National Taitung University
Greenhouse Gas Inventory Report 2022

March 22, 2023

(2nd Ed.)

Edition History

Edition	Publication Date	Remarks on Revisions
1	2023/02/15	New edition published.
2	2023/03/22	Carbon Inventory revised.

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Chapter 1 Introduction and Policy Statement

1.1 Preface

As the base for cultivating higher education talents, universities also undertake the important mission of cultivating future citizens of the earth, and they are duty-bound to educate and practice "sustainable development." In 1990, at the International Symposium on "The Role of Universities in Environmental Management and Sustainable Development" held in Talloires, France, the presidents of the participating universities co-sponsored and signed The Talloires Declaration, revealing the sustainable development of universities action plan. This declaration gradually developed into today's global "Green University" movement; the United Nations Environment Program pointed out in the "Greenhouse Gas Emissions Gap Report" in 2014 that global carbon neutrality should be achieved between 2055 and 2070; otherwise, the earth will face the disaster of climate change. In 2015, the United Nations issued the "2030 Sustainable Development Guidelines", announcing 17 sustainable development goals (SDGs), providing a shared blueprint for the present and future for the "peace and prosperity" of mankind and the earth.

In response to the goals of the United Nations on climate change, my country also proposed the "2050 Net Zero Pathway Milestone", and then passed the "Climate Change Response Act" on January 10, 2023 to achieve the goal of sustainable development of energy conservation and carbon reduction. NTTU has experienced top-down and bottom-up consensus formation, laying a solid foundation for a high-quality university, and gradually developing into an international green university that supports the development of the green knowledge economy industry. In June 2017, in order to declare out determination to become a "Green International University," NTTU specially formulated the "Establishment Guidelines of Committee for International Green University Initiative," with the president as the chairman, and members including dean and other first-level supervisors, student and staff representatives. Based on the blueprint formulated by NTTU in September 2016, the committee drafted the "White Paper for the International Green University Initiative at NTTU" to establish various goals, strategies and action plans for the development of a green international university, and actively implemented them, and introduced ISO 14064-1 Greenhouse Gas Emission Reduction or Removal Increment Management System to promote campus greenhouse gas Inventory reduction management mechanism, and to establish the concept of greenhouse gas reduction deeply rooted in campus environmental education and promoted to the society, making concrete contributions to nation-wide greenhouse gas reduction efforts.

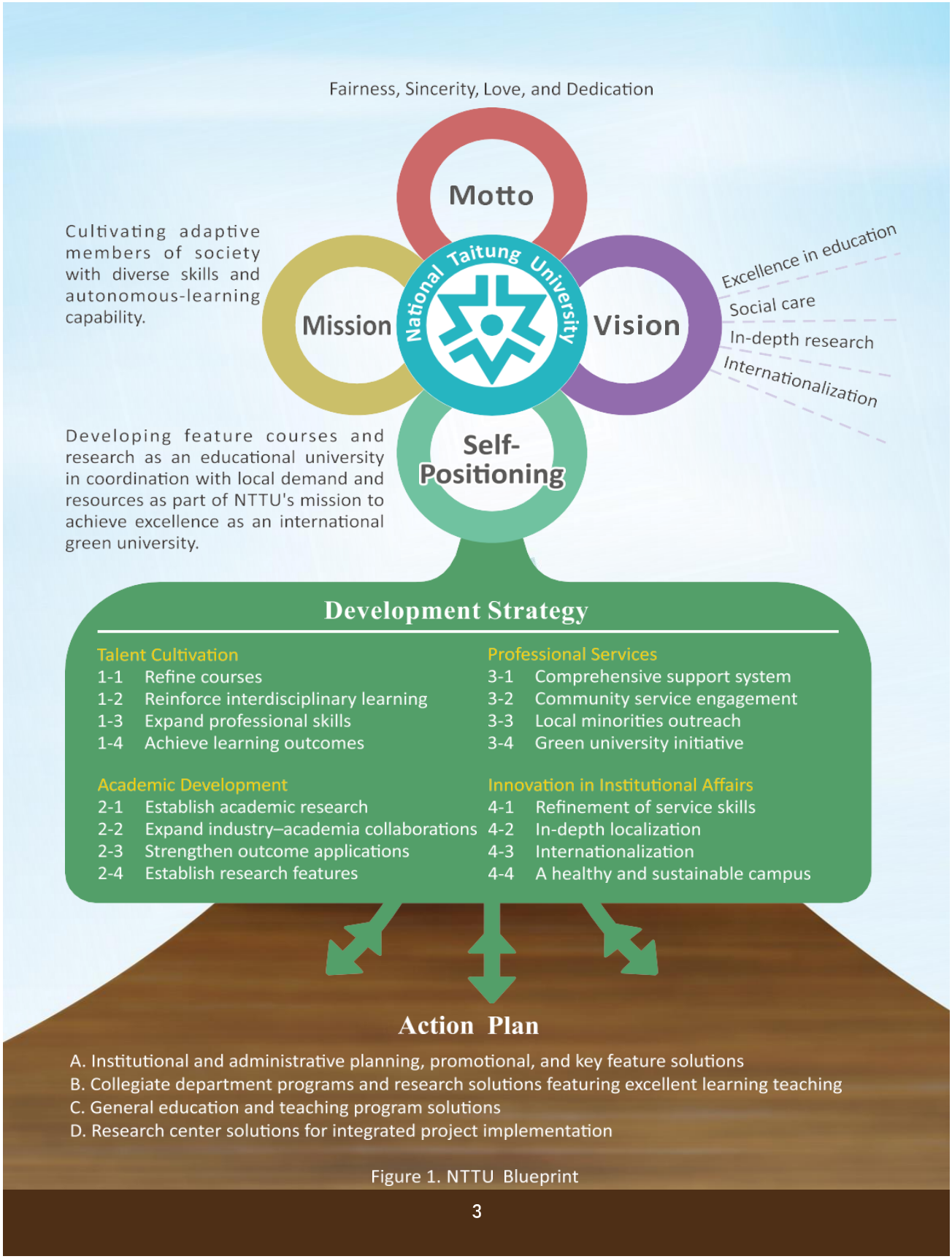


Figure 1 NTTU Blueprint

1.2 NTTU Profile

NTTU was gradually reorganized and developed from "Taiwan Provincial Taitung Teachers College," "Taiwan Provincial Taitung Junior Teachers College," "Taiwan Provincial Taitung Teachers College", and "National Taitung Normal College."

In August 1946, in order to develop local education, the government set up a class of "Simple Teachers Training" in Taitung Provincial Middle School and Taitung Girls' High School, recruiting graduates of national schools and studying for 4 years. One year later, in view of the fact that the educational goals and curriculum equipment of the simplified normal school were quite different from those of ordinary middle schools, the simplified teacher classes attached to the two schools were merged. In February 1948, the " Taiwan Provincial Taitung Teachers College " was formally established.

In August 1948, "Ordinary Teachers Training" was added for junior high school graduates to study for 3 years. At the same time, the Taitung County Government agreed to borrow land from Section 1 of Zhonghua Road in Taitung City to build the school. Afterwards, in order to meet the needs of local education development, one-year "teaching classes" for graduates of national schools with aboriginal status were successively organized; and one-year "education classes" for graduates of high school (vocational) to attend Elective Education Classes, Special Education Classes, etc.

In August 1967, in order to cooperate with the government's policy of improving the quality of teachers in national schools, our school was ordered to restructure into "Taiwan Provincial Taitung Junior Teachers College." The province's only "National School Physical Education Teacher Training" (later renamed "Physical Education Department"), recruits junior high school (vocational) graduates, 5 years of study (1 year of internship is required from the 1970 academic year). Later, the two-year National School Teachers Training Department and the three-year General Teachers Training Department were also set up in the summer to provide advanced education for in-service elementary school teachers in order to improve teachers' professional knowledge and teaching quality.

In 1985, the government decided to transform 9 provincial (municipal) normal colleges in Taiwan into teacher training colleges in order to further improve the quality of elementary school teachers in line with the development trend of teacher education in major countries around the world, so that all elementary school teachers can obtain bachelor's degree qualifications. In August 1987, after careful planning and active preparation, the school was restructured into " Taiwan Provincial Taitung Teachers College"; in July 1991, it was changed to " National Taitung Normal College." On August 1, 2003, the name was officially changed to "National Taitung University," transforming from a teacher's college to a comprehensive university with three colleges: humanities, science and engineering, and teachers colleges.

In November 1998, the government agreed to allocate nearly 60 hectares of the current site of Zhiben Campus as a school building site, and continued to obtain the Zhiben School site in February 2004. After more than ten years of planning and construction, major software and hardware facilities in NTTU’s Zhiben Campus had been completed successively. In September 2007, the Zhiben Campus was unveiled and opened. In 2014, the Zhiben Campus officially replaced the Taitung Campus as headquarters. The new campus is based on green buildings and natural ecology. It is surrounded by

mountains and seas and is uniquely endowed by nature. NTTU Library and Information Center won the first prize of the 2019 Global Excellence in Construction Award for its landscape-style green building. By providing high-quality book and information services, supplemented by Taitung's rich natural resources and diverse cultures, it plays a role in green university knowledge collection and action learning. At the same time, in order to assist the transformation and upgrading of local industries, NTTU Biotechnology Food Factory opened in Taitung Campus at the end of 2019 and obtained the factory registration in October 2021. In addition to actively co-create agriculture, forestry and fishery with local producers at six-level efficiency, it will develop in the direction of disclosing the carbon footprint of products in the future.

Since 2003, NTTU transformed itself from high-quality teaching university with local needs and resources into a renowned university with teaching and research characteristics. Experiencing top-down and bottom-up consensus condensation, NTTU has laid a solid foundation for high-quality green universities, and will gradually develop into an international green university that supports the development of green knowledge economy industry.

NTTU has 5,717 faculty and students (data date: December 2022), including 5,100 students (4,105 day + 995 advanced studies), and 617 teaching staff.

Table 1 : Information table of school premises

Name	National Taitung University
President	Yew-Min Tzeng
Total number of staff and students	5,717
Address	No. 369, Section 2, University Road, Taitung City, Taitung
Greenhouse Gas Manager	Xinyi Li
Tel	(089)318855 #1603
Email	mocca@nttu.edu.tw

1.3 Campus Greenhouse Gas Reduction Policy

As a base for nurturing higher education talents, universities also shoulder the important mission of nurturing future global citizens, and are indispensable to the education and practice of sustainable development. The greenhouse gas reduction policy on NTTU's campus is generally divided into environmental orientation and connotation-deepening orientation.

In terms of the environmentally-oriented aspect, NTTU continues to consolidate energy-saving and renewable energy facilities based on original campus green buildings and grey water systems: including the gradual replacement of energy-saving electrical appliances and equipment, green procurement, strengthening smart water and electricity meter monitoring and collecting real-time data; building solar photovoltaic systems, increasing the proportion of renewable energy, promoting waste reduction and other measures that can directly reduce greenhouse gases. In terms of the connotation-deepening aspect, NTTU seeks to develop green international universities and improve the literacy of sustainable development from the implementation of administration and teaching research. Although this measure will not directly affect the data within the organizational boundaries of the university, it will promote NTTU's green university campus wisdom to "create and tolerate," enrich itself with "wisdom, health, sustainability, and aesthetics" as the connotation. After concretely implementing UN's Sustainable Development Goals, it is hoped that the literacy and actions of every member of the university on sustainable development will not only reduce global greenhouse gas emissions, but also improve the future survival and life of individuals, families, schools, society, countries and even the world from the inside out, ultimately promoting sustainable development, peace and prosperity in the world.

I. Environmental Aspect:

(1) Gradual replacement of energy-saving electrical appliances and equipment: Gradually replace various facilities such as air conditioners, lighting, and transformers with energy-saving electrical appliances and equipment; replace those exceeding the service life and whose efficiency is lower than the energy benchmark announced by the Energy Bureau of the Ministry of Economic Affairs in accordance with the provisions on the service life of the property of public institutions.

(2) Green procurement: Priority is given to the procurement of electricity, water equipment, appliances, and even paper, stationery and other transactional products that comply with the energy-saving label, environmental protection label or water-saving label.

(3) Smart water and electricity meters: Strengthen the monitoring and collection of real-time data by smart water and electricity meters, and adjust accordingly to build a new generation of smart climate-friendly campuses.

(4) Establishment of solar photovoltaic systems: increasing the proportion of renewable energy.

(5) Waste reduction: mainly use electronic documents; paper and disposable containers are reduced during meeting.

II. Connotation-Deepening Aspect

(1) The strategy and basic principles of developing a green international university are in line with the university's motto of "fairness, sincerity, love, and dedication," the vision of "educational excellence, social care, establishing research, advancing toward the international," the mission of "cultivating independent learning, diversified abilities, adaptive development, and serving social talents." Simultaneously, the strategy defines the three stages of academic development and self-positioning as the "advancement towards becoming a green university by developing unique education and research in conjunction with local needs and resources, gradually developing into an outstanding and refined international green university."

(2) Based on the university's blueprint: "talent cultivation, academic development, professional services, and innovation in institutional affairs," planning a series of action to keep pace with the changing environment to promote NTTU as a green international university.

(3) Developing international green university teachings and research based on wisdom, health, sustainability, and aesthetics while reinforcing NTTU's cooperation and services with universities in and outside of Taiwan, exchanging resources and information to optimize collaborative efforts.

(4) Cultivating a campus culture founded in wisdom, health, sustainability, and aesthetics through the collaboration of students, faculty, and staff in administrative affairs, service, teaching, research, and daily life。

(5) Assessing NTTU's performance in its administrative, service, teaching, and research development for becoming an international green university as its short-, mid-, and long-term goals, and developing a strategic smart system to establish long-term sustainable tracking and improvement mechanisms.

(6) Implement NTTU’s motto “create and tolerate” to practice campus wisdom of freedom and democracy through the joint efforts of students, teachers, and staff in all aspects of administration, service, teaching, research, and daily life.

1.4 Campus Greenhouse Gas Reduction Statement

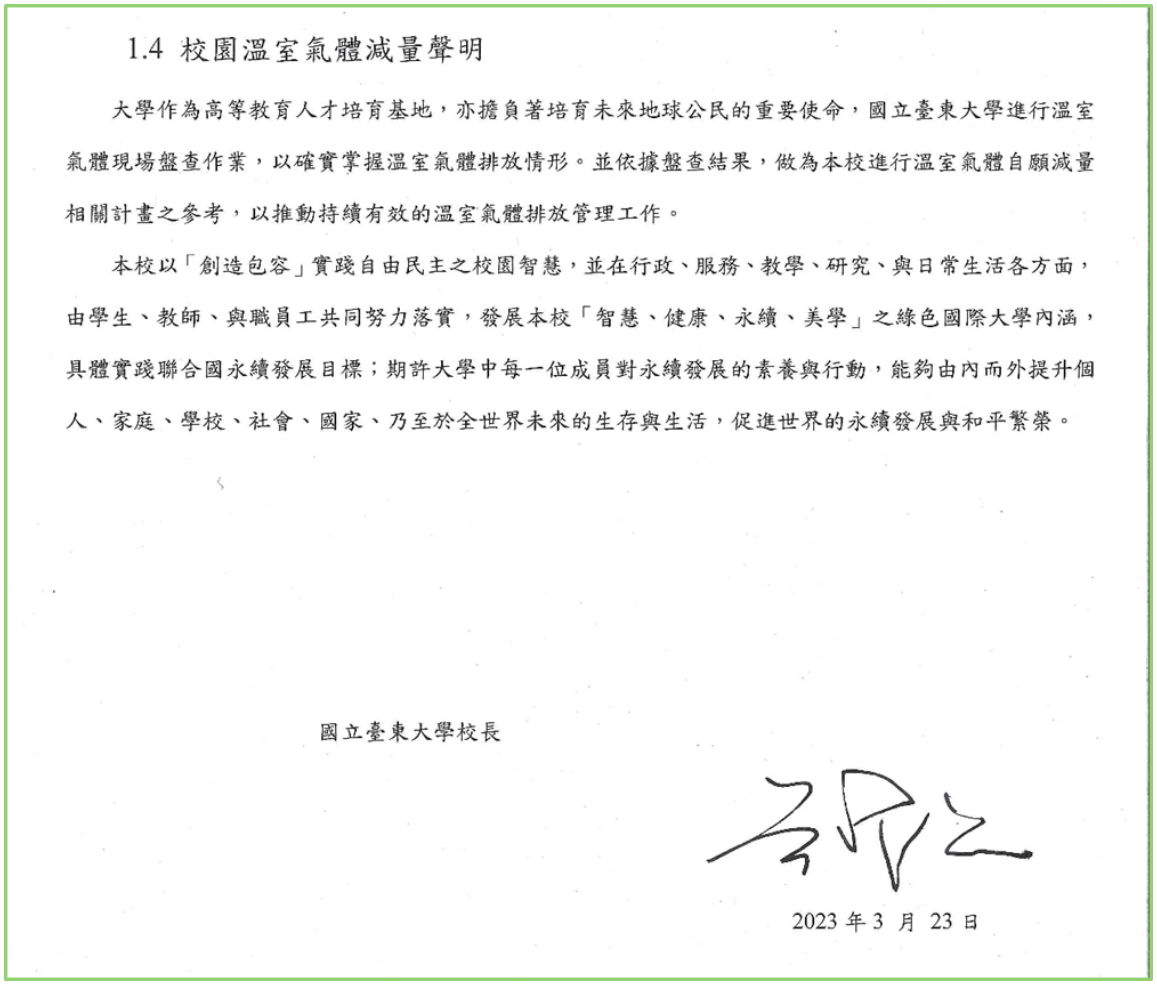
As the base for nurturing higher education talents, universities have an important mission to nurture future global citizens. Therefore, NTTU conducts on-site greenhouse gas Inventory operations to accurately grasp the greenhouse gas emission situation. Based on the results of the Inventory, it will be used as a reference for NTTU's voluntary greenhouse gas reduction plan to promote continuous and effective greenhouse gas emission management.

Through a liberal campus wisdom to "create and tolerate," NTTU seeks to consolidate the connotation of "wisdom, health, sustainability, and aesthetics." It aims to concretely implement UN's Sustainable Development Goals, and hopes that the literacy and actions of every member of the university on sustainable development will not only reduce global greenhouse gas emissions, but also improve the future survival and life of individuals, families, schools, society, countries and even the world from the inside out, ultimately promoting sustainable development, peace and prosperity in the world.

Yew-Min Tzeng, PhD.

President, National Taitung University

March 23, 2023



1.4 校園溫室氣體減量聲明

大學作為高等教育人才培育基地，亦擔負著培育未來地球公民的重要使命，國立臺東大學進行溫室氣體現場盤查作業，以確實掌握溫室氣體排放情形。並依據盤查結果，做為本校進行溫室氣體自願減量相關計畫之參考，以推動持續有效的溫室氣體排放管理工作。

本校以「創造包容」實踐自由民主之校園智慧，並在行政、服務、教學、研究、與日常生活各方面，由學生、教師、與職員工共同努力落實，發展本校「智慧、健康、永續、美學」之綠色國際大學內涵，具體實踐聯合國永續發展目標；期許大學中每一位成員對永續發展的素養與行動，能夠由內而外提升個人、家庭、學校、社會、國家、乃至於全世界未來的生存與生活，促進世界的永續發展與和平繁榮。

國立臺東大學校長

2023 年 3 月 23 日

1.5 Drive Organization and Structure

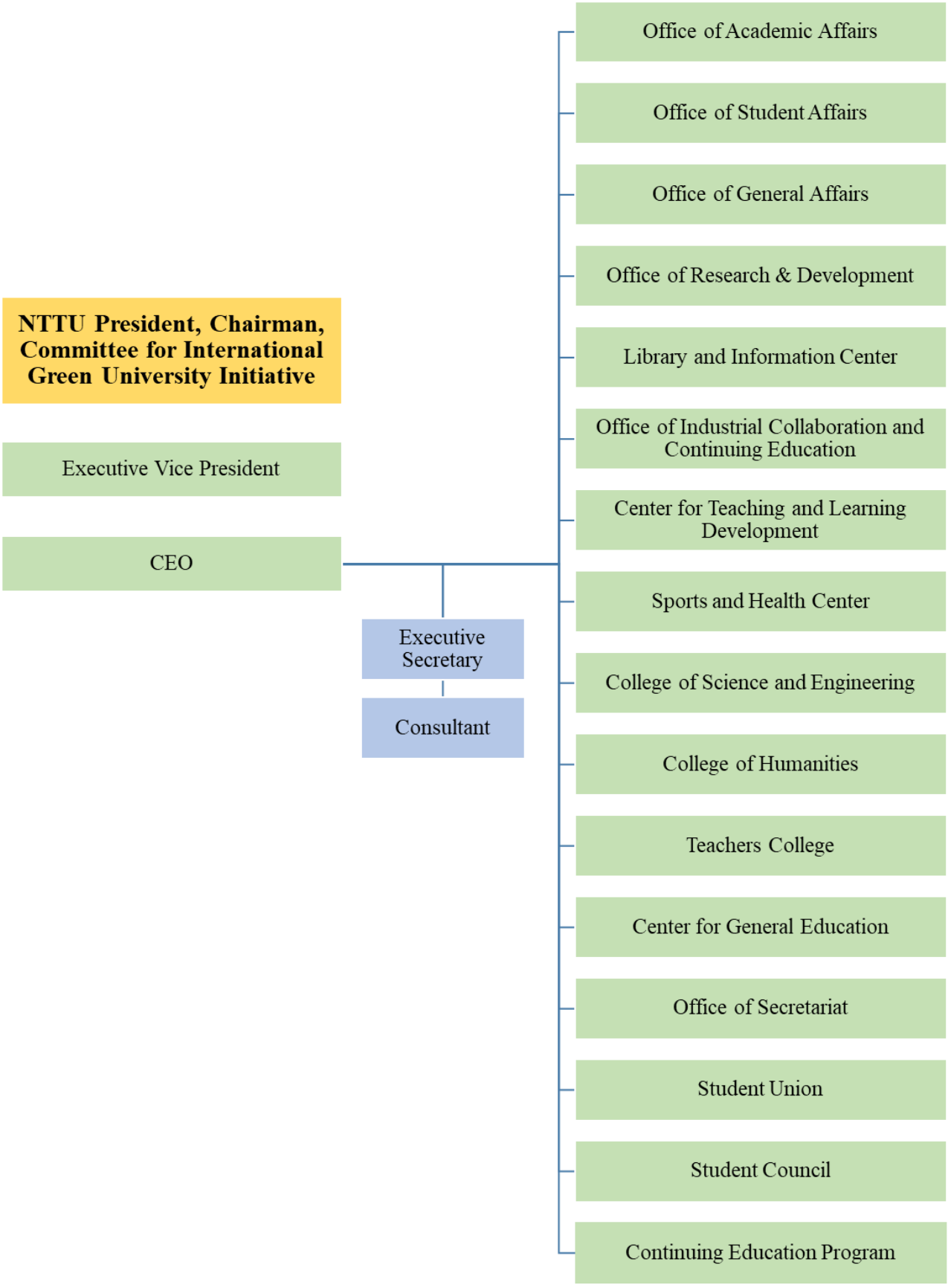


Figure 2: Organizational Chart of Committee for International Green University Initiative

1.6 Report Coverage Period and Responsibilities/Duration of Validity

1.6.1 Coverage Period and Responsibilities
The content of the Inventory in this report is based on the scope of the Inventory of all greenhouse gases produced within the organizational boundary of NTTU in 2022, and is for reference before the completion of the updated report in the following year.

1.6.2 This report starts from January to carry out various inventory work on the greenhouse gas emissions of the previous year, and the content of the report starts in February. It covers the summary of NTTU's greenhouse gas emissions in the previous year and is used for the present year before the completion of the updated report in the following year.

1.6.3 After the report is completed, it will be published internally and announced on NTTU's website after going through the annual internal verification and correction process. This report becomes effective after publication, and is valid until further revision or abolishment.

1.6.4 The scope of this report is limited to the total greenhouse gas emissions in NTTU's service area. If there is any change in the service area, this report will be revised and reissued accordingly.

1.7 Foundation for Making the Inventory Report

This report is based on ISO 14064-1:2018 (CNS 14064-1:2022) for inventory and calculation.

1.8 The Purpose of the Inventory Report

1.8.1 Present the results of NTTU's greenhouse gas Inventory.

1.8.2 Properly record NTTU's greenhouse gas emissions Inventory to facilitate the implementation of external customer and social responsibility standards.

Chapter II Inventory Boundary Setting

2.1 Organizational Boundary Setting

2.1.1 Organizational Boundary Setting of the Report

This report covers NTTU's main campus at Zhiben (Address: No. 369, Section 2, Daxue Road, Taitung City), the Office of Industrial Collaboration and Continuing Education, and National Taitung University Biotechnology Food Factory (address: No. 684, Section 1, Zhonghua Road, Taitung City). The total numbers of students in 2022 are 5717。

Figure 3: NTTU Main Campus Plan

Figure 4: NTTU's Industry-University Innovation Park Plan

2.1.2 The method of setting organizational boundary is based upon the "control law," which is defined by the "operational control" method in the control law.

2.2 Remarks on Organizational Boundary Modification

In the event of modification in NTTU's organizational boundary, this report will be amended and reissued accordingly.

2.3 Remarks on Report Boundary and Modification

According to the GHG Protocol and ISO 14064-1:2018, NTTU's report boundaries are divided into three categories: direct emission sources (Scope 1), indirect energy emissions (Scope 2), and other indirect emissions (Scope 3) greenhouse gas emission sources; It is further subdivided into Scope A to Scope F, and the items covered by each emission source are shown in the table below.

In the event of modification in NTTU's organizational boundary, this report will be amended and reissued accordingly.

Table 2: Sources of NTTU's Greenhouse Gas Emissions

Emission Sources		
Direct Emission Sources (Scope 1)	Scope A Fugitive Greenhouse Gas Emission Sources:	Fugitive Greenhouse Gas Emission Sources: ● Refrigerant Filling: AC HFCs ● Refrigerant Filling: Refrigerator HFCs ● Septic Tank CH4 ● CO2 fire extinguishers CO2 Fixed Combustion Emission Sources: ● Generator CO2、CH4、N2O ● boiler CO2、CH4、N2O Mobile Combustion Emission Sources： ● Official Vehicle Fuel (Gasoline) CO2, CH4, N2O ● Official Vehicle Fuel(Diesel) CO2, CH4, N2O
Indirect Energy Emissions (Scope 2)	Scope B Indirect green-house gas emi-ssions from input energy	● Total Electricity Consumption CO2
Other Indirect Emissions (Scope 3)	Scope C Indirect greenhouse gas emissions during transportation	● Commuting CO2 ● Business Travel CO2
	Scope D Indirect Greenhouse Gas Emissions from the Use of Products (Upstream)	● Total Water Consumption CO2 ● Waste Disposal CO2 ● Paper CO2

2.4 Exclusion Threshold

Sources with emissions less than 0.01% shall be easily quantified based on the emissions of the base year, and the cumulative emissions shall not exceed 1%.

2.5 Modification Threshold

The threshold for modification in greenhouse gas Inventory operations is set to 3.0%. When the change in total emissions is greater than 3.0% due to the modifications in reporting boundaries, an inward or outgoing transfer of ownership and control, or in the quantification method, the Inventory established by the base year will be revised accordingly.

Chapter III Reporting Greenhouse Gas Emissions

3.1 Types of Greenhouse Gases

Greenhouse gases reported here refer to seven greenhouse gases defined in the ISO 14064-1 standard, including carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), fluorohydrogen warmers (HFCs), perfluorinated warmers (PFCs), sulfur hexafluoride (SF6), nitrogen trifluoride (NF3).

3.2 Total Greenhouse Gas Emissions in NTTU

3.2.1 Results of the Inventory of Greenhouse Gas Emission Equivalents

NTTU's total greenhouse gas emissions in 2022 totaled 7763.5960 metric tons of CO2e. The results of the Inventory of the seven GHG emission equivalents of Scope 1 direct GHG emissions are as follows.

Table 3 Results of NTTU's Inventory of Seven GHG Emission Equivalents in Scope 1 in 2022

	CO2	CH4	N2O	HFCs	PFCs	SF6	NF3	Scope 17 GHG Total Annual Equivalent Emissions
Emission Equivalent (CO2e/year)	39.4897	835.6875	0.596	107.865	0	0	0	983.6382
Gas Proportion (%)	4.01%	84.96%	0.06%	10.97%	0.00%	0.00%	0.00%	100%

Table 4: Emission Equivalent Results of NTTU's Greenhouse Gas Inventory in 2022

	Scope 1				Scope 2	Scope 3	Total Emission Equivalent
	Fixed Emission	Process Emission	Mobile Excretion	Fugitive Emission	Energy Indirect Emission	Other Indirect Emission	
Emission Equivalent (Metric Tons CO2e/ year)	983.6382				5650.8187	1,129.1391	7763.5960
	19.2452	0	20.7995	943.5935			
Gas Proportion (%)	12.67%				72.7861%	14.5440%	100%
	0.25%	0.00%	0.27%	12.15%			

[Note] E: Fixed combustion emission sources; P: Process emission sources; T: Mobile combustion emission sources; F: Fugitive emission sources, the above four classifications, are handled in accordance with the Environmental Protection Agency 's Guidelines for Greenhouse Gas Inventory and Registration.

The following is a webpage supporting the trial calculation of greenhouse gas emissions by Executive Yuan Environmental Protection Agency's Greenhouse Gas Emissions Information Platform:

試算工具

首頁 > 盤查指引與試算 > 試算工具

返回首頁

*：必填欄位

範疇別	排放型式	原燃物料代碼	原燃物料名稱	活動數據（小數4位）	活動數據單位
直接	T（移動）	170001	車用汽油	4.7973	公秉/年

溫室氣體	排放係數類型	排放係數值（小數10位）	排放係數單位	排放係數來源	排放量（公噸/年）（小數4位）	GWP	排放當量（公噸CO_2e/年）（小數4位）
CO_2	預設	2.2631328720	公噸/公秉	溫室氣體排放係數管理表6.0.4版	10.8569	1	10.8569
CH_4	預設	0.0008164260	公噸/公秉	溫室氣體排放係數管理表6.0.4版	0.0039	25	0.0975
N_2O	預設	0.0002612563	公噸/公秉	溫室氣體排放係數管理表6.0.4版	0.0013	298	0.3874

備註：
排放係數類型可改為「自訂」，自行輸入排放係數值後，排放量與排放當量即自動運算。

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Figure 5: CO2 Equivalent of Gasoline Emissions for Official Vehicles

首頁 > 盤查指引與試算 > 試算工具

返回首頁

*：必填欄位

範疇別	排放型式	原燃物料代碼	原燃物料名稱	活動數據（小數4位）	活動數據單位
直接	T（移動）	170006	柴油	3.5672	公秉/年

溫室氣體	排放係數類型	排放係數值（小數10位）	排放係數單位	排放係數來源	排放量（公噸/年）（小數4位）	GWP	排放當量（公噸CO_2e/年）（小數4位）
CO_2	預設	2.6060317920	公噸/公秉	溫室氣體排放係數管理表6.0.4版	9.2962	1	9.2962
CH_4	預設	0.0001371596	公噸/公秉	溫室氣體排放係數管理表6.0.4版	0.0005	25	0.0125
N_2O	預設	0.0001371596	公噸/公秉	溫室氣體排放係數管理表6.0.4版	0.0005	298	0.1490

備註：
排放係數類型可改為「自訂」，自行輸入排放係數值後，排放量與排放當量即自動運算。

返回排放量試算列表　清空　下一頁

Figure 6: CO2 Equivalent Emissions of Diesel Fuel for Official Vehicles

Figure 7: CO2 Equivalent Emissions of Emergency Generators (Diesel).

Figure 8: CO2 Equivalent Emissions of Boilers (Diesel)

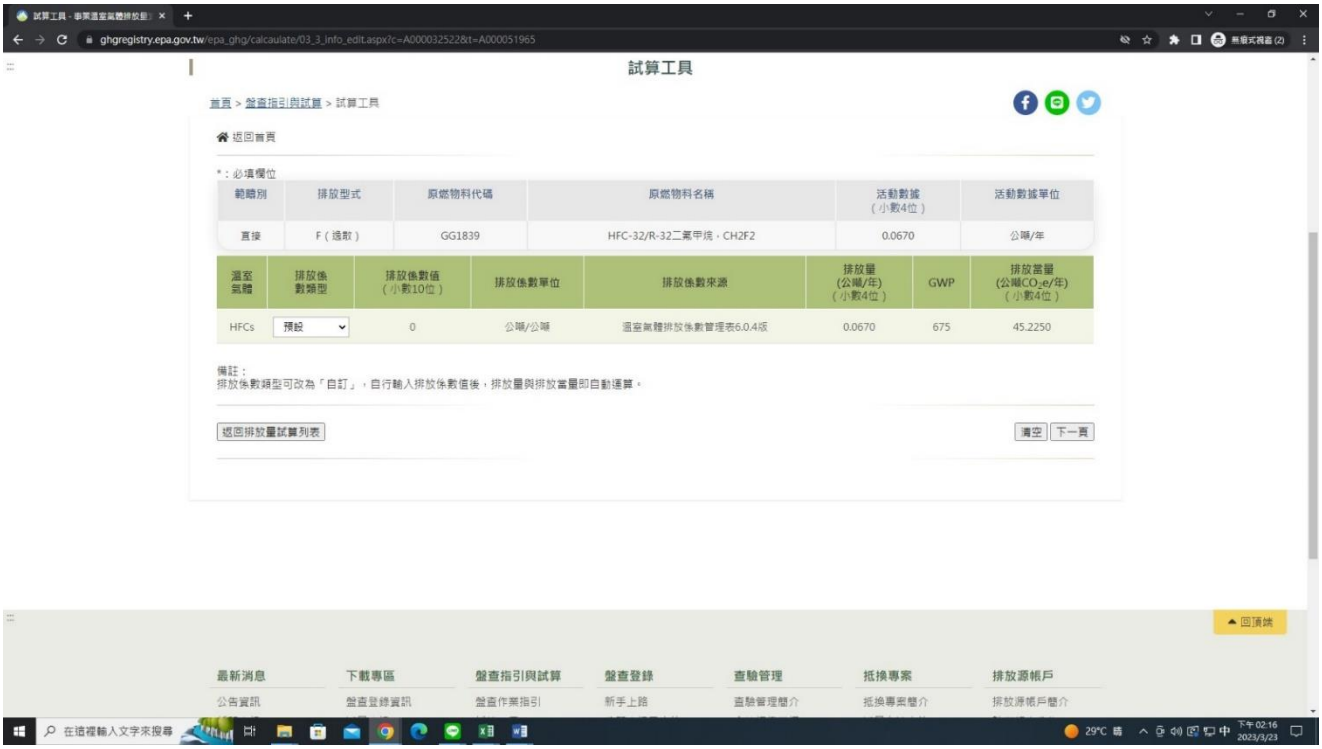

Figure 9: CO2 Equivalent Emissions of Refrigerator Refrigerant Filling (R32)

Figure 10: CO2 Equivalent Emissions of Refrigerator Refrigerant Filling (R410A)

Figure 11: CO2 Equivalent Emissions of Purchased Electricity

Figure 12: CO2 Equivalent Emissions of Commuting Vehicles (Gasoline) of Faculty and Students

3.2.2 Direct GHG emissions (Scope 1; Category A)

3.2.2.1 Definition: Refers to sources of emissions directly from sources owned or controlled by NTTU.

3.2.2.2 Direct sources of emissions include the following:

(1) Fugitive Emissions:

- HFCs generated by the refrigerant of AC and refrigerator need to be calculated.
- Fugitive emissions: CH4 produced by Septic tanks.
- Fugitive emissions: CO2 produced by fire extinguishers.

(2) Fixed Emissions:

- CO2, CH4, N2O produced by emergency generators (diesel).
- CO2, CH4, N2O produced by boilers (diesel).

(3) Mobile Emissions：

- CO2, CH4, N2O produced by office vehicles (gasoline).
- CO2, CH4, N2O produced by office vehicles (diesel).

3.2.2.3 NTTU's biomass combustion emissions in 2022 are 0 metric tons of CO2e.

3.2.3 Indirect GHG emissions from energy (Scope 2; Scope B)

3.2.3.1 Definition: Indirect GHG emissions associated with imported/purchased electricity, heat or steam.

3.2.3.2 The main source of indirect greenhouse gas emissions at NTTU is from purchased electricity. The total indirect energy emissions at NTTU in 2022 were 5650.8187 metric tons of CO_2e, accounting for 72.79% of the university's GHG emissions.

3.2.4 Other indirect GHG emissions (Scope 3): Indirect GHG emissions from transport (Scope C)

3.2.4.1 Definition: Indirect GHG emissions from upstream transportation and distribution, business travel, employee commuting, and downstream transportation and distribution.

3.2.4.2 The indirect GHG emissions during transportation are: official travel, commuting travel for teachers and students.

3.2.5 Other indirect GHG emissions (Scope 3): Indirect GHG emissions from the use of products (upstream) (Scope D)

3.2.5.1 Definitions: Procurement of products and services, capital goods, fuel and energy-related activities, waste from operations, leasing of upstream assets.

3.2.5.2 The indirect GHG emissions (upstream) of the products used by NTTU are: school-wide water, paper use, and waste disposal.

3.2.6 Development and deployment of control measures (Declaration)

In order to reduce or prevent direct greenhouse gas emissions or increase greenhouse gas removal, considering technical feasibility and finance, NTTU will consider energy conservation and carbon reduction practices in daily management operations, such as: monitoring the water and electricity consumption of each unit with smart water and electricity meter information to prevent abnormal values; using NUDGE theory to guide teachers and students to cultivate the habit of turning off computers and lights in the teaching environment; operate a green office to guide faculty and staff to come up with new ideas for sustainability from the work environment; lamps and old electrical appliances to be gradually replaced; conference and handout materials changed to electronic distribution to reduce paper printing and carbon emissions; encourage employees to participate in business trips in the form of online meetings, etc.to achieve energy conservation and carbon reduction so as to facilitate the possibility of sustainable development.

Chapter IV Base Year Setting and Inventory Modification

4.1 Base Year Selection

NTTU selects 2022 as the base year for greenhouse gas inventory, and the total greenhouse gas emissions are 7763.5960 metric tons of CO2e. Explanation of the reasons for the establishment: Since 2022, in addition to the first time that external experts assisted the university in conducting a greenhouse gas inventory, a systematic system was established and the accuracy of quantitative data was high enough to ensure the credibility of the inventory data,. Therefore, 2022 is selected as the base year for the inventory.

4.2 Base Year Modification

If the following circumstances occur, the base year inventory established by NTTU will be updated and calculated again accordingly.

(1) Structural changes in the report or in organizational boundaries (mergers, acquisitions, or divestments).

(2) Changes in calculation method or placement factors.

(3) Errors or significant performance errors result in the change of more than 5.0% in total emissions.

Chapter V: Data Quality Management (Risk Management)

5.1 Activity Data Collection

The flowing energy use related to NTTU GHG inventory accounts for a large proportion of emissions:

(1) Purchased Electricity Information Flow (as shown below)

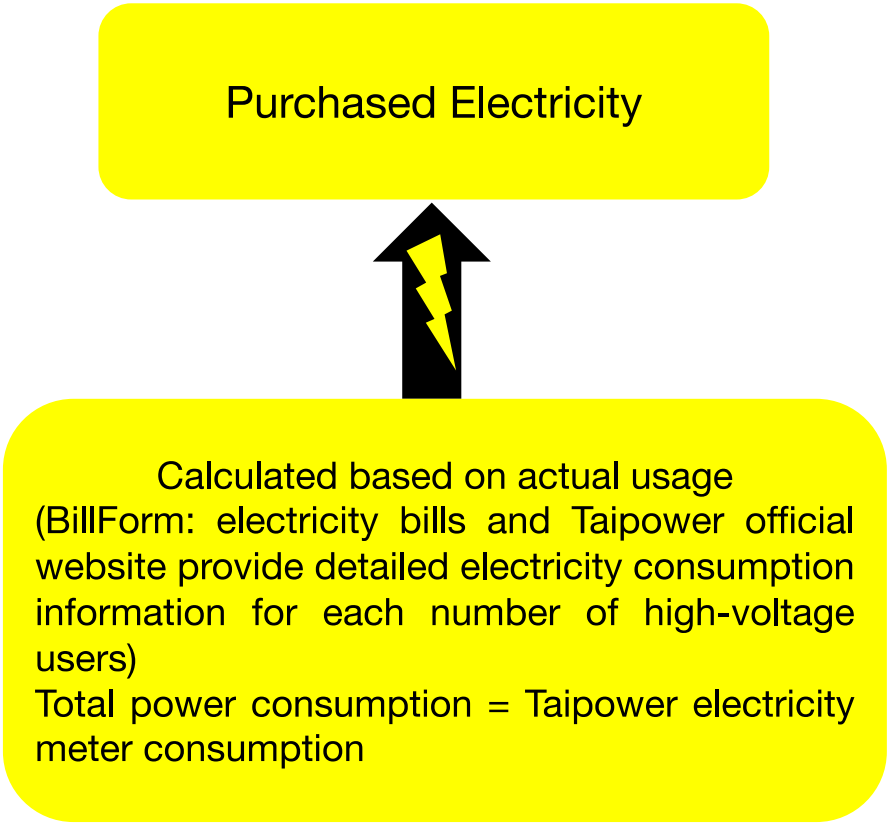

Figure 13: Purchased Electricity Information Flow

5.2 Quantization Method

For the calculation of GHG emissions at NTTU, considering that the most commonly used quantification method is the "emission coefficient method" in Taiwan, and that the main carbon emissions of NTTU come from purchased electricity, "emission coefficient method" is chosen as the main quantification method.

In addition, considering that Taiwan only publishes the emission coefficient of electricity, but the Environmental Protection Agency of the Executive Yuan has collected relevant research and coefficient data on GHG emissions, so the emission coefficient of NTTU will refer to the emission coefficient published by the Environmental Protection Agency of the Executive Yuan (GHG Greenhouse Gas Emission Coefficient Management Table version 6.0.4, 2019), the source of GWP

value refers to IPCC Fourth Assessment Report (2007).

5.2.1 Formula for Calculating Emissions

5.2.1.1 Purchased Electricity Greenhouse Gas Emissions (CO2e) = Total Electricity Degree× Emission Factor ×GWP.
※Formula for Calculating Total Electricity Degrees
Total Electricity Degrees = Tai Electric Meter Degrees (Monthly Electricity Bill)

5.2.1.2 Emissions of official vehicles (CO2e) = total annual fuel consumption of NTTU / annual average oil price × emission coefficient ×GWP
※Average oil price refers to the historical price of gasoline and diesel from CNPC website: http://new.cpc.com.tw/division/mb/oil-more4.aspx

5.2.1.3 Septic CH4 Fugitive Volume Calculate Septic tank fugitive = total school attendance (staff hours + non-residential student hours + residential student hours) × emission coefficient ×GWP.

5.2.1.4 Emergency generators: total oil consumption / annual average oil price× emission factor ×GWP.

5.2.1.5 Boiler: Total oil consumption / annual average oil price × emission coefficient ×GWP.

5.2.1.6 CO2 fire extinguisher calculation: quantity available × total amount of agent per can.

5.2.1.7 Refrigerant greenhouse gas emissions (CO2e) = refrigerant fill × GWP.
Refrigerant filling capacity = actual filling amount of refrigerant of equipment or original filling amount of refrigerant for equipment scrapping.

5.2.1.8 Calculation of official travel = Calculate the Taiwan Railway mileage (major stations in each county and city) travel statistics table based on the travel data, and calculate the carbon footprint using the EPD's Taiwan Rail Transportation Service (Intertrain) Factor: 5.40E+1gCO_2e.

5.2.1.9 Faculty-student commuting calculations: Calculate fuel consumption × emission coefficients ×GWP; Calculation of fuel consumption: The round-trip distance from the Taitung urban area where the largest number of faculty and staff live (using the Taitung campus located in the downtown area of Taitung as the reference point) to the main campus at is 24 kilometers for a day. The automobile and motorcycle certification record form is adopted, and the locomotive is counted first for dual licenses. Total number of locomotives× 1 day of commuter oil for locomotives (0.4 liters) × number of commuting days + total number of cars× 1 day of commuting oil for cars (2 liters) × number of commuting days; Faculty commutes are 5 days × 4 weeks × December, and student commutes are 2.5 days × 4 weeks × December.

5.2.1.10 Calculation of water use across NTTU's site: using Taiwan's tap water in 2020, the equivalent of carbon dioxide (CO2) per kWh of water emitted: 0.152 grams. https://www.water.gov.tw/dist5/Subject/Detail/2269?nodeId=6562

5.2.1.11 Waste disposal calculation: Using the EPD coefficient, the removal volume of the garbage bill× 0.36 ton CO2e/yr.

5.2.1.12 Paper Purchase Record Calculation = Number of Packages of Book or Handout Photocopy Paper or Report Paper Using EPD: Virgin Wood Pulp Photocopy Paper (Announcement Year 2018) Carbon footprint value: 3.60E+0 kgCO_2e.

5.3 Greenhouse Gas Data Quality Management

In order to require data quality and accuracy, each responsible unit needs to explain the source of the data, such as flow meter records, purchase requisition basis, collection records, etc., and all those who can prove and support the credibility of the data should be investigated, and the data should be properly stored as a basis for future verification and tracking。

The uncertainty management of the data in the present Inventory is carried out according to the following formula and the data error rating score: Inventory data error level = activity data type level (A1) × activity data confidence level (A2) × Emission factor data level (A3).

NTTU conducts error level scoring of inventory data according to all corresponding activities in Scope 1 and Scope 2, and the error level scoring results of each emission source data are shown in the table and the summary table of the error level scoring results of each emission source data, and the scoring results are shown in the table and the data error level scoring results.

Table 5. Greenhouse Gas Data Quality Management Error Scale

Grade Score / Items	1 point	2 points	3 points
Active Digital Error Level (A1)	Continuous Monitoring	Periodic Sampling	Self-Estimating
Instrument Calibration Error Level (2)	Data obtained by measuring instruments more than once a year.	Data obtained from instrument measurements less than once a year.	Non-measured estimates.
Emission Calculation Parameter Error Level (A3)	Self-developed parameters, mass balance parameters, or same process/equipment experience parameters.	The manufacturer provides parameters or regional announcement parameters.	National announcement parameters or international announcement parameters.

Table 6: Summary of Data Error Level Scoring Results for Each Emission Source

GHG Protocol	ISO14064-1:2018	Emission Sources	Activity Data	Consumption	CO2 Emissions	Activity data category level (A1)	Activity Data Confidence Level（A2）	Emission Factors Data Classes Level (A3)	Sum	CO2 Emission Percentage	Emission's Proportion Weighted Average	Grade
Scope 1	Scope A	Official Vehicle Fuel (gasoline)	CPC card, Requisition System Documents	4.7973 KL	11.3418	2	2	3	12	0.15%	0.0175	
Scope 1	Scope A	Official Vehicle Fuel (diesel)	CPC card, Requisition System Documents	3.5672 KL	9.4577	2	2	3	12	0.12%	0.0146	
Scope 1	Scope A	Septic Tank	Staff + non-residential students: 3883 days and 250 days, 8 hours a day "CH4 emissions = 0.0031875 ton/people-yr residential students 1834 days 300 days 24 hours a day" "CH4 emissions = 0.011475 ton/people-yr"	33.4223 MT	835.5575	3	3	3	27	10.76%	2.9059	
Scope 1	Scope A	Emergency Generator (diesel)	Requisition System Documents	0.0963 KL	0.251	2	2	3	12	0.00%	0.0004	
Scope 1	Scope A	CO2 Fire Extinguishers	Fire Report 38 Sets*4.5KG Dosage	0.171 MT	0.171	2	2	3	12	0.00%	0.0003	
Scope 1	Scope A	Boilers (diesel)	Bills	7.258 KL	18.9942	2	2	3	12	0.24%	0.0294	
Scope 1	Scope A	Refrigerant Filling (R32)	Requisition System Documents	0.067 MT	45.225	2	3	3	18	0.58%	0.1049	
Scope 1	Scope A	Refrigerant Filling (R410A)	Requisition System Documents	0.03 MT	62.64	2	3	3	18	0.81%	0.1452	
Scope 1	Scope A	Refrigerant Filling (R600A)	Requisition System Documents (Not Announced)	0.0065 MT	0.0000	2	3	3	18	0.00%	0.0000	
Scope 2	Scope B	Purchased Electricity	Electricity Bills	11101.805 Thousand Degrees	5650.8187	2	2	3	12	72.79%	8.7343	
Scope 3	Scope C	Business Travel	Travel Records	1343907.8 KM	72.5710	3	3	3	27	0.93%	0.2524	
Scope 3	Scope C	Faculty, Staff, Student commuting	Vehicle Fuels	403.344 KL	952.4628	3	3	3	27	12.27%	3.3124	
Scope 3	Scope D	Campus Water Consumption	Water Bills	187549 Degrees	28.5074	2	2	3	12	0.37%	0.0441	
Scope 3	Scope D	Waste Disposal	Cleaning and Removal Bills×0.36ton CO2e/yr	196.2 T	70.6320	2	3	3	18	0.91%	0.1638	
Scope 3	Scope D	Paper Use	Requisition System Data 3.60E+0 $kgCO_2e$	690 Packs*2.18K=1504K=1.504MT	4.9659	3	3	3	27	0.06%	0.0173	
				Total	**7763.5960**					**100%**	**15.7424**	**Grade 2**

※Septic Tank Discharge Calculation

Activity Data: Faculty + non-residential students: 3883 days 250 days 8 hours per day

CH4 Emissions= 0.0031875 ton / people-yr

0.0031875 ton / people-yr * (Total number of people in 2022)

=0.0031875 * 83

=12.3771ton4/ yr

12.3771ton CH4/ yr * 25(GWP Value)

=309.4275 ton CO2e/ yr

Activity Data：1834 residential students 300 days 24 hours a day

CH4 Emissions= 0.011475 ton / people-yr

0.011475 ton / people-yr * (Total number of people in 2022)

= 0.011475 * 1834

=21.0452ton CH4/ yr

21.0452ton CH4/ yr * 25(GWP Value)

=526.13 ton CO2e/ yr

309.4275+526.13=835.5575 ton CO2e/ yr

Table 7. Conversion Table of CH4 Emission Coefficient of Septic Tank

Septic Tank											
Septic Tank Emission Sources			Emission Coefficient Consideration Parameters							Emission Coefficient	
Coefficient Selection	Product/Raw Material Name	Device Name	BOD Emission Factor	Unit	Average Sewage Concentration (mg/L)	Working Day (days)	Working Hours Per Person Per Day (hours)	Wastewater Volume Per Person Per Hour (liter/hour)	Septic Tank Treatment Efficiency (%)	CH4 Emission Coefficient	Unit
Example	Fertilizer	Septic Tank	0.6	mt CH4/mt-BOD	200	300	8	15.625	85	0.003825	mt/person-year
Custom Coefficient	Fertilizer	Septic Tank		mt CH4/mt-BOD							mt/person-year
Note: CH4 emission coefficient = BOD emission coefficient × average sewage concentration × number of working days (days) × (working time per person per day (hours) × wastewater volume per hour per person (liter/hour)) × septic tank treatment efficiency											

※Paper Use Calculation

Paper factor carbon footprint: Virgin wood pulp photocopy paper (2018 Announcement Year)

2022 total paper use 690 packs *2.18 kg= 1504.2 kg= 1.5042 ton/ yr

1.5042 * 0.9 * 0.5=0.67689 ton C

0.67689 ton C * 44/12 = 2.48193 ton CO_2e/yr

Virgin wood pulp photocopy paper 3.60E+0 $kgCO_2e$

690 packs * 3.6 $kgCO_2e$/yr / 1000 =2.484 ton CO_2e/ yr

Total Emissions for Paper Use= 2.48193 + 2.484 = 4.9659 ton CO_2e/ yr

Figure 14：Paper factor carbon footprint: Virgin wood pulp photocopy paper (2018 Announcement Year)

Table 8. Coefficient Conversion Table of Wood Products Used (Paper, Cardboard, Pulp, Recycled Pulp Fiber, Recycled Paper)

Wood Products

CO2 Emissions = Carbon Pool Change ✕ 44/12

Tire 1

Item				Coefficient Selection	Coefficient Value	Unit	Source
The preset half-life of the carbon sink of the product in use and the relevant proportion of annual retention.	Half Life	Solidwood Products		Default Coefficient	30	Number of Years	2006 IPCC Volume IV, Chapter 12, Table 12.2
				Custom Coefficient		Number of Years	
		Paper Products		Default Coefficient	2	Number of Years	2006 IPCC Volume IV, Chapter 12, Table 12.2
				Custom Coefficient		Number of Years	
	Disposal Rate	Solidwood Products		Default Coefficient	0.023	%	2006 IPCC Volume IV, Chapter 12, Table 12.2
				Custom Coefficient		%	
		Paper Products		Default Coefficient	0.347	%	2006 IPCC Volume IV, Chapter 12, Table 12.2
				Custom Coefficient		%	
Carbon Content Per Unit of Product	Round logs, industrial round logs, sawn logs, other industrial round logs, pulpwood, wood chips, wood fiber boards, fuel wood, wood residues.	Temperate Species	Density	Default Coefficient	0.45	MT Drying/Cubic Meter	2006 IPCC Volume IV, Chapter 12, Table 12.4
				Custom Coefficient		MT Drying/Cubic Meter	
			Carbon Ratio	Default Coefficient	0.5	MT-C/MT Drying	2006 IPCC Volume IV, Chapter 12, Table 12.4
				Custom Coefficient		MT-C/MT Drying	
		Tropical Species	Density	Default Coefficient	0.59	MT Drying/Cubic Meter	2006 IPCC Volume IV, Chapter 12, Table 12.4
				Custom Coefficient		MT Drying/Cubic Meter	
			Carbon Ratio	Default Coefficient	0.5	MT-C/MT Drying	2006 IPCC Volume IV, Chapter 12, Table 12.4
				Custom Coefficient		MT-C/MT Drying	
	Charcoal		Density	Default Coefficient	0.9	MT Drying / MT Air Drying	2006 IPCC Volume IV, Chapter 12, Table 12.4
				Custom Coefficient		MT Drying / MT Air Drying	
			Carbon Ratio	Default Coefficient	0.85	MT-C/MT Drying	2006 IPCC Volume IV, Chapter 12, Table 12.4
				Custom Coefficient		MT-C/MT Drying	
	Plank Mean		Density	Default Coefficient	0.628	MT Drying/Cubic Meter	2006 IPCC Volume IV, Chapter 12, Table 12.4
				Custom Coefficient		MT Drying/Cubic Meter	
			Carbon Ratio	Default Coefficient	0.468	MT-C/MT Drying	2006 IPCC Volume IV, Chapter 12, Table 12.4
				Custom Coefficient		MT-C/MT Drying	
	Paper and Board, Pulp, Recycled Pulp Fiber, Recycled Paper		Density	Default Coefficient	0.9	MT Drying / MT Air Drying	2006 IPCC Volume IV, Chapter 12, Table 12.4
				Custom Coefficient		MT Drying / MT Air Drying	
			Carbon Ratio	Default Coefficient	0.5	MT-C/MT Drying	2006 IPCC Volume IV, Chapter 12, Table 12.4
				Custom Coefficient		MT-C/MT Drying	

Table 9: Data Error Level Scoring Results

Total Weighted Average	Grade
15.7424	Grade 2
◎ Grade Scoring Criteria According to the calculation results of the error level of the single emission source data: Those with an error level of 1-9 are rated as Grade 1 Those with an error level of 10-18 are rated as Grade 2 Those with an error level of 19-27 are rated as Grade 3 The weighted average of emissions is the product of the error level of the single source data and the ratio of a single source to total emissions.	

The results of NTTU's emission source data error rating are ranked at Grade 2, and the basic data quality can be further advanced in the future.

Table 10. Uncertainty Table of IPCC Recommended Activity Data and Emission Factors

Gas	Source Type	Emission Coefficient	Activity Data	Overall Uncertainty
CO2	Energy	7%	7%	10%

Source: Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reporting Instructions

According to 1996 IPCC Guidelines for National Greenhouse Gas Inventories : Reporting Instructions, Uncertainty in IPCC recommended activity data and emission factors.

According to the above-mentioned 1996 IPCC uncertainty estimation, corresponding to the greenhouse gas inventory registration form, the upper and lower limits of the 95% confidence interval below are obtained. Scope 2 of the assessment (Scope B): The indirect greenhouse gas emissions from input energy are 5650.8187 metric tons of CO2e, accounting for 72.79% of NTTU's greenhouse gas emissions. The lower limit of the corresponding 95% confidence interval is -9.899%, and the upper limit of the 95% confidence interval is +9.899%.

Chapter 6 Report Verification

Internal verification work will be carried out in the annual year (2022) in order to enhance the credibility of NTTU's greenhouse gas Inventory data and report, as well as the quality of the greenhouse gas Inventory, and to meet the requirements of the government (such as the Environmental Protection Bureau), trade unions, suppliers and customers.

6.1 Confirmation Items in the Verification Operation

- Internal Verification Area: NTTU
- Verification Operation Principles: ISO 14064-3:2019
- Competence and Qualifications of Verifiers: All of our internal verification personnel have participated in the greenhouse gas inspector training course for at least 40 hours and obtained the certificate of eligibility.
- Internal Verification Operation
- On March 21, 2023, NTTU has carried out the internal greenhouse gas verification operation, selected qualified auditors to participate in the internal verification plan, and revised the deficiencies and suggestions accordingly. Internal verifier: Zheng Yihan, Manager.

Chapter 7 Report Management

7.1 Period Covered

January 1, 2022—December 31, 2022.

7.2 Frequency of Production

Once a year.

7.3 Primary Foundation

Produced according to 14064-1:2018 (CNS 14064-1:2022).

7.4 Publication and Custody

7.4.1 This report is an internal reference document for internal greenhouse gas management purposes only.

7.4.2 The report shall take effect after publication and shall be valid for at least 10 years until further amended or repealed.

7.4.3 After the report is prepared by the administrative unit, it is submitted to the person in charge of the responsible center for approval.

7.5 Usage

After the approval of the person the responsible center, the original text version is kept by the administrative unit for use by prospective users.

7.6 Contact Information

Institution Name: National Taitung University

Responsible unit: Green University Promotion Committee

Written by: Li Xinyi

Address: No. 369, Section 2, University Road, Taitung City, Library and Information Center, Taitung Regional Network Center

Tel：089-318855 #1603

Chapter 8 References

(1) GHG reporting requirements under the Greenhouse Gas Inventory Protocol.

(2) ISO 14064-1:2018 requirements for the content of greenhouse gas inventory reports.

(3) Protocol on greenhouse gas inventories initiated by the World Commission for Sustainable Business and the World Resources Institute. (Accounting and Reporting Standards for Business Enterprises 2nd Edition).

(4) ISO/CNS 14064-1 Specification for guidelines for quantification and reporting of greenhouse gas emissions and removals at the organizational level.

(5) ISO 14064-3:2019 EPD Guidelines for Greenhouse Gas Inventory and Registration.

(6) Principles for the Management of Greenhouse Gas Inventory and Registration of the Environmental Protection Department of the Executive Yuan.

(7) The EPD Greenhouse Gas Verification Guidelines ISO/CNS 14064-3 Specification for Identification and verification of greenhouse gas claims with guidelines.

(8) 2007 and 2014 Assessment Reports of the United Nations Intergovernmental Panel of Experts on Climate Change (IPCC). Catalogue 6.0.4 of the Environmental Protection Department's Greenhouse Gas Emission Factor Management Table, Executive Yuan.