



Times Higher Education
**Sustainability
Impact Ratings**

SDG

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Affordable and
Clean Energy



2024 Sustainability Report



4.2 Energy Saving and Carbon Reduction Actions

Greenhouse Gas Emissions

MCUT conducted its first greenhouse gas inventory in 2010 and established this as the base year. In 2022, MCUT resumed its greenhouse gas inventory and conducted both the inventory and verification in September 2023. The greenhouse gas inventory for 2023 was finalized and verified in 2024 and is disclosed in this report. MCUT's greenhouse gas emissions reached 10,441.620 tCO₂e in 2010 and 9,475.313 tCO₂e in 2023, respectively. The verification work, a crucial step in ensuring the accuracy of our data, was conducted by a third-party company called TÜV SÜD. Their findings indicated that the carbon emissions of MCUT in 2023 were reduced by 8.99% compared to those in the base year. Over the past twelve years, MCUT has consistently installed digital electricity meters, set up solar power generation facilities, comprehensively replaced original lamps with LED lights and substituted air-conditioning units with variable frequency units, and established an "Energy Monitoring System." An intelligent information transmission system has been implemented to monitor and manage the university's energy consumption at all times. MCUT continues to implement its Greenhouse Gas Inventory work to evaluate the effectiveness of its CO₂ reduction strategy, enhance energy-consuming equipment and facilities, and minimize CO₂ emissions. In 2023, due to improvements in MCUT's research capabilities, the laboratory facilities were continuously upgraded, leading to an increase in the university's power consumption. The primary sources of MCUT's greenhouse gases are indirect energy emissions. Looking ahead, MCUT plans to regularly conduct greenhouse gas inventory assessments and work towards achieving Net Zero emissions.

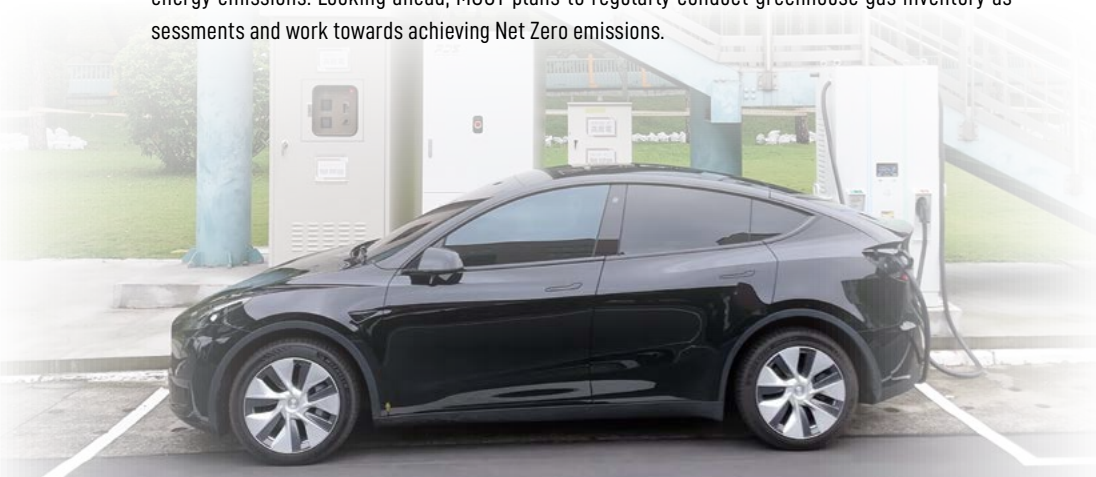
Statistics of MCUT's greenhouse gas emissions

Year	2023	
	Emission equivalent (tCO ₂ e/year)	Ratio
Scope 1 Direct emissions	879.8930	9.29 %
Scope 2 Indirect emissions	8,179.8620	86.33 %
MCUT's greenhouse gas emissions	9,059.755	95.61 %
Scope 3 Other indirect emissions	415.7376	4.39 %
Total greenhouse gas emissions	9,475.313	100 %
Greenhouse gas emissions per capita (tCO ₂ e/person)		1.88

Note 1: Four types of greenhouse gases were emitted, including carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and hydrofluorocarbons (HFCs); there were no emissions of perfluorocarbons (PFCs), sulfur hexafluoride (SF₆), and nitrogen trifluoride (NF₃).

Note 2: Relevant data from 2024 were disclosed during MCUT's greenhouse gas inventory in 2023. Since MCUT's annual greenhouse gas inventory is verified in September of the following year, the greenhouse gas inventory process for MCUT in 2024 is as follows: internal verification will be conducted in September 2025; external verification will take place in October 2024; and the certificate will be obtained in December 2025.

Note 3: The number of teachers and students used to calculate carbon emission intensity per capita was the sum of the number of students in the academic year 2023 (4,383 students) and the number of faculty and staff (excluding part-time teachers, totaling 644), amounting to a total of 5,027.



Energy Consumption and Management

Item	Handling status
Energy utilization	- In 2024, the overall power consumption increased by 0.4% compared to 2023. The energy usage index (EUI) per unit of floor area reached 92.15 kWh/m² on average, up by 0.41 kWh/m compared with the previous year. - Microgrid of energy storage system: Installed capacity of solar panels: 30kWp; energy storage system installation: 100kw/200kWh; charging piles of electric vehicles: 180kW*1 + 7kW*5 - Solar energy facility installation: In 2024, the solar energy facility generated a total of 454,976 kWh of electricity in the first phase, resulting in a savings of NT\$ 2,346,871. The installation cost of the second phase of the solar energy facility was approximately NT\$48 million, and it is expected to be completed by the end of 2025. - Energy management installation cost: The cost of 85 smart electricity meters in phase 1 as well as the energy platform maintenance fees reached NT\$ 7.5 million, while the cost of 150 smart electricity meters in phase 2 would be NT\$ 7.5 million. - Air-conditioning replacement expenses in 2024: NT\$ 1.21 million.
Energy saving and carbon reduction measures	- In 2023, MCUT introduced energy-saving technologies and implemented an energy monitoring system in September. They strengthened management of high-energy-consuming equipment and continuously upgraded or replaced systems like lighting, elevators, and exhaust ventilation to boost energy efficiency and lower greenhouse gas emissions on campus. They also adopted measures such as an official vehicle carpooling system and the purchase of electric scooters. In December 2024, the university released the second edition of its energy policy, which outlines plans for energy control, conservation initiatives, and evaluation mechanisms. This policy aims to promote proper energy usage concepts and behavioral awareness, implement source-level management, and reduce overall energy and resource consumption. - Below is the data regarding carbon reduction as estimated in the energy-saving measures adopted in 2024 - In 2024, a total of 35 LED street lamps were replaced. Based on an estimated annual usage of 4,380 hours, this upgrade is expected to reduce electricity consumption by 40.9%, saving approximately 6,898 kWh of electricity and reducing greenhouse gas emissions by 3.27 metric tons of CO₂e. - In 2024, we replaced 600 panel lights. If calculated over 2,120 hours, this is expected to reduce power consumption by 55.4% annually. Specifically, 39,432 kWh of electricity can be saved, resulting in a reduction of 18.69 tCO₂e. - In 2024, night-time energy-saving mode was implemented on 104 water dispensers. For the UW-9505AG-110V model, which consumes approximately 1.2 kWh per day for 24-hour standby heating, an 8-hour shutdown from 10:00 PM to 6:00 AM was applied. This results in a daily energy saving of approximately 0.4 kWh per unit (1.2 × 8 / 24). Over the course of the year, the total estimated electricity savings amounted to 15,184 kWh, equivalent to a reduction of 7.19 tCO₂e. - In 2024, a total of 96 ceiling lights on the stadium's first floor were replaced. Based on an estimated annual usage of 780 hours, this upgrade is expected to reduce energy consumption by 54%, resulting in annual electricity saving of approximately 2,246 kWh, which is equivalent to a reduction of 1.064 tCO₂e. - In 2024, the lighting fixtures on the third-floor court of the stadium were replaced. With an estimated annual usage of 1,200 hours, this replacement is expected to reduce energy consumption by 25%, leading to annual electricity saving of about 5,280 kWh, which corresponds to a reduction of 2.5 tCO₂e. - In 2024, the lighting fixtures on the fifth-floor court of the stadium were replaced. Based on an estimated annual usage of 900 hours, the upgrade is expected to reduce operating time by 37%, resulting in annual electricity saving of approximately 13,320 kWh, which is equivalent to a reduction of 6.313 tCO₂e.
Solar photovoltaic net-zero construction	- In March 2021, in support of Taiwan's green energy policy, MCUT completed the first phase of solar panel installation across three buildings: the Machinery Hall, Innovation Building, and Teaching Building, with a total installed capacity of 413.06 kWp. By December 2024, the system had generated a cumulative total of 1,858,158 kWh of electricity, resulting in a reduction of approximately 918.93 metric tons of carbon emissions. - In August 2024, the campus energy storage solar microgrid system was completed, offering a solar power installation capacity of 30 kWp. From September to December, the system produced 5,743 kWh of electricity, resulting in a reduction of approximately 2.7 metric tons of carbon emissions. - In 2025, MCUT plans to implement the second phase of its solar panel installation project, with a planned installed capacity of 548.6 kWp.
Energy policy and sustainable development	- MCUT's energy policy has been developed with the joint participation of all faculty, students, and relevant stakeholders. It aligns with global trends in reducing greenhouse gases and government policies, aiming to advance the transition toward Net Zero and carbon neutrality while fully implementing ESG principles and the Sustainable Development Goals (SDGs). - Through the establishment of administrative management procedures, MCUT actively promotes Green Procurement, encourages faculty and students to engage in Green Research and Development (R&D), and integrates industry resources to foster collaboration between the green industry and academia. Additionally, we organize workshops and seminars focused on energy saving, carbon reduction, and community awareness to deeply embed the concept of Green Education within student development. - In 2024, MCUT received a subsidy from the Energy Administration, Ministry of Economic Affairs, as a demonstration unit for the ISO 50001 Energy Management System and carbon inventory. We engaged GPTEK Technology Co., Ltd. to assist in establishing the necessary systems and processes. As of December 2024, MCUT has successfully obtained the audit certification.

Note: The unit of the power carbon emission factor is kilograms of CO₂e per kWh. The power carbon emission factors for 2020, 2021, 2022, 2023, and 2024 were 0.502, 0.509, 0.495, 0.494, and 0.474, respectively.

MCUT's energy utilization

Unit: GJ

Type of fuel	2023	
	GJ	Ratio
Gasoline	73.8056748	0.12 %
Diesel	33.1667952	0.06 %
Purchased electricity	59524.22691	99.82 %
Total energy consumption	9,475.313	100 %
Energy density per capita of teachers and students (GJ/number of persons)		11.86218408

Note 1: The source of energy conversion factors is version 6.0.4 of the Greenhouse Gas Emission Coefficient Management Table published by the Ministry of Environment. The calorific value coefficients for other energy types are also based on version 6.0.4 of the same table: gasoline — 7,800 Kcal/L; diesel — 8,400 Kcal/L; and electricity — 860 Kcal/kWh. The conversion factor from Kcal to GJ is 0.00000418 GJ/Kcal.

Note 2: The population used to calculate per capita carbon emission intensity includes the total number of students in the 2023 academic year (4,383) plus faculty and staff (excluding part-time teachers, totaling 644), resulting in a total of 5,027 people.

Changes of EUI in past three years

Item	Year	2022	2023	2024
Electricity usage		10,959,360	11,958,448	11,906,036
Floor area (m ²)		129,199	129,199	129,199
Energy Use Intensity (EUI)		84.83	92.55	92.15
Per capita electricity consumption		2,334.3	2,650.4	2,368.4
Percent change in per capita electricity consumption		5.6 %	13.59 %	-10.6 %

Note 1: According to sunshine duration data released by the Central Weather Administration, the sunshine duration recorded at the Taipei Observation Station in 2024 was 1,469.5 hours, representing a decrease of 10.58% compared to 2023.

Note 2: Definition of sunshine duration: The actual amount of time that sunlight is received at a location; when the heat flux density exceeds 120 watts per square meter (W/m²), it is counted as sunshine duration for that location.



Solar power generation in the past three years

Electricity generated by solar photovoltaic panels	2022	2023	2024
For campus use	134,575	147,290	137,476
Sold to the grid	302,345	336,659	318,461
Total	436,920	483,950	455,937

Note 1: According to sunshine duration data released by the Central Weather Administration, the sunshine duration recorded at the Taipei Observation Station in 2024 was 1,469.5 hours, representing a decrease of 10.58% compared to 2023.

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觀音山環境與生態教育年報



當 ESG 智慧綠能遇 SDGs 永續發展跨域課程

新北市泰山區同榮國小教務主任 李琇貞 撰稿

同榮 Hi 翻轉永續環境教育，將 **SDGs** 永續發展以跨域課程融入 **ESG**，朝向「臺灣 2050 環境教育學習目標 - 淨零轉型新世代」，透過親師生共學共好的課程規劃、設計與實踐，進行豐富多元的環境教育實踐活動，整合學校社區化與社區學校化的合作力量，共同推廣 **ESG** 綠能環境教育的理念，提升同榮親師生的環境危機意識，並鼓勵共同實施環保行動～開展環保、友善與幸福的校園文化與社區環境！

綠能智慧學習創造力 / 小小環保實踐家

今年幼兒園主題教學以「家庭紙箱」為探索活動，透過細心的觀察與收集家中的紙箱活動，讓孩子認識生活上紙箱的處理流程為「購物、裝物、回收再用」，建立友善消費及保護環境的能力與好習慣，並運用家校合作的雙贏策略，將紙箱回收再利用，能大幅提升實踐環境韌性的行動力。

本次幼兒園主題課程包含三個階段，『初階』- 覺知辨識：觀賞各種形式的紙箱，並觀看回收再創作的環保藝術品影片或是圖片。『中階』- 推理賞析：除了影片或圖片中的藝術作品，老師也會提問孩子自己的創作想法。『進階』- 想像創作：畫一畫我的紙箱環保聖誕藝術作品設計圖。

在師生合力的創作過程中，使用閒置紙箱進行大型藝術作品，



雖然幼童尚未有創作家的專業技術能力，仍能達成永續發展綠能的學習目標，並巧妙選用無害環境的環保色彩顏料與資源回收素材，在嘗試多次練習的經驗後，孩子終於能開心完成彩繪任務，個個笑顏逐開成為最美的課堂風景。

師生資訊科技素養力 / 環保防災小勇士

響應教育部與新北市政府落實永續發展推廣計畫，積極推動全民防災教育，促進升級全民防災素養力，希冀透過學校、家庭與社區之聯合網絡系統，提高彼此的互助能力，期待能降低災害的損害，達到防災、減災與災後復原的三大目標。

這是一項保護地球的使命與對下一代的責任，為了深化環境教育向下扎根，政府攜手民間單位與 **PaGamO** 以公益合作模式，攜手打造高國中小學創新環保防災學習平臺，讓環保防災線上遊戲能跨越時空的限制，加乘學習發揮最大的解方成效。同時在老師、家長及志工的共同引領下，培養學生減少碳足跡的知能與習慣，讓學校、社區及

肆、淡水河流域夥伴年度成果

環保電競遊戲能落實永續環境教育，創造出親子共樂共學的環保防災素養。

本校邀請文斌與家丞等資訊教師與六年級導師通力協作，融入校訂資訊轉化課程共同推動「環保防災勇士養成計畫」電競比賽活動，激發學童能自主學習永續發展環保課程的動機，建立正確的環保防災知識、技能及態度價值觀，進而在生活中落實具體環保行動。

淨零碳排永續課程力 / 環保知識閱讀家

為了讓學生認識並應用「淨零碳排」的主題學習，學校呼應政府永續發展的目標理念，規劃整合式的「永續發展環境課程計畫」，以淨零碳排出發，讓學生共同體驗環保活動，課程設計以排碳排廢為方向，以點、線、面為概念設計一系列永續課程，幫助孩子們能善用平板自動開展「搜尋、辨識、摘要、整合、反思」的學習優序，連結生活經驗豐富了學習視野。在此，誠摯感謝「友綠環保工作坊」社區



環保專家熱心入校進行綠能宣導活動。

在專題活動後，孩子開心地問：「什麼時候還會再開課？」，志工老師感受孩子們熱情思考、踴躍討論問題，以及提出解決方案的態度，師生共同合作完成報告，一起努力成果發表。透過本次「淨零碳排」專題閱讀體驗行動，同榮環保教育的種子深耕了，淨零綠生活正逐漸發芽、成長與茁壯……，導入每天的永續發展行動～你今天「綠能」了沒？

