC, and the basics of corporate sustainability certification management	Carbon management and circular sustainability from the perspective of construction supply chain, narratives and strategies for the low-carbon products of TCC, and the 2024 TCC low-carbon product sales strategies
Participants | Persons in charge of GHG Inventory from various business units (designated by supervisors) & employees that voluntarily sign up for the program 81 participants in total	**Participants |** Assistant Vice Presidents/Plant CEOs and managers of higher level at TCC & Presidents/Plant CEOs and managers of higher level at the affiliated enterprises to TCC 83 participants in total	**Participants |** Personnel in charge of the business related to the research and development/manufacturing/sales of low-carbon products 177 participants in total

CHAPTER 5

Planning Green and Sustainable Finance

TCC establishes a climate-friendly sustainable finance framework, which incorporates climate risks into financial considerations, and integrates the principles of sustainability into business operations and investment decisions. This not only helps to reduce carbon emissions and environmental impacts but also promotes long-term economic stability and growth for the company. At the same time, it is a dedication to future generations, ensuring that they can continue to enjoy a clean, healthy environment and sustainable economic development.

5.1_Green Investment/Financing

TCC Group Holdings has established a solid operating model and growth curve since the launch of its transformation blueprint in 2018. At the end of 2023, TCC was assigned an "international credit rating" of BBB- and a "Stable" outlook by Fitch Ratings, one of the three major global capital market credit rating agencies. The report was mainly based on Taiwan Cement's leading position in the cement markets of Taiwan, Turkey, and Portugal, as well as its important position in the cement markets of southern and southwestern provinces in Mainland China. Meanwhile, Fitch Ratings affirmed that the profit model of TCC can generate stable profits and cash flow. With the advancement towards the goal of Net Zero by 2050, the world has entered an era of green competition at scale. The green transformation of TCC demands an ongoing investment, which also ushers in endless opportunities for the Company to build a more innovative and carbon-competitive future for TCC.

Green/ Sustainable Financial Instruments	Description
Sustainable and Green Credits **Fund Raised** **Sustainable and green financing lines of NT$95,734,509 thousands**	TCC has proactively requested financial institutions to add green or sustainable use indicators to the credit line of the Group. It is expected that more than 30% of TCC Group Holdings' credit lines will be converted into green or sustainable credits by 2024. The purposes of these sustainable uses include, but are not limited to: Carbon Reduction: Decreasing greenhouse gas emissions, reducing air pollution | Promoting the circular economy, waste reduction | Manufacturing, transmission, and related uses and products of renewable energy | Acquiring energy storage systems and charging stations | Clean Transportation: Purchasing electric vehicles, using low-sulfur fuels in ships, implementing shore power systems, and manufacturing batteries for new energy vehicles | Green Building Construction | Biodiversity Conservation: Protecting terrestrial and aquatic biodiversity The Hoping Industrial Port Corporation invests in projects of marine resources such as corals, fish, and shellfish, based on which some financial institutions have marked the credit line for Hoping Port as green credit.
Sustainabilty -linked Loan **Fund Raised** **€800 million**	In February 2024, TCC's subsidiary signed an €800 million unsecured sustainability-linked term loan, which was oversubscribed by 1.5 times. The loan interest rate is linked to the Scope 1 and Scope 2 carbon emission intensity indicators, demonstrating the determination of TCC Group Holdings to carbon reduction and low-carbon transition.
Green Euro-Convertible Bond (Green ECB) **Fund Raised** **US$ 420 million**	TCC successfully became the first Taiwanese enterprise that issued a Green Euro-Convertible Bond certified by Sustainalytics, as well as released the "Green Financing Framework," which received the Second-Party Opinion from Sustainalytics. This framework includes the following initiatives: use of alternative raw materials/fuels, energy efficiency, air pollution control, water resource utilization and management, renewable energy, clean transportation, green building, and environmental sustainability management of natural resources and land use.

Green/ Sustainable Financial Instruments	Description
Green Euro-Convertible Bond (Green ECB) **Fund Raised** **US$ 420 million**	TCC issued $420 million Green Euro-Convertible Bond in green projects within this framework and obtained certification from an independent third party. The company will regularly disclose the progress and execution details of these green projects and allow audits by independent third-party entities.
Global Depositary Receipt (GDR) **Fund Raised** **US$384.7 million**	TCC's US$384.7 million Global Depositary Receipts (GDR) issued in October 2023 was the largest GDR successfully issued in Asia in the past two years. It is one of the few cases in which the ratio of subscriptions from long-only funds and ESG investment institutions exceeded double digits, mainly for green spending on energy storage, electric vehicles, and charging stations in subsidiaries.

5.2_Financial impacts arising from the climate risks and opportunities

Climate Action	Low-Carbon Circular Production
Response to Climate Risk	**Transition Risk** R1 Carbon trading/carbon fee/carbon tax for Cap and Trade R2 Costs in the low-carbon technologies, equipment and management R3 Rising prices of raw materials and energy R4 Impacts on corporate reputation R5 Impacts on the strength of supports from financial institutions in investment, financing, and insurance R8 Regulations and procurement of renewable energy
Response to Climate Opportunity	O1 Smart low-carbon production and waste co-processing O2 Securing inventors' willingness for long-term investment O3 Involvement in the electricity trading market O4 Involvement in the carbon trading market O5 Installation of new energy projects O6 Exploration of the market for low-carbon products
Financial Impact	**Current Impact:** The increase in the use of alternative fuels, reducing the consumption of coal, has led to a reduction in operating costs by NT$1,190,466 thousands and has contributed to generating positive cash flow. Waste heat power generation and the self-consumption of solar energy reduce the purchased electricity, decreasing operating costs by NT$1,560,313 thousand and contributing to positive cash flow.

Climate Action	Low-Carbon Circular Production
Financial Impact	Unit: NT$ thousand

Capital Expenditures and Related Expenses	2022	2023	Estimated Planning Investment in 2024
Alternative raw materials/ fuels	1,649,965	2,349,129	2,971,647
Energy saving and carbon reduction equipment	191,286	113,117	915,686
Equipment and process enhancements	1,338,983	2,191,219	2,732,092
Self-generated renewable energy equipment	546,875	506,502	274,424
Total	**3,727,109**	**5,159,967**	**6,893,849**

Future Impact:

In the future, it is anticipated that payments for carbon fees to regulatory authorities or participation in carbon trading markets will be required. Therefore, it is expected that there will be an increase in operating costs, liabilities, and cash outflows from operating activities. TCC has set SBT for carbon reduction. Additionally, plans are in place to set the next phase target for 2030 in 2024, referencing SBT's 1.5°C global warming scenario, to mitigate the impact on operating costs.

The goal for the thermal substitution rate is to reach 25% by 2025 and 35% by 2030. It is anticipated that the use of alternative fuels will increase, leading to a reduction in the amount of purchased coal. Consequently, this is expected to lower future operating costs and is anticipated to contribute to generating positive cash flow.

Improvements in waste heat recovery efficiency and an increase in self-generated solar energy will reduce the need for purchased electricity. Additionally, TCC has joined EP100, aiming to increase energy productivity by 50% by 2040 compared to 2016. This is expected to reduce future operating costs and contribute to positive cash flow.

Climate Action	Leading the Industry in Low-Carbon Building Materials
Response to Climate Risk	**Transition Risk:** R2 Costs in the low-carbon technologies, equipment and management R3 Rising prices of raw materials and energy R4 Impacts on corporate reputation R5 Impacts on the strength of supports from financial institutions in investment, financing, and insurance
Response to Climate Opportunity	O2 Securing inventors' willingness for long-term investment O6 Exploration of the market for low-carbon products

Climate Action	Leading the Industry in Low-Carbon Building Materials

Financial Impact

Current Impact:

The construction of facilities and equipment for sustainable cement products resulted in capital expenditures of NT$117,523 thousand, leading to cash outflows, as well as depreciation expenses of NT$10,184 thousand for the year.

TCC continues to implement relevant management systems and certifications in the process of producing low-carbon products. These investments include the costs for the introduction and certification of ISO management systems, as well as third-party certification fees (including carbon labels, carbon reduction labels, green building material labels, green factory labels, etc.). To enhance the promotion of low-carbon products and services, TCC internally expands the manpower of the New Cement Business Center and invests in employee/supplier education and training costs. Externally, TCC continues to invest in marketing and communication expenses. The aforementioned investment has impacted the finances, including generating operating costs and expenses of NT$19,040 thousand, leading to cash outflows from operating activities.

Selling low-carbon products, including Portland Type I Cement, Portland Type II (MH) Cement, which have obtained carbon reduction labels in Taiwan, achieved the Ministry of the Interior's certification for low-carbon circular building materials; Portland Limestone Cement, and Portland Limestone Cement Concrete; cementitious materials with less than 50% cement content or obtaining carbon reduction labels, low-carbon concrete with green building material certification, and low-carbon cement certified by Mainland China's low-carbon cement certification. This resulted in generating operating revenue of NT$39,279,069 thousand, leading to an increase in cash inflows from operating activities.

Unit: NT$ thousand

Capital Expenditures and Related Expenses	2022	2023	Estimated Planning Investment in 2024
Consultancy and verification of the carbon footprint of Portland Type I Cement (bulk)	1,007	1,062	1,915
Verification and auditing operations of BS 8001 Circular Economy	150	-	751
ISO 14064 and ISO 14067 project consulting and certification for RMC plants	7,384	2,264	6,518
Maintenance of carbon labels and carbon reduction labels for cement plants in Taiwan	-	-	2 ,162
Application of carbon labels and carbon reduction labels for RMC Plants in Taiwan	1,620	3,270	3,404
Application of green factory labels for RMC Plants in Taiwan	-	1,216	-
Application of green building material labels for RMC Plants in Taiwan	-	2,411	2,156
ISO 50001 Energy Management certification for RMC plants in Taiwan	-	1,617	-
Low-carbon cement label certification for Plants in Mainland China	869	1,206	1,163
Total	**11,030**	**13,046**	**15,907**

Climate Action	Leading the Industry in Low-Carbon Building Materials

Financial Impact

Future Impact:

In the process of promoting sustainable products and services, the involvement of low-carbon product R&D costs, ISO management system implementation and certification costs, and expenses for employee/supplier education and training, as well as the expansion of the New Cement Business Center, will lead to an increase in future operating costs and expenses, as well as cash outflows from operating activities.

TCC continues to optimize product formulations in Mainland China, driving an increase in the sales of low-carbon products, which will lead to an increase in future operating revenue and cash inflows from operating activities.

Climate Action	Innovation in Low Carbon and Negative Carbon Technologies

Response to Climate Risk

Transition Risk:

R4 Impacts on corporate reputation

R5 Impacts on the strength of supports from financial institutions in investment, financing, and insurance

R11 Breakthrough in the advanced technology of carbon capture and storage (CCS)

Response to Climate Opportunity

O2 Securing inventors' willingness for long-term investment

O7 Application of the oxygen enriched combustion and oxy-fuel combustion technologies to carbon capture and reuse

Financial Impact

Current Impact:

With significant advancements in AI technology, future investments in AI-related hardware and software will substantially increase. This year, TCC has already increased investments in AI-related equipment (such as GPUs) by NT$8,050 thousand. Additionally, investments in AI talent development and related expenses have increased this year's operating costs and expenses by NT$9,993 thousand, resulting in cash outflows.

Investing in the development and application of alternative raw materials, alternative fuels, oxygen-enriched combustion, and carbon capture technologies has resulted in research and development expenses of NT$604,036 thousand, leading to an increase in cash outflows.

Invest in negative-emissions technology. End of January 2024, TCC announced signing the MOU for cooperation on a carbon capture project with thyssenkrupp Polysius (tkPOL). Hoping Plant will implement the concept, and jointly develop the third-generation pure oxygen combustion process and technology. It is expected to lead to an increase in capital expenditures, resulting in cash outflows, as well as an increase in operating expenses and cash outflows from operating activities.

Climate Action Innovation in Low Carbon and Negative Carbon Technologies

Financial Impact

Unit: NT$ thousand

Capital Expenditures and Related Expenses	2022	2023	Estimated Planning Investment in 2024
Research and development of Ultra-High Performance Concrete (UHPC)	304,614	187,587	45,725
Efficient combustion project for alternative fuels	-	31,094	33,095
Oxygen-enriched and oxy-fuel combustion technologies	-	3,878	228,761
Total	**304,614**	**222,559**	**307,581**

Future Impact:

Continued investment in AI-related equipment will lead to an increase in capital expenditures, resulting in cash outflows. Additionally, investing in AI talent development and related expenditures will lead to an increase in operating costs and expenses, resulting in an increase in cash outflows from operating activities.

Carbon capture stands as a leading global climate technology. Presently, TCC is collaborating with thyssenkrupp Polysius (tkPOL) to co-develop the third-generation oxy-fuel combustion process and technology. It is expected to lead to an increase in capital expenditures, resulting in cash outflows, as well as an increase in operating expenses and cash outflows from operating activities.

Climate Action Smart New Energy Business

Response to Climate Risk

Transition Risk:

R1 Carbon trading/carbon fee/carbon tax for Cap and Trade

R4 Impacts on corporate reputation

R5 Impacts on the strength of supports from financial institutions in investment, financing, and insurance

R8 Regulations and procurement of renewable energy

R10 Transformation of the coal-fired Hoping Plant

Response to Climate Opportunity

O2 Securing inventors' willingness for long-term investment

O3 Involvement in the electricity trading market

O4 Involvement in the carbon trading market

O5 Installation of new energy projects

Financial Impact

Current Impact:

By integrating energy storage systems, coupled with green electricity and enhancing the Energy Management System (EMS), TCC can help regulate the power grid to achieve stable power supply. Additionally, through the model of storing electricity during off-peak hours and discharging during peak hours, TCC adjusts the electricity demand within the plant to save operating costs of NT$54,069 thousand and generate positive cash flow.

Climate Action Smart New Energy Business

Financial Impact

Current Impact:

The revenues generated from energy storage power transactions and charging services amounted to NT$5,321,096 thousand. (If the amount before offsetting transactions with related parties within the consolidated entities is included, the figure is NT$10,029,748 thousand. The difference is due to the subsidiary NHOA and NHOA.TCC assists the parent company and other subsidiaries in establishing energy storage systems.) This led to an increase in cash inflow from operating activities.

The trading of renewable energy generated revenues of NT$496,301 thousand. (If the amount before offsetting transactions with related parties within the consolidated entities is included, the figure is NT$ 560,070 thousand. The difference is due to the subsidiary, TCC Green Energy Corporation, selling green electricity to related enterprises.) This resulted in an increase in cash inflow from operating activities.

Unit: NT$ thousand

Capital Expenditures and Related Expenses	2022	2023	Estimated Planning Investment in 2024
Solar power project sites	40,362	-	-
Fishery and electricity	738,454	777,515	3,715,370
symbiosis project sites			
Wind farms	82,691	285,322	112,338
Geothermal energy development	6,504	251,624	133,600
Energy storage projects	2,658,684	8,242,171	1,926,265
Super battery factory construction project	5,441,368	2,186,616	4,988,532
Super Battery machinery and equipment	5,574,632	4,069,665	4,786,708
Charging stations (Taiwan)	72,157	52,681	458,008
Ocean energy development	18,443	23,755	814,741
The micro-hydropower construction project for power	-	-	18,404
plant thermal discharge channels			
Feasibility research on micro-hydropower	1,417	3,471	-
Total	**14,634,712**	**15,892,820**	**16,953,966**

Future Impact:

Investing in a diverse array of renewable energy projects, including the Chiayi fishery and electricity symbiosis and the Changhua wind farm, the Taitung Vakangan geothermal energy, and the Hualien OTEC projects, as well as engaging in new energy project development and the installation of energy storage systems within the facilities, will lead to an increase in future capital expenditures and cash outflows and will generate depreciation expenses.

The energy business continues to develop new project sites. The renewable energy management targets are set at 500 MW for 2025 and 700 MW for 2030. The energy storage installation goal is to achieve a global installed capacity of >2GWh by 2025. This will lead to an increase in capital expenditures, resulting in cash outflows, higher depreciation expenses, non-depreciation operating costs and expenses, and an increase in cash outflows from operating activities.

Climate Action Smart New Energy Business

Financial Impact

Continued investment in new energy and cross-industry talent cultivation. The target for investment in employee education and training expenses is NT$125,000 thousand by 2025 accumulatively and NT$250,000 thousand by 2030 accumulatively. This will lead to an increase in operating costs and expenses, as well as an increase in cash outflows from operating activities.

The future plan to purchase renewable energy electricity will lead to an increase in operating costs and expenses, as well as an increase in cash outflows from operating activities.

Operational sites are successively installing energy storage systems, including a 35 MW/123.6 MWh system at the Suao plant and a 50 MW/160.8 MWh system at the Hualien plant. These systems support internal electricity usage or participate in power trading platforms for ancillary services. It is expected to increase operating revenue and positively impact the cash inflow from operating activities; reduce the cost of purchased electricity, decrease future operating costs, and contribute to generating positive cash flow.

Climate Action Low-Carbon Supply Chain

Response to Climate Risk

Transition Risk:
R2 Costs in the low-carbon technologies, equipment and management
R3 Rising prices of raw materials and energy

Response to Climate Opportunity

O1 Smart low-carbon production and waste co-processing
O6 Exploration of the market for low-carbon products

Financial Impact

Current Impact:

Importing electric bulk cement tractor heads, and gradually updating the RMC trucks in the RMC plants to Phase 6 eco-friendly RMC trucks. At the same time, we are continuously converting company cars at each operating site to electric vehicles, and evaluating the purchase of electric trucks, tractors, and mining trucks.

TCC Group's affiliated company, Ta-Ho Maritime Corporation, currently owns two environmentally friendly cement carriers and is collaborating with a renowned Japanese shipbuilding company to design third-generation high-efficiency carriers. In 2023, the 'NAPA Voyage Optimization System' was introduced to provide real-time fleet positioning, integrate weather and sea conditions, and port schedules, plan the best routes and speeds, and implement the Ship Energy Efficiency Management Plan Part III (SEEMP PART III) to reduce the carbon intensity of ship operations.

Climate Action Low-Carbon Supply Chain

Financial Impact

Unit: NT$ thousand

Capital Expenditures and Related Expenses	2022	2023	Estimated Planning Investment in 2024
Procurement of Phase 6 eco-friendly RMC trucks for RMC plants in Taiwan	-	5,100	21,560
Procurement of electric RMC trucks for RMC plants in Taiwan	-	-	25,530
Procurement of new eco-friendly cement carriers	290,292	-	449,231
Docking overhaul of cement carriers	40,369	26,098	157,236
Transformation of existing cement carriers (Installation of Alternative Maritime Power system)	24,435	4,885	5,868
Construction of Alternative Maritime Power systems	20,154	37,999	1,657
Electrification of large transportation vehicles	17,400	-	272,500
Third-party consultant for carbon data collection and on-site assessment	700	1,638	2,133
Total	**393,350**	**75,720**	**935,715**

Future Impact:

TCC will adopt electric vehicles for all company cars in the future, along with the purchase of electric trucks, tractors, and mining trucks, which is expected to lead to an increase in capital expenditures, resulting in cash outflows and generating depreciation expenses.

Climate Action Climate Disaster Adaptation

Response to Climate Risk

Physical Risk:
R6 Drought (production)
R7 Flood (production)
R9 Changes in precipitation patterns and extreme changes in climate patterns (transportation)

Financial Impact

Current Impact:

In response to droughts and floods, TCC has improved resilience and adaptability by setting up water storage tanks, implementing projects to enlarge discharge outlets, recycling waste water from waste heat recovery power generation projects, introducing water resource management systems, and ensuring against natural disasters. In total, this includes an increase in equipment costs of NT$50,162 thousand, resulting in cash outflows from investing activities, and operating costs and expenses of NT$47,766 thousand, leading to cash outflows from operating activities.

Climate Action Climate Disaster Adaptation

Financial Impact

Unit: NT$ thousand

Capital Expenditures and Related Expenses	2022	2023	Estimated Planning Investment in 2024
Water recycling-related facilities	45,539	50,162	16,444
Climate resilience enhancing facilities	47,744	1,369	13,949
Typhoon additional insured	19,092	25,711	25,711
Certification of Water Footprint and Water Efficiency Management System	3,006	2,226	2,529
Total	**115,381**	**79,468**	**58,633**

Future Impact:

If extreme climate events such as floods and droughts occur, they may cause disruptions in the delivery and scheduling of products or raw materials, necessitating adjustments in transportation methods, which could lead to increased transportation expenses. Floods may also lead to equipment being submerged and requiring repairs, as well as the future need to enhance slope protection. During severe droughts, the cost of purchasing water will increase. This will lead to an increase in operating costs and expenses, resulting in an increase in cash outflows from operating activities.

CHAPTER 6

Climate Metrics and Targets

Just as light guides people towards the right path, TCC has set clear climate metrics and targets to ensure effectiveness in climate action. By establishing specific and quantifiable objectives, TCC can measure the progress of its climate actions and motivate the participation and support of internal and external stakeholders.

6.1_Greenhouse Gas Emissions Metrics and Targets

Climate Related Metrics and Targets

Item	Status of performance	Performance in 2023	Target by 2023	Target by 2025	Target by 2030	Target by 2050
GHG Management						
Base year 2016						
Unit: tCO_2e/metric ton of cementitious materials						
Taiwan	V	0.769	0.775	0.758 (SBT -11%)		Carbon
Mainland China	Achievement Rate 99.11%	0.671	0.669	0.651 (-11%)	0.585	Neutral Concrete
Taiwan & Mainland China (weighted average)	Achievement Rate 99.13%	0.686	0.691	0.675		
Water Intensity Reduction-						
Base year 2023						
Unit: megaliter/ metric ton of cementitious materials						
Taiwan & Mainland China (weighted average)	▲	0.000236	0.000240	0.000233	0.000225	0.000220
Thermal Substitution Rate of Alternative Fuels						
Taiwan & Mainland China (weighted average)	▲	13%	15%	25%	35%	50%
Ratio of Alternative Raw Materials						
Taiwan & Mainland China (weighted average)	▲	19%	19%	21%	22%	25%
Clinker/cement ratio						
Taiwan & Mainland China (weighted average)	▲	0.799	0.800	0.796	0.780	0.570
Renewable Energy Installed Capacity						
Unit: MW	145 MW (Cumulative by the end of 2024)		—	235MW	400MW	750MW
Taiwan & Mainland China						
Carbon capture	Carbon capture technology scale-up verification measures under development		—	—	100,000 tons/year	1,600,000 tons/year
Unit: ton						
Valid Data of Carbon Emissions Collected from Critical Tier-1 Suppliers	V	95.7%	78%	—	90%	—
	Implementation of the third-party carbon review program for raw material suppliers in Taiwan and Mainland China in 2024					

Note 1 ▲New or adjusted metrics

Note 2 Projects that have not achieved their targets will continue to be monitored for improvements. For details on climate action-related content, please refer to Chapter 3.

GHG Emissions

Absolute GHG Emissions in 4 Years

Absolute emissions | Unit: tCO_2e		2020	2021	2022	2023
Scope 1	Cement plants | Taiwan	4,411,086	4,797,296	4,312,390	3,457,601
	RMC plants | Taiwan	2,059	1,517	1,776	1,893
	Operations Offices | Taiwan	140	132	146	137
	Subtotal | Taiwan	4,413,285	4,798,945	4,314,312	3,459,631
	Cement plants | Mainland China	31,255,633	25,867,678	20,715,305	17,405,089
	Operations Offices | Mainland China	-	-	-	19
	Subtotal | Mainland China	31,255,633	25,867,678	20,715,305	17,405,108
	Total | Taiwan & Mainland China	35,668,918	30,666,623	25,029,617	20,864,739
Scope 2	Cement plants | Taiwan	202,312	212,407	210,273	186,576
	RMC plants | Taiwan	7,101	6,866	6,571	5,905
	Operations Offices | Taiwan	1,199	1,119	1,636	1,544
	Subtotal | Taiwan	210,612	220,392	218,480	194,025
	Cement plants | Mainland China	1,257,882	1,094,397	846,574	642,045
	Operations Offices | Mainland China	-	-	-	110
	Subtotal | Mainland China	1,257,882	1,094,397	846,574	642,155
	Total | Taiwan & Mainland China	1,468,494	1,314,789	1,065,054	836,180
Scope 1+2	Cement plants | Taiwan	4,613,398	5,009,703	4,522,663	3,644,176
	RMC plants | Taiwan	9,160	8,383	8,347	7,798
	Operations Offices | Taiwan	1,339	1,251	1,782	1,681
	Subtotal | Taiwan	4,623,897	5,019,337	4,532,792	3,653,655
	Cement plants | Mainland China	32,513,515	26,962,075	21,561,879	18,047,134
	Operations Offices | Mainland China	-	-	-	129
	Subtotal | Mainland China	32,513,515	26,962,075	21,561,879	18,047,263
	Total | Taiwan & Mainland China	37,137,412	31,981,412	26,094,671	21,700,918
Scope 3	Cement plants | Taiwan	22,427	28,761	16,709	511,001
	RMC plants | Taiwan	-	-	181,053	267,430
	Operations Offices | Taiwan	907	814	719	5,499,459
	Subtotal | Taiwan	23,334	29,575	198,481	6,277,890
	Cement plants | Mainland China	-	-	-	1,104,573
	Total | Taiwan & Mainland China	23,334	29,575	198,481	7,382,463

Emissions Intensity in 4 Years

Item	2020	2021	2022	2023
Scope 1 & 2				
Cement Plants | Taiwan (tCO_2e/ metric ton of cementitious material)	0.813	0.806	0.803	0.769
RMC Plants | Taiwan (tCO_2e/m^3 of concrete)	0.0018	0.0016	0.0016	0.0016
Cement Plants | Mainland China (tCO_2e/ metric ton of cementitious material)	0.723	0.709	0.690	0.671

Note [1]The GHG emissions were inventoried in terms of operational control. The formula used is emissions = activity data × emissions factor (EF) × global warming potential (GWP). The EF used for Taiwan is subject to the EPA GHG Emissions Factor Management Table (v. 6.0.4); the GWP for the Cement Plants is derived from the IPCC Fourth Assessment Report (2007); the GWP for RMC Plants and Operation Headquarters is derived from the IPCC Sixth Assessment Report (2021). The EF for Mainland China is subject to the Guidelines for Accounting and Reporting Greenhouse Gas Emissions: China Cement Production Enterprises (Trial), the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, and the 2019 Refinement, and the GWP is derived from the IPCC Sixth Assessment Report (2021).

Note [2]For the data of the Cement Plants in Taiwan in 2022, the Scope 1 draws reference from the EPA GHG Emissions Factor Management Table (v. 6.0.4); the Scope 2 draws reference from the electricity EF of 0.495 kg of CO_2e/kWh from the Energy Administration, MOEA in 2022.

Note [3]Since 2018, the most important activity associated with Scope 3 emissions: Upstream Transportation and Distribution has been inventoried based on the GHG Protocol - Corporate Value Chain (Scope 3) Accounting and Reporting Standard (WRI & WBCSD), and it is verified by a third-party entity. In 2023, TCC conducted inventory and verification on all categories. Details please refer to ESG Section on TCC Corporate Website.

Note [4]In 2023, due to operational adjustments, the Liaoning and Huaihua Cement Plants, as well as the grinding plants in Mainland China, are excluded from the disclosure scope. New additions include "Distribution Stations" (excluding those under the jurisdiction of RMC Plants) and "Operations Offices in Mainland China." Cement Plants in Mainland China and Operations Offices in Taiwan have added "Scope 3" disclosures

Note [5]The baseline year for the GHG inventory of cement plants is 2016, with emissions of 4,621,312 tCO_2e for Scope 1 and Scope 2 in Taiwan and 32,523,195 tCO_2e in Mainland China.

Note [6]From 2020 to 2023, Taiwan Cement's operational sites purchased renewable energy or renewable energy certificates from external sources. As a result, the Scope 2 emissions under the market-based method and the Scope 2 emissions under the location-based method are consistent.

Note [7]Due to alignment with internal operational planning, the climate-related metrics and targets in CH6.1, specifically the 2023 greenhouse gas management performance data for Mainland China, which is 0.675, does not include the subsidiary Guizhou Gang'an Cement Co., Ltd. However, the figure of 0.671 in this table does include the subsidiary, hence the difference.

Note [8]The 2023 GHG emissions data for Cement Plants, RMC Plants, and Operations Offices have been verified under ISO 14064-1 verification. The data for RMC Plants includes emissions from Distribution Stations under their jurisdiction, as well as the Hualien Plant.

6.2_Other Climate-related Key Indicators

Energy use

Energy used in 4 years

Energy Used Directly | Energy Used Indirectly | Energy Recovery and Recycling | Total

Energy Used (Unit GJ)	2020	2021	2022	2023
Cement Plants | Taiwan (including coals, diesel fuel, and gasoline)	16,316,761	17,667,458	16,399,563	11,614,267
RMC Plants | Taiwan (including diesel fuel and gasoline)	28,170	20,786	24,304	20,901
Operations offices| Taiwan (including diesel fuel, gasoline, and natural gas)	251	434	427	151
Subtotal | Taiwan	16,345,182	17,688,678	16,424,294	11,635,319
Cement Plants | Mainland China (including coals, diesel fuel, and gasoline)	125,512,147	102,964,854	78,040,602	65,413,927
Operations offices| Mainland China (including diesel fuel, gasoline, and natural gas)	-	-	-	267
Subtotal | Mainland China	125,512,147	102,964,854	78,040,602	65,414,194
Total | Taiwan & Mainland China	141,857,329	120,653,532	94,464,896	77,049,513
Cement Plants | Taiwan (purchased electricity)	1,481,726	1,580,660	1,540,800	1,423,590
RMC Plants | Taiwan (purchased electricity)	50,219	48,636	46,800	43,852
Operations offices | Taiwan (purchased electricity)	12,420	11,700	14,184	13,524
Subtotal | Taiwan	1,544,365	1,640,996	1,602,000	1,480,966
Cement Plants | Mainland China (Purchased electricity)	9,303,773	8,179,002	5,763,600	4,898,715
Operations offices | Mainland China (Purchased electricity)	-	-	-	697
Subtotal | Mainland China	9,303,773	8,179,002	5,763,600	4,899,412
Total | Taiwan & Mainland China	10,848,138	9,819,998	7,365,600	6,380,378
Cement Plants | Taiwan (waste heat to power)	428,486	497,725	388,800	228,780
Cement Plants | Mainland China (waste heat to power)	4,620,139	3,723,552	2,919,600	2,565,800
Total | Taiwan & Mainland China	5,048,625	4,221,277	3,308,400	2,794,580
Cement Plants | Taiwan	18,226,973	19,745,843	18,329,163	13,266,637
RMC Plants | Taiwan	78,389	69,422	71,104	64,753
Operations offices | Taiwan	12,671	12,134	14,827	13,675
Subtotal | Taiwan	18,318,033	19,827,399	18,415,094	13,345,065
Cement Plants | Mainland China	139,436,059	114,867,408	86,723,802	72,878,442
Operations offices | Mainland China	-	-	-	964
Subtotal | Mainland China	139,436,059	114,867,408	86,723,802	72,879,406
Total | Taiwan & Mainland China	157,754,092	134,694,807	105,138,896	86,224,471

Energy used in 4 years

Note 1 The heating values of coal for the Cement Plants in Taiwan are converted per the respective settings of the plants. The converted heating value of coal for the Suao Plant: 5,532.69 kcal/kg; the converted heating value of coal for the Hoping Plant: 5,570.14 kcal/kg; the converted heating value of coal for other plants: 5,500 kcal/kg. The values for other items are converted based on the heating values in the Emissions Factor Management Table (v. 6.0.4) released on the Energy Administration's website. The values are 5,500 kcal/kg for coal, 8,400 kcal/l for diesel, 7,800 kcal/l for gasoline, 3,600 GJ/GWh for electricity, and 8,000 (kcal/m3) for natural gas. The scope 2 draws reference from the electricity EF of 0.495 kg of CO2e/kWh from the Energy Administration, MOEA in 2022.
Note 2 The data of energy use is subject to the reported data to the Energy Administration.
Note 3 The Cement Plants in Taiwan started collecting data on gasoline use in 2022, which were used all by corporate cars.
Note 4 Based on the 2023 cementitious materials yield of 4,736,970 metric tons in Taiwan, the energy consumption is 2.8007 GJ/metric ton of cementitious materials. In Mainland China, based on the 2023 cementitious materials yield of 26,811,285 tons, the energy consumption is 2.7182 GJ/metric ton of cementitious materials.
Note 5 Based on the 2023 concrete yield of 4,923,159.50 m3 in Taiwan, the energy consumption in concrete production is 0.01315 GJ/m3 of concrete.
Note 6 Due to operational adjustments in 2023, the Liaoning Cement Plant, Huaihua Plant, and grinding plants in Mainland China are not included in this disclosure. Additionally, data from manufacturing plants exclude the associated distribution stations, and the "Mainland China Operations Office" has been added.
Note 7 The data for the Operations Offices in Taiwan includes subsidiaries and affiliated companies located within the Operation Headquarters building, as well as the foundation.
Note 8 In 2023, the total internal energy consumption at Taiwan sites was 14,678,126 GJ. Of this, non-renewable energy consumption amounted to 13,651,712 GJ, while renewable energy consumption was 1,026,414 GJ. The categories of non-renewable energy fuels included coal, diesel, gasoline, natural gas, purchased electricity, power generation by waste heat recovery, and non-renewable alternative fuels, with non-renewable alternative fuels totaling 306,646 GJ. The categories of renewable energy included renewable biomass fuels and self-generated solar energy. Renewable biomass fuels, converted at 4.186 kJ per kcal, amount to approximately 1,016,321 GJ. Self-generated solar energy, converted at 3.6 GJ/kWh, amounts to approximately 10,093 GJ.

Energy Use Efficiency

Item		2020	2021	2022	2023
Energy Intensity	Cement Plants | Taiwan (Unit GJ/metric ton of cementitious material)	3.137	3.097	3.186	2.801
	RMC Plants | Taiwan (Unit GJ/m3 of concrete)	0.0150	0.0124	0.0140	0.0132
	Cement Plants | Mainland China (Unit GJ/metric ton of cementitious material)	2.924	2.819	2.682	2.718

Renewable energy use

Renewable energy use in 2023 | Unit kWh

Item		2020	2021	2022	2023
Self-generated and self-used					
Taiwan	TCC Operation Headquarters	48,371	50,114	45,000	10,544
	Cement plants	30,987	68,940	63,136	1,908,471
	RMC plants	-	47,044	192,705	884,554
	Subtotal	79,358	166,098	300,841	2,803,569
Mainland China	Cement plants	-	-	889,310	14,029,781
Taiwan & Mainland China	Subtotal	79,358	166,098	1,190,151	16,833,350

Note 1 Self-generated and self-used renewable energy had not been activated at Mainland China Plants for 2020 – 2021.

Alternative raw fuel related ratios

Alternative raw fuel related ratios	2020	2021	2022	2023
Percentage of use of alternative raw materials *	16.4%	18.2%	19.6%	18.7%
Thermal substitution rate of alternative fuel *	-	1.2%	7.6%	12.6%

*Cement Plants | Taiwan & Mainland China

Water Resources Used

Water Resources Used in 4 Years

**Water Resources Use	** Unit: megaliters		2020	2021	2022	2023
Freshwater	Cement Plants | Taiwan (including Municipal water, Groundwater, Industrial water and Rainwater)		2,065.35	1,861.55	1,648.81	2,148.75
	RMC Plants | Taiwan (including Municipal water and Groundwater)		580.90	589.56	638.34	662.83
	Operations offices | Taiwan (including Municipal water)		14.96	12.69	13.60	14.23
	Cement Plants | Mainland China (including Municipal water, Groundwater, Industrial water, surface water of rivers, lake / reservoir, Rainwater and mining water)		18,107.02	14,109.44	9,644.61	10,043.81
	Operations offices | Mainland China (including Municipal water)		-	-	-	2.04
Recycled water from manufacturing process	Cement Plants | Taiwan		93.48	102.43	112.81	73.07
Total	Cement Plants | Taiwan		2,158.83	1,963.98	1,761.62	2,221.82
	RMC Plants | Taiwan		580.90	589.56	638.34	662.83
	Operations offices | Taiwan		14.96	12.69	13.60	14.23
	Subtotal | Taiwan		2,754.69	2,566.23	2,413.56	2,898.88
	Cement Plants | Mainland China		18,107.02	14,109.44	9,644.61	10,043.81
	Operations offices | Mainland China		-	-	-	2.04
	Subtotal | Mainland China		18,107.02	14,109.44	9,644.61	10,045.85
	Total | Taiwan & Mainland China		20,861.71	16,675.67	12,058.17	12,944.73

Total		2020	2021	2022	2023
Process	Cement Plants | Taiwan	94,049.42	90,787.46	87,945.39	62,047.29
Recycled	RMC Plants | Taiwan	307.39	430.20	448.61	438.00
Water	Cement Plants | Mainland China	15,510.87	11,773.31	9,609.60	9,779.46
Other	Cement Plants | Taiwan	-	-	-	54.49
Recycled					
Water					

Note 1The water use data on cement plants is the sum of the reported data. The municipal water use on RMC plants is the sum of water used on the water bills, and the groundwater data is the sum of the reported data, as the water use data is subject to the actual months of water use. The municipal water use data on the Operation Headquarters is the sum of water used on the water bills.

Note 2The scope of disclosure for RMC plants is the water for which TCC holds water rights. Disclosure of groundwater began in 2019. The water use data for the water for which TCC holds no water rights in 2020 is estimated on the basis of sales.

Note 3All the sources of water are freshwater.

Note 4TCC employed WRI's Aqueduct Water Risk Atlas to assess the future water supply. The result revealed that only the Guangan Plant and the Huaying Plant in Sichuan as well as the Anshun Plant in Guizhou are located in the regions of high-water stress, while all other operation sites in Taiwan and Mainland China are not located in water stress areas.

Note 5In 2023, due to operational adjustments, the Liaoning and Huaihua Cement Plants, as well as the grinding plants in Mainland China, are excluded from the disclosure scope. New additions include "Distribution Stations" (excluding those under the jurisdiction of RMC Plants) and "Operations Offices in Mainland China"; The disclosure items for the cement plant have been updated to include "Rainwater/Spring Water Extraction" in Taiwan, and "Process Recycled Water" has been renamed to "Discharged Reclaimed Water."

Note 6The 2023 use of tap water of Cement Plant in Taiwan is due to the expansion of the statistical scope to include TCC DAKA.

Note 7The increase in water use data in Taiwan's RMC Plants in 2022 compared to 2021 is attributed to the expansion of scope.

Note 8In 2023, the water discharge from the cement plants in Taiwan was 265.95 million liters. The cement plants in Mainland China had zero discharge, with all being disposed of in accordance with local regulations. Taiwan's cement plants consumed 1,955.87 million liters of water, while the cement plants in Mainland China consumed 10,043.64 million liters of water. The total water consumption for cement plants was 11,999.51 million liters; RMC plants achieved zero discharge.

Note 9The data for the Operations Offices in Taiwan includes subsidiaries and affiliated companies located within the Operation Headquarters building, as well as the foundation.

Note 10The increase in water withdrawal from water-stress regions in 2023 is due to the inclusion of Guangan Jiuyuan Environmental Protection in the scope, as well as the addition of Mining Water and Rainwater in the statistics.

Water Resources Use Efficiency

Item		2020	2021	2022	2023
Water usage intensity	Cement Plants | Taiwan & Mainland China (Unit million liters/metric ton of cementitious material))	-	-	-	0.000236

Note 1Since the new disclosures are made based on water consumption intensity from 2023, hence there is no relevant statistical information for the years from 2020 to 2022.

6.3_Cross-industry Climate-Related Metrics

Metrics and Targets	Contents	Corresponding section
Greenhouse gas emissions	Entities should disclose the total absolute greenhouse gas emissions of Scope 1, Scope 2, and Scope 3 for the reporting period, expressed in metric tons of CO_2 equivalent; they should also disclose the methods used to measure their greenhouse gas emissions.	6.1 Greenhouse Gas Emissions Indicators and Targets
Transformation Risk	The amount and percentage of assets or operational activities susceptible to climate-related transformation risks.	CH1 Foresight of Climate-related Risks
Physical Risk	The amount and percentage of assets or operational activities susceptible to climate-related physical risks.	CH1 Foresight of Climate-related Risks
Climate-related Opportunities	The amount and percentage of assets or operational activities.	1.1 Identification of Climate-related Risks and Opportunities Ch5 Planning Green and Sustainable Finance
Capital Arrangement	The amount of capital expenditure, financing, or investment allocated for climate-related risks and opportunities.	Ch5 Planning Green and Sustainable Finance
Internal Carbon Price	Entities should disclose: whether and how they apply a carbon price in decision-making (for example, investment decisions, transfer pricing, and scenario analysis); and the price per ton of greenhouse gas emissions used by the entity to assess the cost of its greenhouse gas emissions.	1.2 Climate Scenario Analysis 3.2 Industry-leading Low-carbon Construction Materials
Remuneration and Reward	Entities should disclose: whether and how climate-related considerations are incorporated into the compensation of senior executives; and the percentage of compensation for senior management recognized in the current period that is linked to climate-related considerations.	CH4 Establishing A Solid Management Framework

APPENDIX

Reference Sources

1. Global Risks Report 2023 (WEF, 2023)

2. World Energy Outlook 2023 (WEO, 2023)

3. Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2021)

TCC Sustainability and Climate Related Policies, Reports and Publications

1. TCC Sustainability Report 2023
2. TCC Annual Report 2023
3. TCC Corporate Sustainable Development Committee Organizational Procedures
4. TCC Risk Management Executive Committee - Organizational Procedures
5. TCC Risk Management Policy and Principles

TCFD Disclosure Comparison Table

Aspects	TCFD disclosure items	Corresponding section of this report	Page
Governance	a) Describes the risks and opportunities associated with the Board's oversight of climate-related matters	4.1 Establishing A Solid Management Framework	44
	b) Describes the role of management in assessing and managing climate-related risks and opportunities	4.1 Establishing A Solid Management Framework	44
Strategies	a) Describes the short-, mid-, and long-term climate related risks and opportunities identified by the organization	1.1 Identification of Climate-related Risks and Opportunities	05
	b) Describes the climate related risks and opportunities that have a significant or material impact on the organization's business, strategy and financial planning, and clearly discloses the actual financial impact on the organization and information on the organization's low carbon economic transformation plan	1.1 Identification of Climate-related Risks and Opportunities 5.2 Financial impacts arising from the climate risks and opportunities	05 52
	c) Describes the organization's strategic resilience, taking into account different scenarios of climate change, including scenarios of 2°C or lower	1.2 Climate Scenario Analysis	11
Risk Management	a) Describes the organization's process for identifying and assessing climate-related risks	1.1 Identification of Climate-related Risks and Opportunities 4.1 Establishing A Solid Management Framework	05 44
	b) Describes the organization's process for managing climate-related risks	1.1 Identification of Climate-related Risks and Opportunities 4.1 Establishing A Solid Management Framework	05 44
	c) Describes how the organization's processes for identifying, assessing, and managing climate related risks are integrated into overall risk management program	1.1 Identification of Climate-related Risks and Opportunities 4.1 Establishing A Solid Management Framework	05 44
Indicators and Objectives	a) Discloses the metrics used by the organization to assess climate related risks and opportunities in accordance with the strategy and risk management process	6.1 Greenhouse Gas Emissions Indicators and Targets	62
	b) Discloses Scope I, II, III emissions quantities and related risks (if applicable)	6.1 Greenhouse Gas Emissions Indicators and Targets	62
	c) Describes the organization's goal for managing climate-related risks and opportunities and the performance of that goal, adding disclosure of milestones (if the organization has a mid- to long-term goal)	6.1 Greenhouse Gas Emissions Indicators and Targets 6.2 Other Climate-related Key Indicators	62 65

Additional Disclosures for the Construction Materials Industry

Aspects	TCFD disclosure items	Corresponding section of this report	Page
Strategies	d) Incorporates climate risks and opportunities into existing strategic decision-making considerations, including planning for climate change mitigation and adaptation targets	1.1 Identification of Climate-related Risks and Opportunities	05
	e) Organizations with more than US$1 billion in annual revenue need to implement more complete climate related scenarios	1.2 Climate Scenario Analysis	11
Indicators and Objectives	d) Disclosure of relevant key indicators, including energy, water and land use, etc.	6.1 Greenhouse Gas Emissions Indicators and Targets	62
		6.2 Other Climate-related Key Indicators	65

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CONFORMITY STATEMENT

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Conformity Statement

Climate related Financial Disclosure

This is to conform that

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Holds Statement Number CFD 792269

TCC Group Holdings CO., LTD. follows the Recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) with Supplemental Guidance for the Non-Financial Groups to disclose climate-related financial information which is clear, comparable and consistent against its organizational risks and opportunities as well as its financial impacts. The disclosure covers the four core elements of the TCFD and is prepared based on the seven guiding principles for effective disclosures.

The maturity model for the Climate-related Financial Disclosures with Supplemental Guidance for the Non-Financial Groups is **Level 5+: Excellence** grade.

涵蓋非金融產業補充指引之氣候相關的財務揭露的成熟度模型為**[第五級 Plus：優秀]**等級。

For and on behalf of BSI

Managing Director BSI Taiwan, Peter Pu

Latest issue: 2024-06-24 Expiry date: 2025-06-23

Page 1 of 2

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