

112年智慧化氣候友善永續循環校園 先導型計畫

示範計畫分享

報告人:南華大學永續中心
洪耀明執行長



南華大學
Nanhua University

簡報大綱

- 一、學校簡介與地理位置
- 二、跨領域教師社群
- 三、112年示範計畫構想
- 四、示範計畫物理調查與施作項目
- 五、校園碳盤查
- 六、結論





建構智慧化氣候友善校園113年度說明會暨112年度成果交流

一、學校簡介與地理位置



南華大學
Nanhua University

南華大學為星雲大師設立

推動背景：佛光山百萬人興學



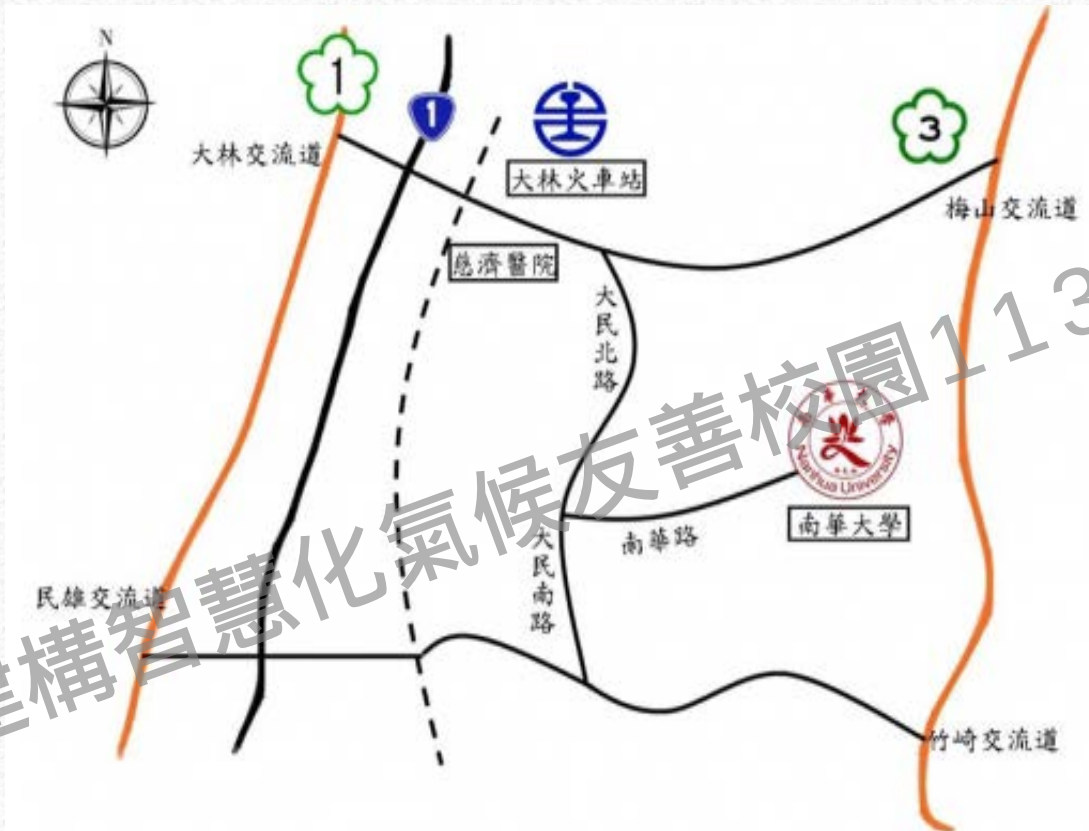
星雲大師號召百萬人興學

危機就是轉機



校園地理位置及資訊

本校屬於山坡地，
由頭嵙山層、礫石曾、沖積扇組成，
地勢東西低，三疊溪及葉子寮溪，分別由南北兩側





建構智慧化氣候友善校園113年度說明會暨112年度成果交流

一句話，道盡千言萬語

已有18所大學明確承諾淨零或碳中和

承諾淨零／碳中和達成年

大學	年份
南華大學	2028
國立成功大學	2041
逢甲大學	2041
朝陽科技大學	2045
國立台灣大學	2048
國立台北科技大學	2048
國立屏東科技大學	2049
中原大學	2049
國立中央大學	2050

大學	年份
國立台北大學	2050
國立東華大學	2050
國立聯合大學	2050
元智大學	2050
台北醫學大學	2050
亞洲大學	2050
長榮大學	2050
弘光科技大學	2050
慈濟科技大學	2050

天下雜誌
CommonWealth
Magazine

<https://www.cw.com.tw/article/5121022?template=transformers>

南華大學碳中和推動時間 規劃進程

● 2021基
準
◎4555噸
(範疇1+範
疇2+範疇3)

● 2022盤查
◎ISO 14064-1
確認

● 2022-2027減量/增匯/抵換

- ◎太陽能發電自用(減量1000噸)
- ◎ISO50001能源管理系統(持續改善)
- ◎軟硬體智慧化減碳措施
- ◎樹木固碳(80%森林/增匯3555噸)
- ◎已跟綠色公益基金會合作，基於IPCC公式，提出森林碳匯方法學，並準備提送國際平台認證。
- ◎土壤固碳、濕地固碳
- ◎改變行為(環境教育、綠色辦公力求減碳)

● 2027

- ◎2027辦理
PAS2060
(ISO14068)

● 2028

- ◎PAS 2060確認
- ◎獲碳中和證書

2028碳中和



建構智慧化氣候友善校園112年度說明會暨112年度成果交流

二、跨領域教師社群

永續校園教師專業成長社群

- ✓於111-2及112-1學期已舉行六次
- ✓社群理念:推動南華大學永續發展，以達到全校碳中和為目的。



日期	時間	主題	目的
5/2	11:30~15:30	植樹 : 咖啡樹高空壓條	藉由學習無性繁殖方式，不消耗成本，繁殖校內樹苗。
5/3	09:45~17:00	循環經濟 : 農產品的後加工與循環再利用	藉由參訪三家廠商，了解農產品後加工與農業廢棄物分解新解方及蜜蜂養殖與副產品利用等知識。
5/9	09:00~12:00	跨校討論 : 南華&中正大學聯合USR會議	藉由兩校老師分享，讓團隊成員了解本年度合作與執行內容。
11/7	15:00~18:00	食品碳足跡 及食農教育	介紹碳足跡如何計算及食品碳足跡，後半藉由烹飪在地食材進行食農教育。
11/28	12:00~15:00	太陽能 介紹與永續農場太陽能建置細節	介紹淨零碳排趨勢、認識太陽能光電，並實際至永續農場認識太陽能系統。
11/28	15:00~18:00	碳盤查系統 及中草藥與食農教育	前半課程針對南華碳盤查系統Debug做測試與資料收集，後半以中草藥結合食農教育為題材做相關介紹。





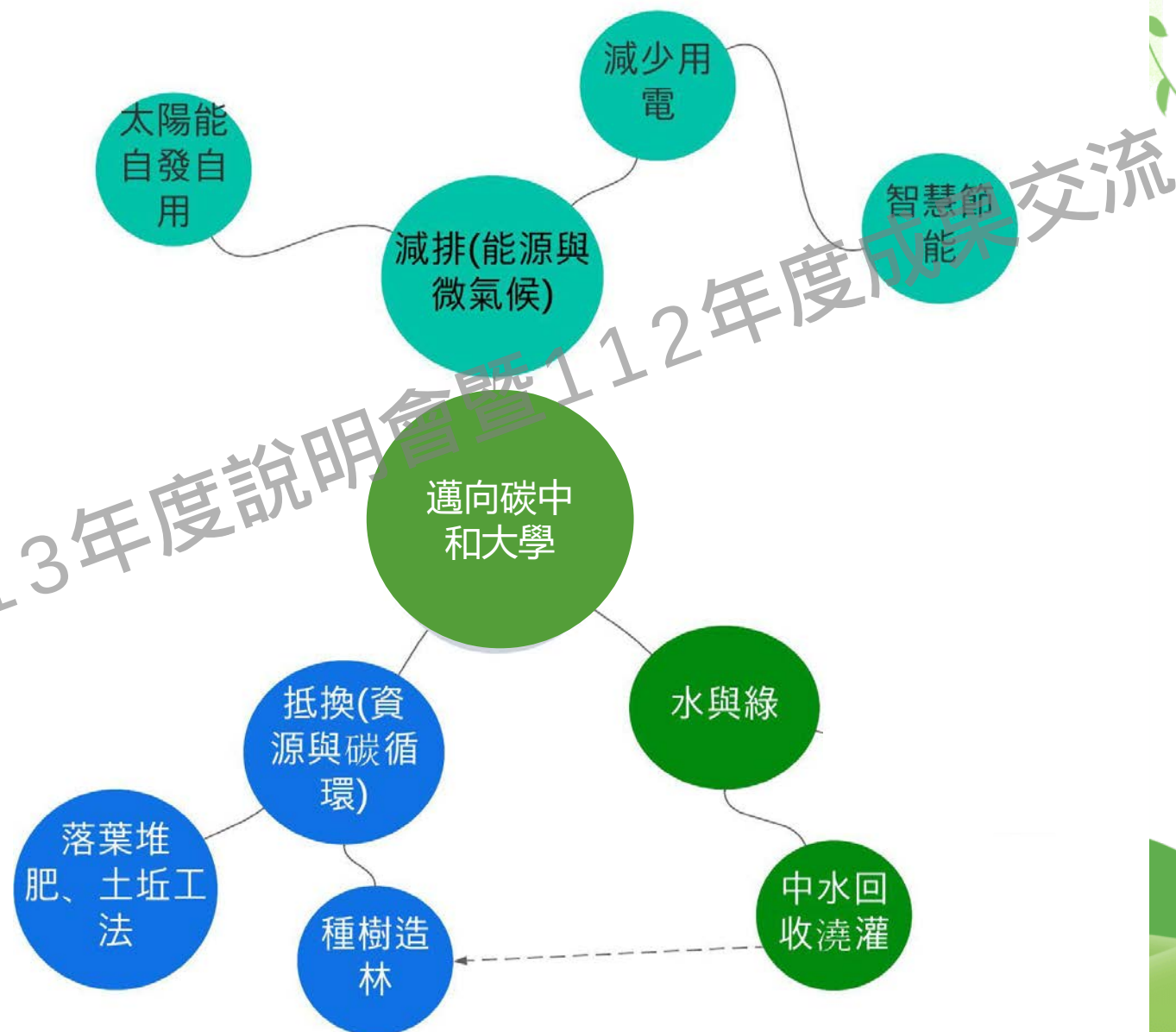
三、112年示範計畫構想

建構智慧化氣候友善校園113年度說明會暨112年度成果交流

永續示範校園構想圖

透過本計畫推動本校碳中和目標

- (1) 碳排放減量：正行中心(體育館)、圖書館更換節電設施，進行人工智慧監測系統。
- (2) 增匯抵換：太陽能自發自用(正行中心、永續農場)，實質減少用電所產生之間接排放；種樹造林，辦理先期抵換專案，取得碳權。
- (3) 碳中和：2027年申請PAS2060碳中和宣告。
- (4) 2028年達成碳中和



建構智慧化氣候友善校園113年度說明會暨112年度成果交流



四.示範計畫 物理調查與施作項目



南華大學
Nanhua University

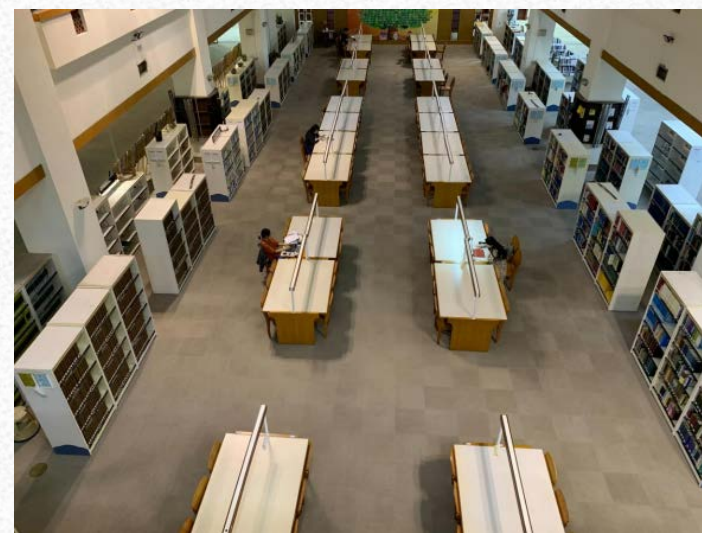
結合本校碳中和目標 永續示範校園軟硬體施作項目

1. 能源與微氣候：

A. 正行中心(體育館)：建立人工智慧監測系統、更換節能設備設施與建置屋頂太陽能(非本計畫示範項目)，並合併授課大綱及建立環境教育教案。

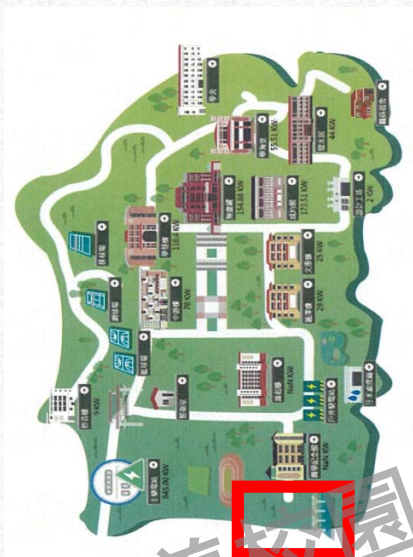
B. 圖書館：建立人工智慧監測系統，更換節能設備設施。

*兩項工程施工完成後，整合於本校既有能源管理系統，可比較施工前後節能成效。



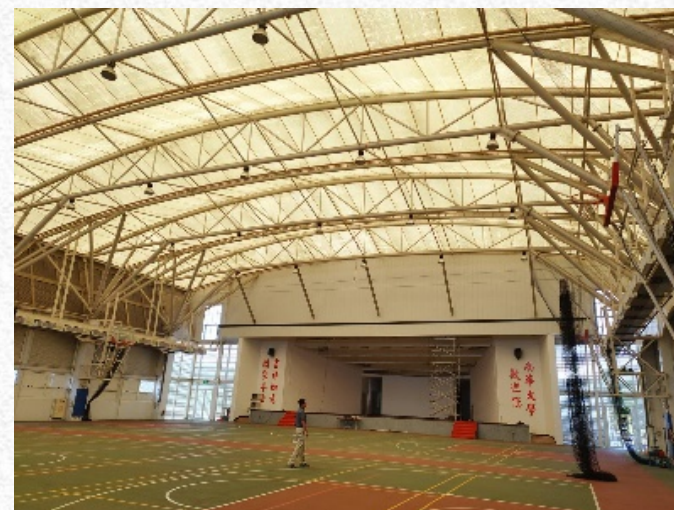
示範校調查與施作項目

能源與微氣候:
正行中心體育館
智慧節能系統



監控系統缺少正行中心部分

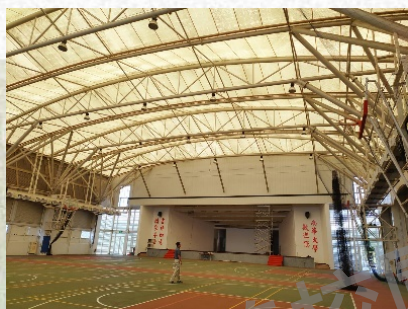
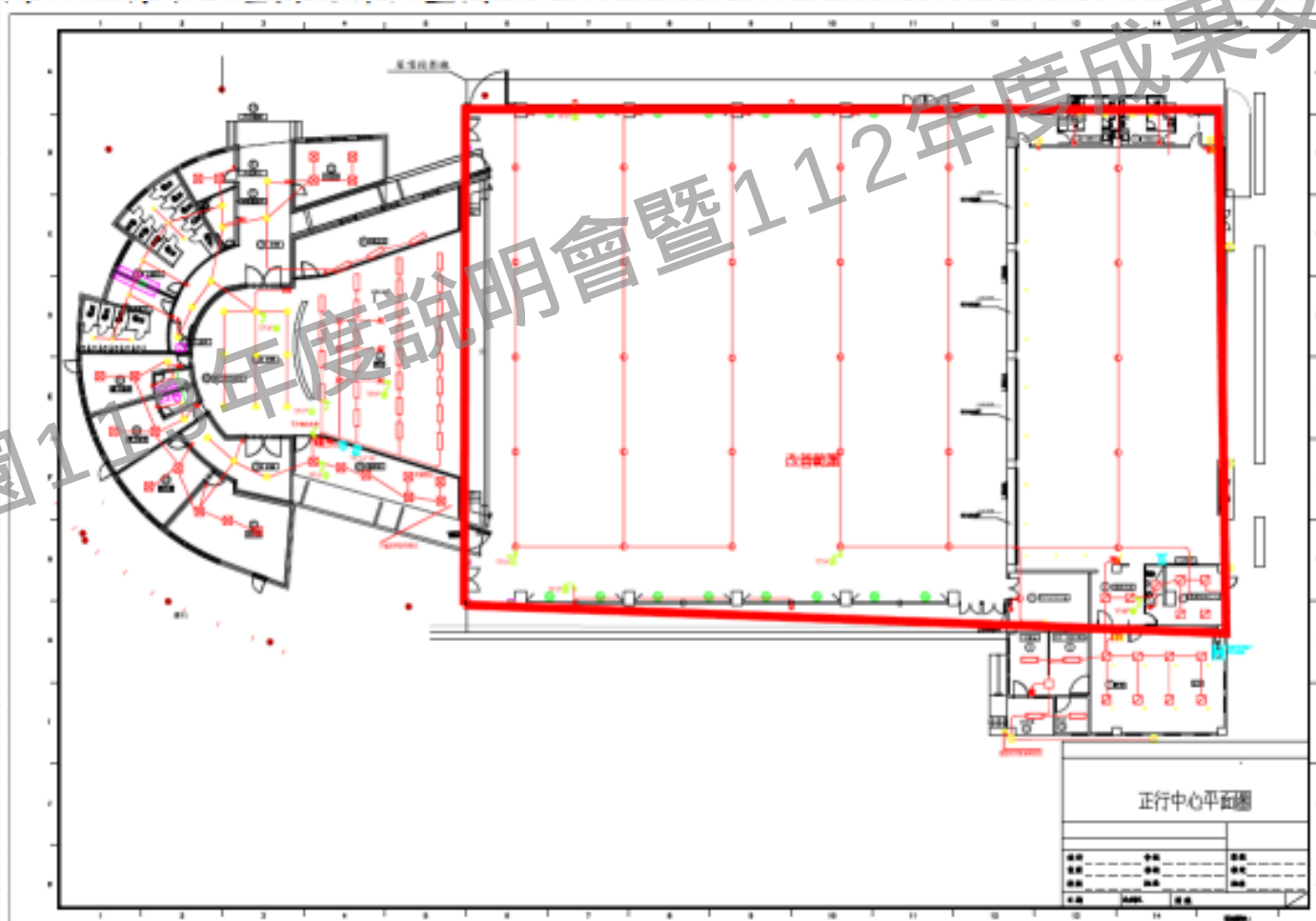
- ✓補齊校園監控系統地圖
- ✓示範節能系統，改善大型場館能源使用問題。
- ✓設置與更換節電風扇、燈具
- ✓場館AI智慧監控節電系統
- ✓室內外微氣候監測設備



示範校調查與施作項目

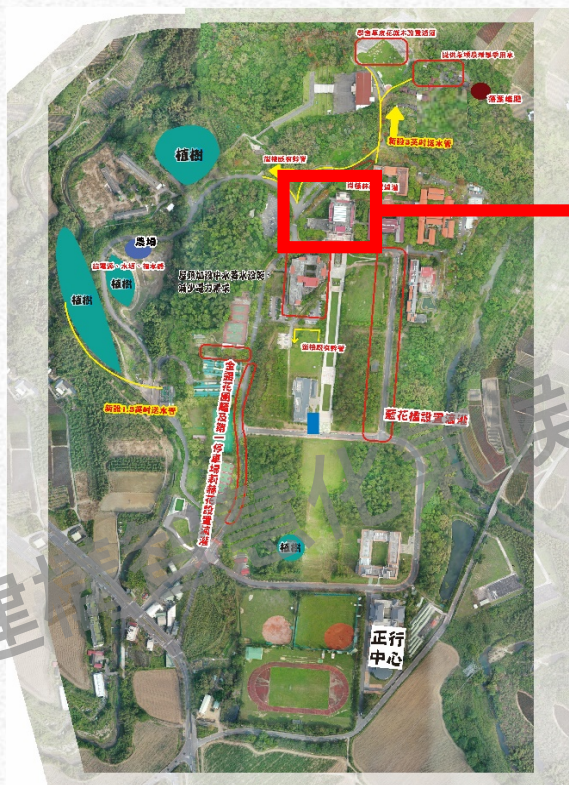
能源與微氣候:
正行中心體育館
智慧節能系統

正行中心更換節能燈具施作位置圖



示範校調查

能源與微氣候: 圖書館人流監測與 智慧節能系統



- 於104年建置能源管理系統，並獲ISO 50001認證。
- 104年本校總務處啟動每年節能專案，經初步盤查本校圖書館用電量占本校一半。
- 經104年~112年之間節能專案執行，目前圖書館能源使用已較104年減少1/3。

目前現況:-期望再減量

- 圖書館每日進出館**平均715人次**➔使用率高

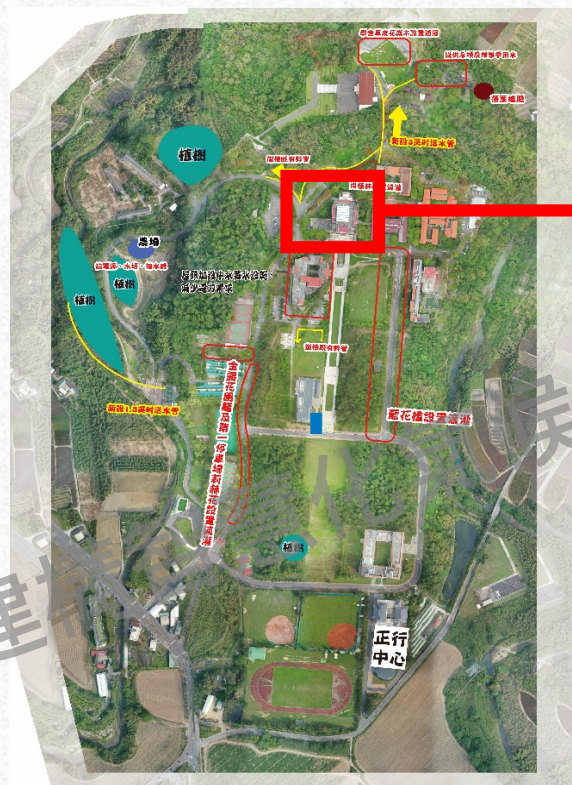
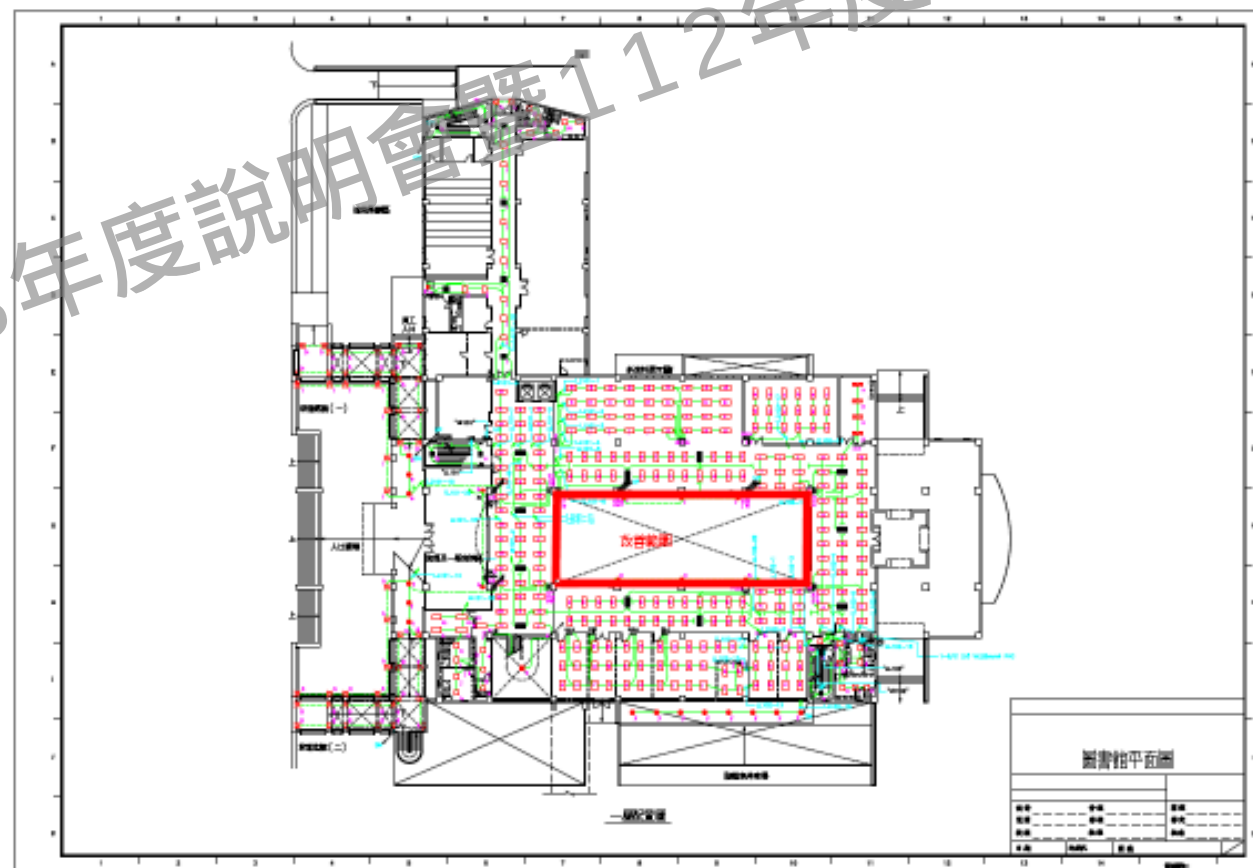


示範校調查

能源與微氣候:
圖書館人流監測與
智慧節能系統

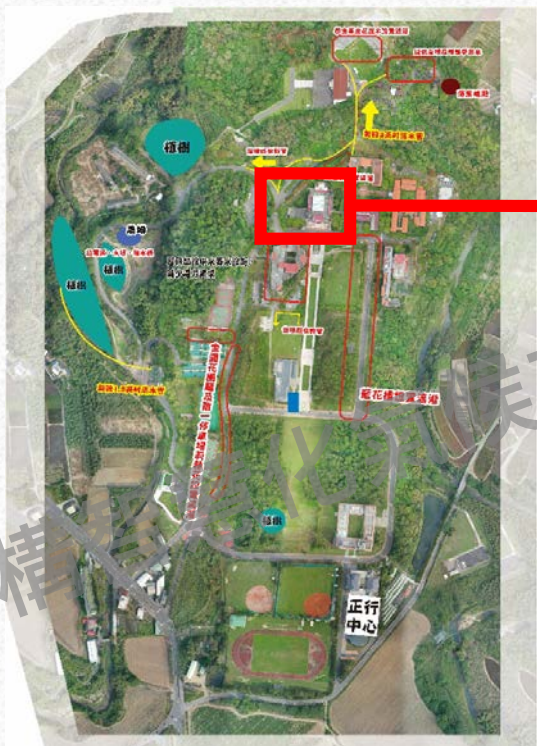


圖書館更換節能燈具施作位置圖



示範校調查與預計施作項目

能源與微氣候: 圖書館人流監測與 智慧節能系統



- ✓**智慧人流管理系統**:設置系統主機、高效率網路攝影機、專屬資通訊系統及管理程式系統，並借此分析。
- ✓**智慧環境監測系統**:設置系統主機、溫度、濕度、照度及二氧化碳等偵測設備、專屬資通訊系統及管理程式系統。
- ✓**雲端監控系統**:以上述兩系統收集建築物內外光源、溫度、溼度、二氧化碳、館內人數等資訊。
- ✓**整合既有能源管理系統**:新增圖控畫面、連線系統修改、系統測試。
- ✓**入口LED螢幕顯示**:於圖書館/正行中心入口明顯處，設置螢幕顯示系統收集/分析後數值。
- ✓**新設置與更換節能 LED 燈具及空氣循環大吊扇**
- ✓**依據 M&V 進行績效分析**

結合本校碳中和目標 永續示範校園軟硬體施作項目

能源與微氣候(自籌)：

C. 永續農場：

- (1)建立太陽能自發自用
- (2)建立太陽能教案。

- 110年16片，
 - 建置16塊太陽能板(友達 SunVivo PM060MW2 功率範圍：290W~310W，25年達80%功率之保證：232W~248W)，
- 111年搭設第二座太陽能板鋼架
 - 112年再增加48片太陽能電板
 - 進行光照不足試驗，解決農電共生問題



結合本校碳中和目標 永續示範校園軟硬體施作項目

能源與微氣候(自籌)：

D. 碳中和平台：利用本校歷年累積之充分經驗，委託開發碳盤查計算平台，協助各級學校與單位進行碳盤查、碳足跡及固碳作為。

ESG System

FUNCTION LIST

 **南華大學**
Nanhua University
三好南華 · 永續寰宇
Leading the Future · Soaring to New Heights

ISO14064 Carbon Inventory Service Platform

Account:

Password:

Verification code:

 [Refresh](#)

[Verification Code](#) (Verification is case insensitive.)

結合本校碳中和目標 永續示範校園軟硬體施作項目

資源與碳循環：

- A. 永續農場(自籌)：進行落葉堆肥、生物動力農法及土坵工法之示範基地，成為大學及碩士班課程，並撰寫食農教育、農地固碳教案。



土坵工法



MICP工法



結合本校碳中和目標 永續示範校園軟硬體施作項目

資源與碳循環：

B.新設B區農場(自籌)：利用滯洪池旁土地旁種植水稻，研究濕地固碳效益，應用至校內滯洪水池固碳量計算。

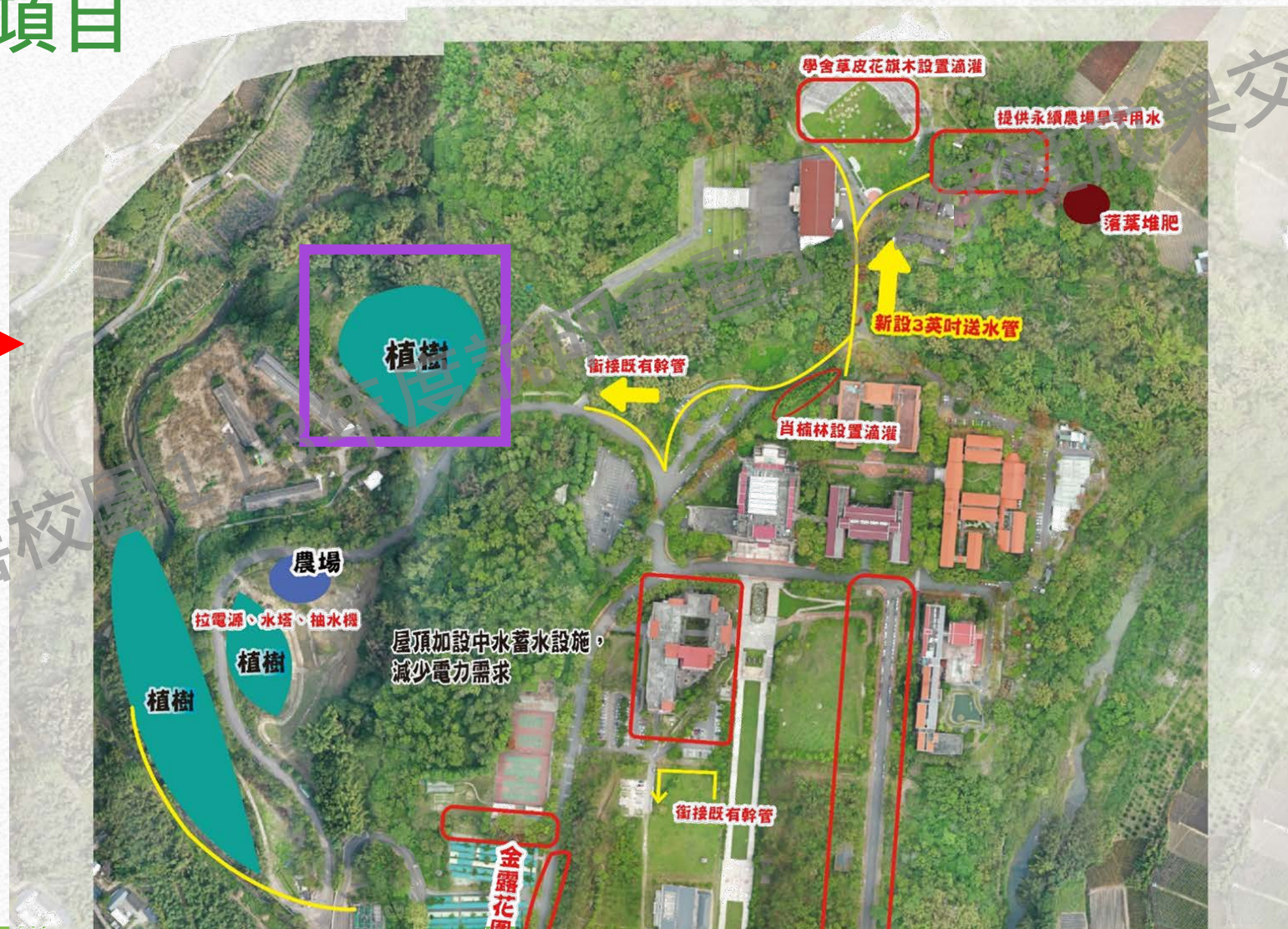


示範校調查與施作項目

水與綠系統:
C.中水回收澆灌森林與植樹



紫色區塊因工程集土及施作，延後一到兩年植樹



示範校調查與施作項目

水與綠系統:

C.中水回收澆灌森林與植樹



未設中水滴灌管線區域，
植物易乾枯冬季



既有中水滴灌管線



B區可植樹區域

- ✓校園種植大量植物及樹木
- ✓氣候變遷，久旱不雨
- ✓植樹初期，需大量澆灌用水
- ✓中水利用，減少用水

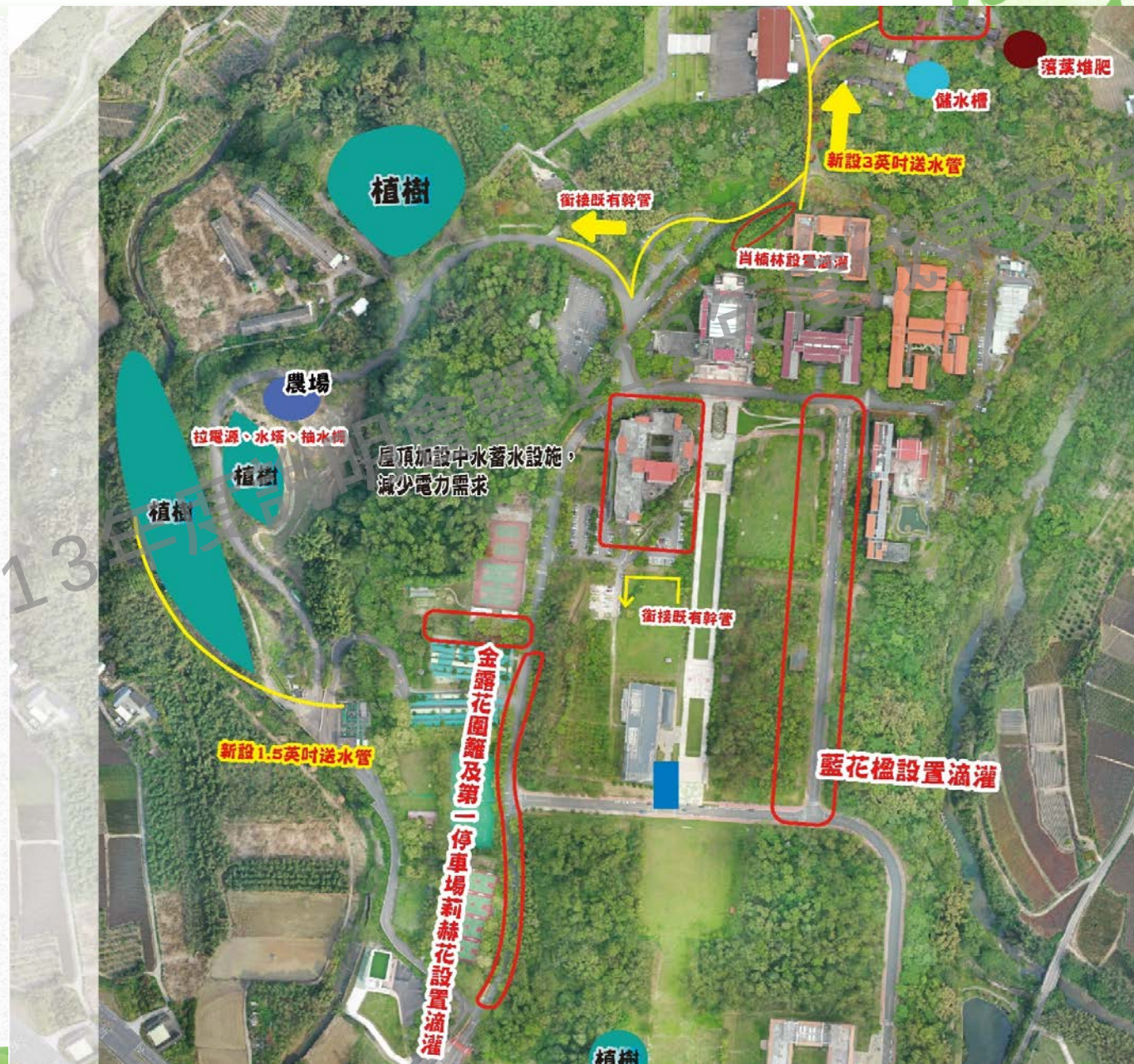


示範校調查與施作項目

水與綠系統:

D.中水回收管路延伸，
回收水可再次利用。

- ✓以往處理過中水過多時，若廁所沖廁及澆灌都已足夠，多餘水將直接放流，較可惜。
- ✓新增管路將多餘中水再次利用至澆灌系統。
- ✓採用滴灌方式澆灌，不浪費一滴水。
- ✓永續農場目前採自來水澆灌，增加中水管線後，可以輸送至農場做農業使用。
- ✓增加校園道路旁滴灌管線，灌溉校園樹木，減少旱季使用灑水車灌溉之碳排。





五、校園碳盤查

建構智慧化氣候友善校園112年度說明會暨112年度成果交流

過去校園碳盤查-ISO 14064-1:2006 2018年



Opinion Statement

Greenhouse Gas Emissions
Verification Opinion Statement

This is to verify that: **Nanhua University**
No.55, Sec. 1, Nanhua Rd.
Dalin Township
Chiayi County
Taiwan

南華大學
臺灣
嘉義縣
大林鎮
南華路一段55號

Holds Statement No: **GHGEV 1495**

Verification opinion statement
As a result of carrying out verification procedures in accordance with ISO 14064-3:2006, it is the opinion of BSI with reasonable assurance that:

- The Greenhouse Gas Emissions with the Nanhua University for the period from 2017-01-01 to 2017-12-31 is 4,688.04 tonnes of CO₂ equivalent, including scope 1 emissions 252.09 tonnes of CO₂ equivalent and scope 2 emissions 4,435.95 tonnes of CO₂ equivalent.
- No material misstatements for the period from 2017-01-01 to 2017-12-31 Greenhouse Gas Emissions calculation were revealed.
- Data quality was considered acceptable in meeting the principles as set out in ISO/CNS 14064-1:2006.
- The emission factor for electricity for the year 2017 is 0.554 kgCO₂ per kWh.

The total emissions were verified in selected branches and representative offices, including but not limited to the following:

For and on behalf of BSI: 
Managing Director BSI Taiwan, PRC
Originally Issue: 2018-12-20 Latest Issue: 2018-12-20 Page: 1 of 2

 ...making excellence a habit.

Statement No: **GHGEV 1495**

Location
Nanhua University
No.55, Sec. 1, Nanhua Rd.
Dalin Township
Chiayi County
Taiwan
南華大學
臺灣
嘉義縣
大林鎮
南華路一段55號

Verification Information
The Greenhouse Gas Emissions for the Year 2017
is 4,688.04 tCO₂e, including scope 1 emissions 252.09 tCO₂e and scope 2 emissions 4,435.95 tCO₂e

Originally Issue: 2018-12-20 Latest Issue: 2018-12-20 Page: 2 of 2

The British Standards Institution is independent to the above named client and has no financial interest in the above named client. This Opinion Statement has been prepared for the above named client only for the purposes of verifying its statements relating to its carbon emissions more particularly described in the scope. It was not prepared for any other purposes. The British Standards Institution will not, in providing this Opinion Statement, accept or assume responsibility (legal or otherwise) for or in connection with any other purpose for which it may be used or to any person by whom the Opinion Statement may be used. This Opinion Statement is prepared on the basis of review by The British Standards Institution of information presented to it by the above named client. The review does not extend beyond such information and is solely based on it. In performing such review, The British Standards Institution has assumed that all such information is complete and accurate. Any queries that may arise by virtue of this Opinion Statement or matters relating to it should be addressed to the above named client only.

- ✓初次盤查
- ✓外購電力為碳排大宗
- ✓節能減碳為主要目標

表 5-17 2017 年溫室氣體總排放計算

類別	來源	排放 CO _{2e}	排放 CO _{2e} 總量	溫室氣體排放密集度
範疇一	柴油	31.51	4688.04	0.0474
	車用汽油	38.35		
	車用汽油	34.21		
	溶劑、噴霧劑與冷媒	148.02		
範疇二	外購電力	4435.95		

說明：溫室氣體排放密集度公式：溫室氣體排放總量 (CO_{2e}) / 樓地板面積 (m²)

ISO 14064-1:2006碳盤查查證證書 (針對2017年盤查)

校園碳盤查- -ISO 14064-1:2018 2021年

bsi. Opinion Statement



Greenhouse Gas Emissions Verification Opinion Statement

This is to verify that: Nanhua University
No. 55, Sec. 1, Nanhua Rd.
Dalin Township
Chiayi County 622301
Taiwan

南華大學
臺灣
嘉義縣
大林鎮
南華路一段 55 號
622301

Holds Statement No: GHGEV 776279

Verification opinion statement

As a result of carrying out verification procedures in accordance with ISO 14064-3:2006, it is the opinion of BSI with reasonable assurance that:

- The Greenhouse Gas Emissions with Nanhua University for the period from 2021-01-01 to 2021-12-31 was verified, including direct greenhouse gas emissions 416.53 tonnes of CO₂ equivalent and indirect greenhouse gas emissions from imported energy 4,138.56 tonnes of CO₂ equivalent.
- No material misstatements for the period from 2021-01-01 to 2021-12-31 Greenhouse Gas Emissions calculation were revealed.
- Data quality was considered acceptable in meeting the principles as set out in ISO 14064-1:2018.
- The emission factor for electricity of year 2021 is 0.509 kgCO₂/per kWh.

The other selected indirect GHG emissions listed in the attached table on the next page were also reported and thus verified with limited assurance, and data quality was not considered unacceptable in meeting the principles as set out in ISO 14064-1: 2018.

For and on behalf of BSI:

Managing Director BSI Taiwan, Peter Pu

Originally Issue: 2022-11-04

Latest Issue: 2022-11-04

Page: 1 of 3

...making excellence a habit.

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Location Verification Information

The greenhouse gas emissions information reported by the organization for the period from 2021-01-01 to 2021-12-31 is as follows:

EMISSIONS	Notes	tonnes CO ₂ e
Category 1: Direct GHG emissions and removals		
1.1 Stationary combustion		63.93
1.2 Mobile combustion		79.15
1.3 Industrial processes (anthropogenic systems)		0.00
1.4 Fugitive (anthropogenic systems)		273.46
1.5 Land use, land use change and forestry	N/A	
Direct emissions in tonnes of CO ₂ e from biomass		0.00
Category 2: Indirect GHG emissions from imported energy		
2.1 Indirect emissions from imported electricity	location-based approach	4,138.56
2.2 Indirect emissions from imported energy (steam, heating, cooling and compressed air)		0.00
Category 4: Indirect GHG emissions from products used by organization		
4.1 Emissions from purchased goods		870.74
4.2 Emissions from capital goods	NS	814.19
4.3 Emissions from the disposal of solid and liquid waste		56.55
4.4 Emissions from the use of assets	NS	
4.5 Emissions from the use of services that are not described in the above subcategories	NS	

* NS: Non significant; N/A: Non available. * NS: Non significant; N/A: Non available.

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The total emissions were verified in selected branches and representative offices, including but not limited to the following:

Location	Verification Information
Nanhua University No. 55, Sec. 1, Nanhua Rd. Dalin Township Chiayi County 622301 Taiwan 南華大學 臺灣 嘉義縣 大林鎮 南華路一段 55 號 622301	The Greenhouse Gas Emissions with Nanhua University for the period from 2021-01-01 to 2021-12-31 was verified, including the direct greenhouse gas emissions 416.53 tonnes of CO ₂ equivalent and indirect greenhouse gas emissions from imported energy 4138.56 tonnes of CO ₂ equivalent.

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ISO 14064-1:2018碳盤查查證證書 (針對2021年盤查)

校園碳中和步驟及2021年經第三方查證 碳盤查項目

ISO 14064-1:2018碳盤查查證 (針對2021年盤查)

南華大學達成碳中和之步驟	
項目	南華大學
目標	校園內碳中和
排放範疇	校園內範疇一直接溫室氣體排放，及範疇二輸入能源的間接溫室氣體排放。
量化方式	依循ISO 14064-1查證標準進行。
減量	(1) 減少燃料使用量。 (2) 推動綠色辦公、高效率能源設備ISO 50001能源管理系統。 (3) 規劃興建校內太陽能電廠方式抵換
抵換方式	(1) 以植樹做抵換 (2) 輔導促使溫室氣體減量之技術轉移

類別	來源	排放CO2e	占比%	排放CO2e總量	溫室氣體排放密集度
1直接溫室氣體排放和移除	1.1 固定燃燒直接排放量-柴油	63.93	1.18%	5425.84	0.0455
	1.2 移動燃燒直接排放量-車用汽油	79.15	1.46%		
	1.4 人為系統中溫室氣體釋放產生的直接逸散排放量	273.46	5.04%		
2輸入能源的間接溫室氣體排放	2.1 輸入電力的間接排放	4,138.56	76.28%		
4使用產品的間接溫室氣體排放(上游)	4.1 源自採購商品的排放	814.19	15%		
	4.3 固體和液體廢棄物處理產生的排放	56.55	1.04%		

補充說明：

說明：溫室氣體排放密集度公式=溫室氣體排放總量(CO_{2e})/樓地板面積(m²)

2022年碳盤查比較

各類型排放源排放比例	固定式排放源	移動式排放源	逸散性排放源	能源間接排放源	其他間接排放	總碳排放當量	負碳排放源及減碳作為/策略
碳排放當量 (公噸CO ₂ e/年)	66.40512228	79.29888	820.832424	4150.47303	23.547377	5140.556833	853.086651
占總排放量比例 (%)	1.29%	1.54%	15.97%	80.74%	0.46%	100.00%	

使用友善校園計畫碳盤查EXCEL表填報顯示數據

類別	來源	排放公噸CO ₂ e	占比%	排放公噸 CO ₂ e 總量	溫室氣體排放密集度
1直接溫室氣體排放和移除	1.1固定燃燒直接排放量-柴油	48.8503	0.99%	4922.2393	0.0413
	1.2移動燃燒直接排放量-車用汽油	66.4150	1.35%		
	1.4人為系統中溫室氣體釋放產生的直接逸散排放量	272.8427	5.54%		
2輸入能源的間接溫室氣體排放	2.1輸入電力的間接排放	3699.7430	75.16%		
4使用產品的間接溫室氣體排放 (上游)	4.1源自採購商品的排放	777.8385	15.80%		
	4.3固體和液體廢棄物處理產生的排放	56.5498	1.15%		

補充說明：
 說明：溫室氣體排放密集度公式=溫室氣體排放總量(公噸CO₂e)/樓地板面積(m²)

自行碳盤查數據

依據ISO法規
自行碳盤查
碳排量較少

未來碳中和不足目標

(1)減碳：太陽能

(2)增匯：植樹 + 濕地+輔導

報告完畢，謝謝您的聆聽!

建構智慧化氣候友善校園113年度說明會暨112年度成果交流



南華大學
Nanhua University

