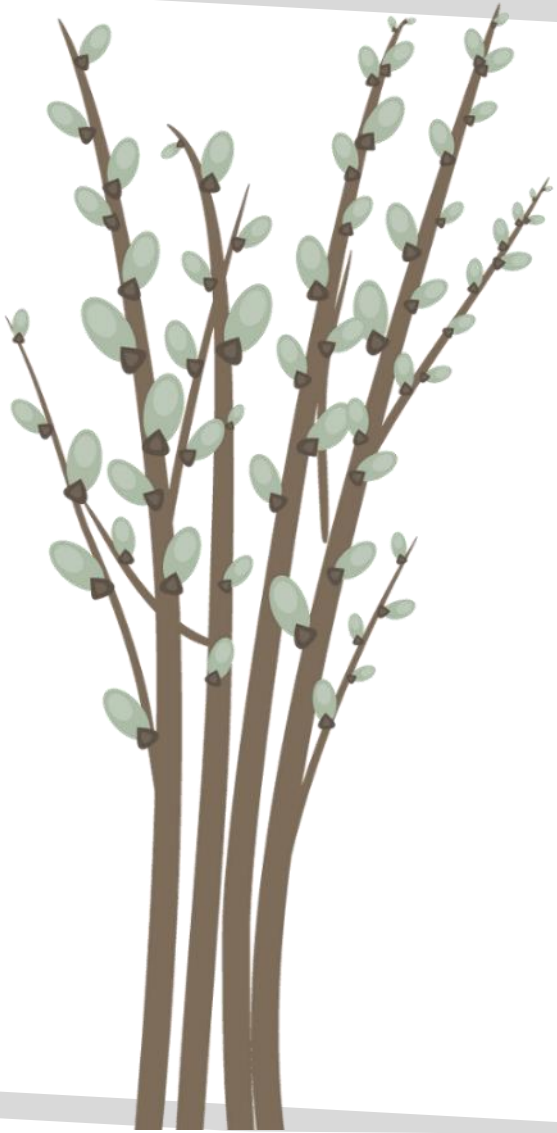
ISO 14064-1:2018 Greenhouse Gas Emissions Inventory



Professor Hong Yaoming,CEO

Nanhua University Sustainability Center

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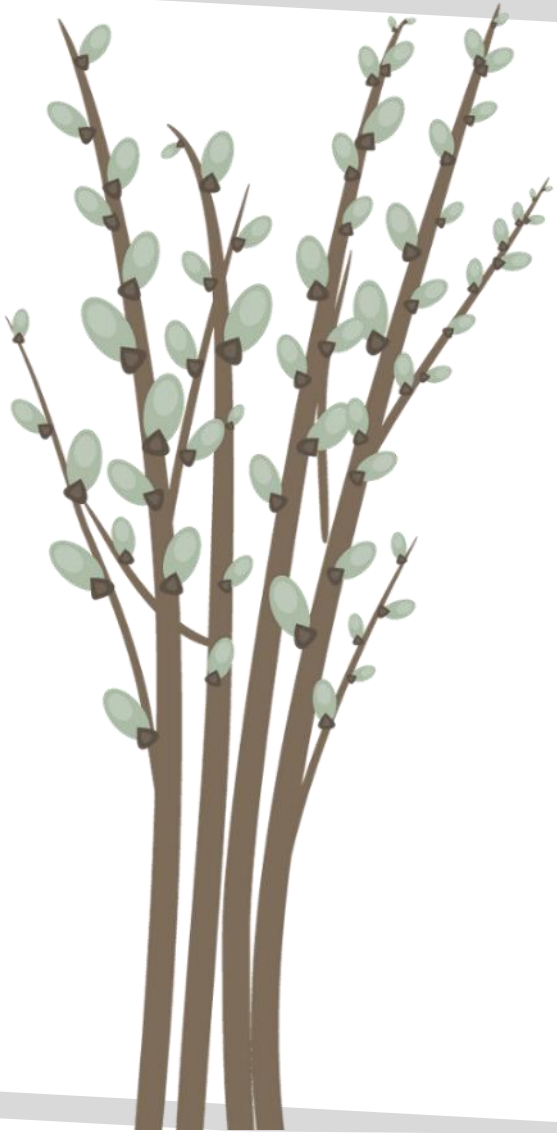
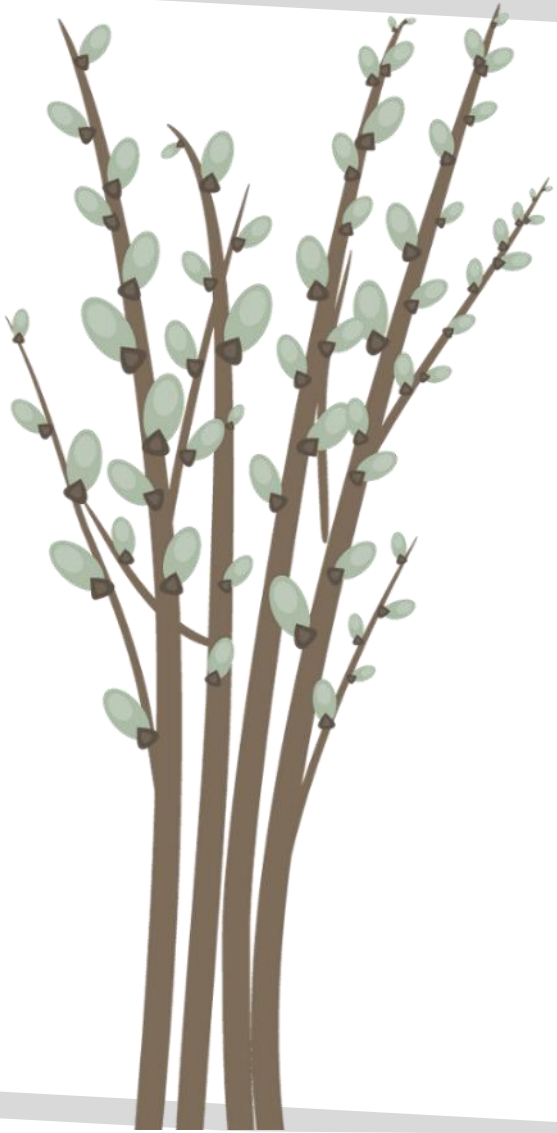


1.

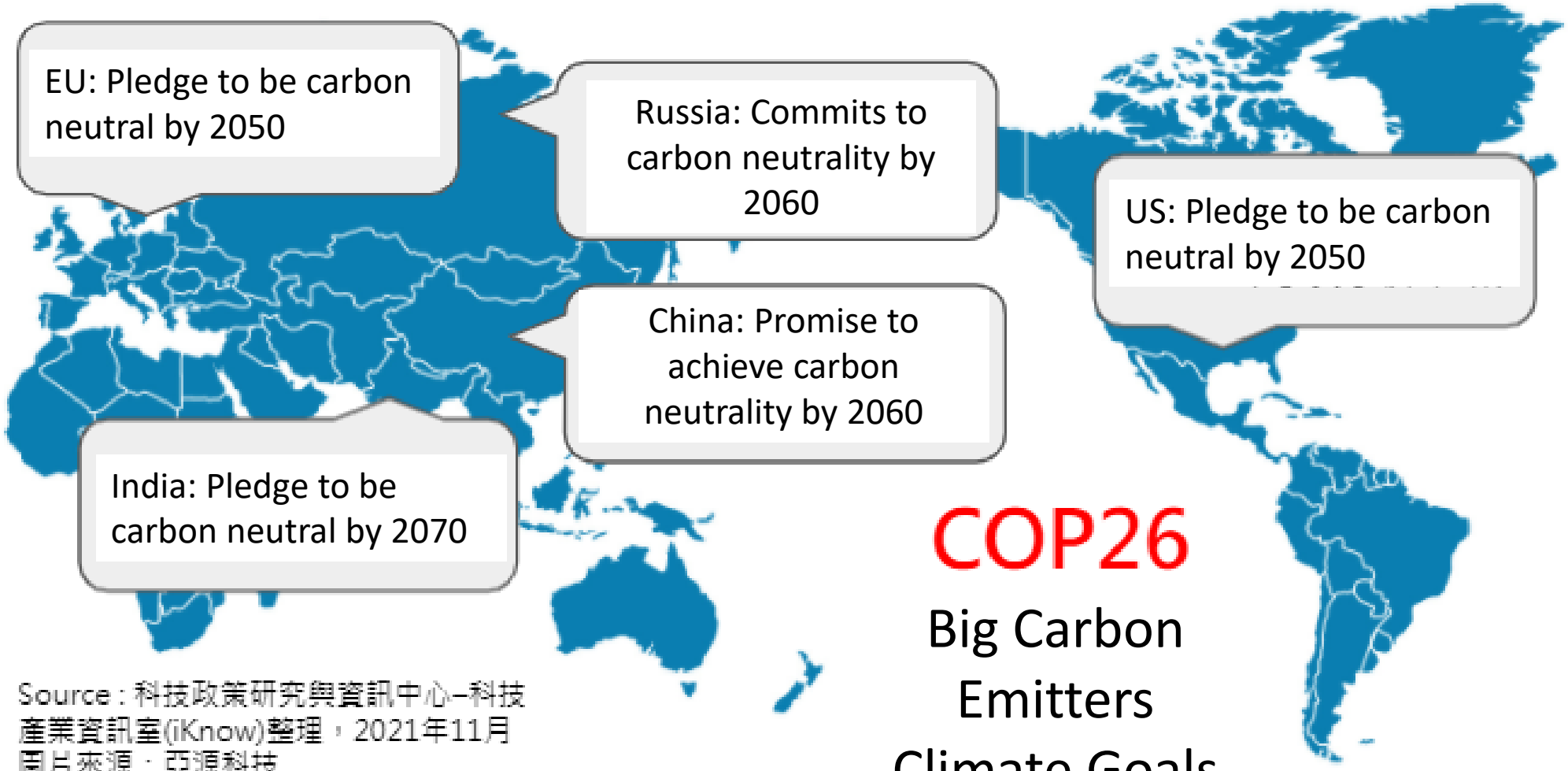
I N T R O D U C T I O N

The Necessity and Scope of Carbon Neutrality



Why Carbon Inventory?

✓136 countries around the world and the EU declared net zero emissions



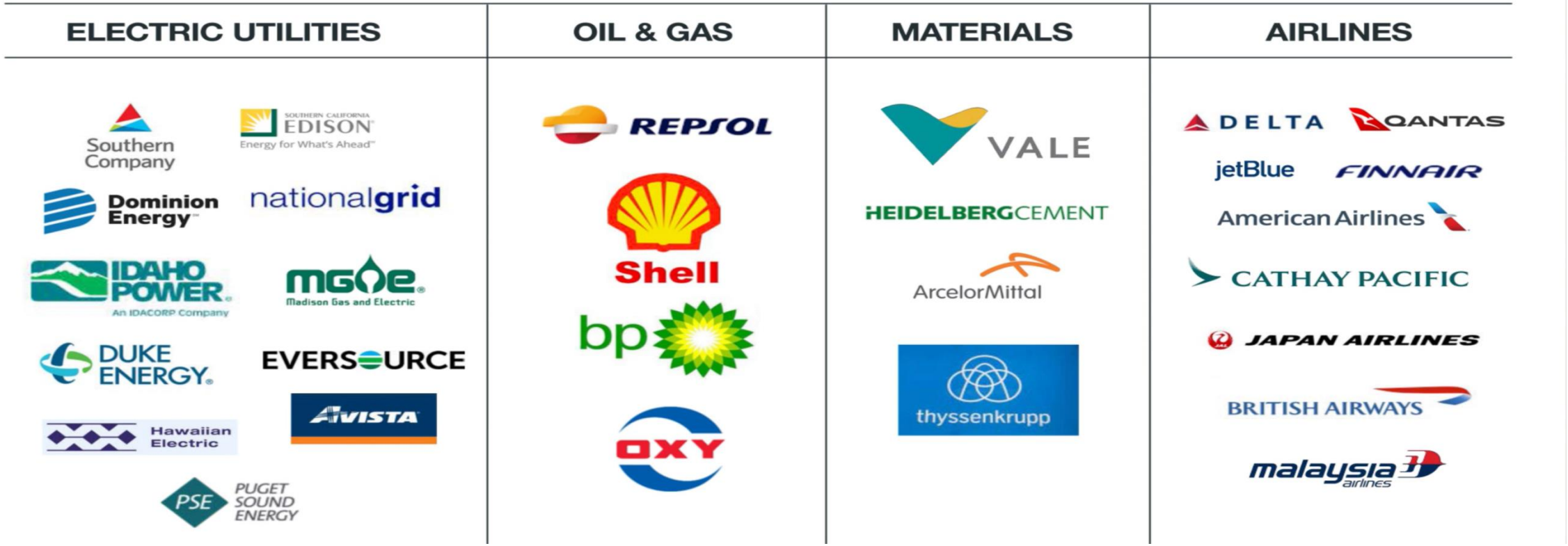
Source：科技政策研究與資訊中心–科技產業資訊室(iKnow)整理，2021年11月
圖片來源：亞源科技

COP26

Big Carbon Emitters Climate Goals

International brands require supply chains and products to be carbon-neutral

- (Carbon Disclosure Project, CDP)
  - Greenhouse gas emissions from the company's supply chain are on average 11.4 times the greenhouse gas emissions from the company's own operations
  - World Economic Forum 2021: Net-Zero Challenge: The supply chain opportunity report
  - The first key action is to establish supplier GHG emissions data



01 EU publishes CBAM draft/domestic carbon fee

✓European Union CBAM

2023 — DURING THE TRIAL PERIOD — **2025** — **2026** OFFICIAL IMPLEMENTATION

Point

1. Implement the "Information Declaration Business" 4 times a year, and fill in the carbon content and quantity of imported products.
2. In the trial phase, the EU will propose implementation rules and standardize the calculation method of carbon content, the deduction calculation method of the carbon price in the country of origin, etc.
3. There is no need to purchase CBAM vouchers yet.

Point

Officially carry out CBAM declaration, product carbon content calculation, verification, payment of carbon price declaration, CBAM certificate sales, pricing,, return, repurchase, cancellation, reduction and exemption, etc.

✓Domestic carbon fees

✓From big to small, big with small mode

✓Design differential rates to encourage enterprises to take the initiative to reduce carbon

✓The purpose of charging carbon fees is to reduce carbon rather than collect money

Preliminary estimated timing of carbon fee collection

Point in time	Estimated Progress
End of April 2022	Draft revision of temperature management law sent to Legislative Yuan for review
Before the end of 2022	Temperature control law revision completed
2023	Established the related sub-methods of the temperature management method
2024	It is estimated that a carbon fee can be introduced

資料來源：採訪整理　　翁至威／製表

01 2050 Net Zero Transformation_Industrial Carbon Reduction Demand

254 large enterprises

- Announcement of emission sources under the temperature management method, the emission amount shall be checked and registered every year.
- 105.1.7 Public first batch
- Steel Industry/ Petroleum Refining Industry/ Cement Industry/ Semiconductor Industry/ Panel Industry
- Various Industries: direct emissions amounted to 25,000 tons

Carbon Trading/
Carbon Offsetting
Net Zero Emissions

URGENT

190, 000 small and medium-sized enterprise

Carbon reduction requirements from the supply chain (client)
Electronic industry, Textile industry, Transportation industry, Food Industry

URGENT

Export products (subject to CBAM control) iron and steel industry, metal products industry

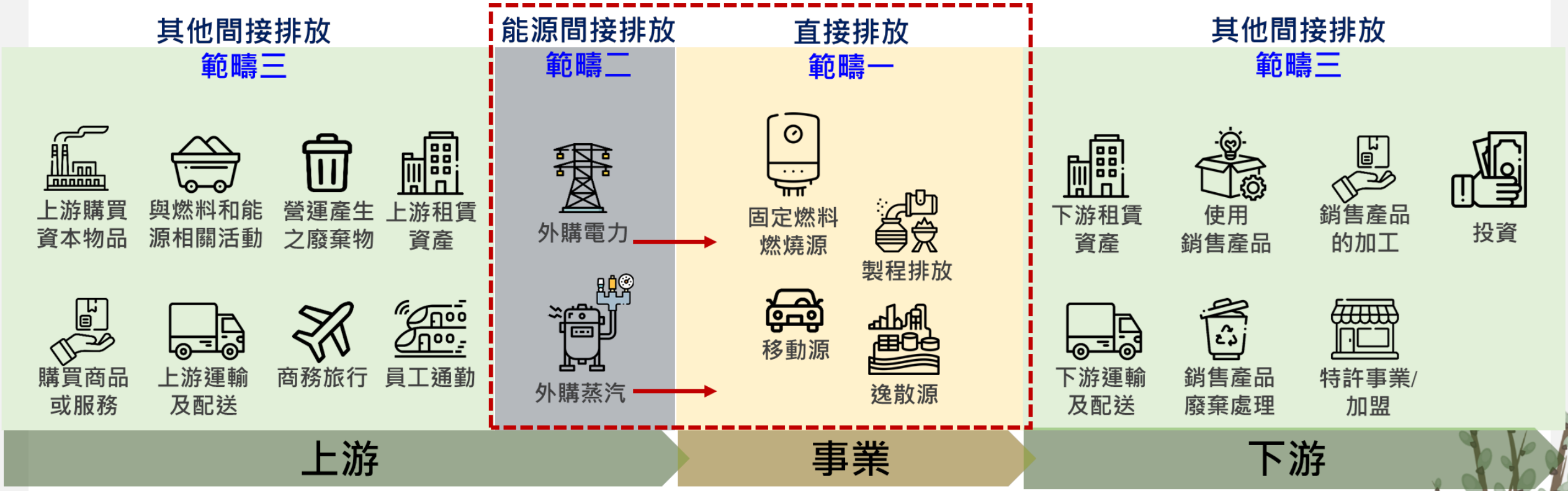
URGENT

Increased production costs (carbon fee/ energy price increase

SLOW

01 Scope of Greenhouse Gas Inventory Coverage

- Scope of International Greenhouse Gas Inventory Coverage(SCOPE)
  - Direct emissions (Scope 1), Energy indirect emissions (Scope 2), Other indirect emissions (Scope 3)



資料來源：環保署溫室氣體排放量盤查作業指引

01 Scope of Greenhouse Gas Inventory Coverage

- Scope of Greenhouse Gas Inventory Covered by the Environmental Protection Agency at the Present Stage
  - Direct emissions and energy indirect emissions (i.e. Scope 1 and Scope 2)
- Scope of Inquiry Covered by Regulations in the EU Cap-and-Trade System
  - Including: Scope 1 Direct emissions from energy use of stationary combustion sources and manufacturing processes
  - Does not include: Scope 1 emissions from fugitive sources and mobile sources
- Multinational corporations or domestic industry supply chains
  - Select the scope of inspection according to the needs of upstream suppliers or downstream customers

Source: EPA Greenhouse Gas Emissions Inventory Operation Guidelines

01 Classification comparison table of emission categories of each inventory specification

EPA regulation scope	Greenhouse Gas Inventory Protocol (GHG Protocol)		ISO/CNS 14064-1 註1
直接排放 註3 direct discharge 3	**Category one**		**Category 1: Direct GHG emissions and removals Note 2**
Energy indirect emissions	**Category two**		**Category 2: Indirect GHG emissions from input energy**
Other indirect discharge	**Category three**	**Category 4:** Emissions from upstream transport and distribution Put **Category 6:** Emissions from business travel **Category 7:** Emissions from employee commuting **Category 9:** Emissions from downstream transport and distribution put	**Category 3: Indirect GHG emissions from transport**
		Category 1: Discharges arising from the purchase of goods or services put **Category 2:** Generation of capital goods purchased upstream emissions **Category 3:** Activities related to fuel and energy Emissions (not covered by Scope 1 or 2)	**Category 4: Produced by products used by organizations between indirect greenhouse gas emissions**

Source: EPA Greenhouse Gas Emissions Inventory Operation Guidelines

01

Classification comparison table of emission categories of each inventory specification

EPA regulation scope	Greenhouse Gas Inventory Protocol (GHG Protocol)	ISO/CNS 14064-1 註1
	Category 5: Disposal and Treated Emissions Category 8: Emissions from upstream leased assets	
	Category 10: Emissions from processing of products for sale put Category 11: Emissions from the use of products sold Category 12: Emissions from disposal of products sold Category 13: Emissions from downstream leased assets Category 14: Franchising Category 15: Emissions from investments	Category 5: Between and associated with the organization's product use indirect greenhouse gas emissions
	—	Category 6: Indirect GHG emissions from other sources

Source: EPA Greenhouse Gas Emissions Inventory Operation Guidelines

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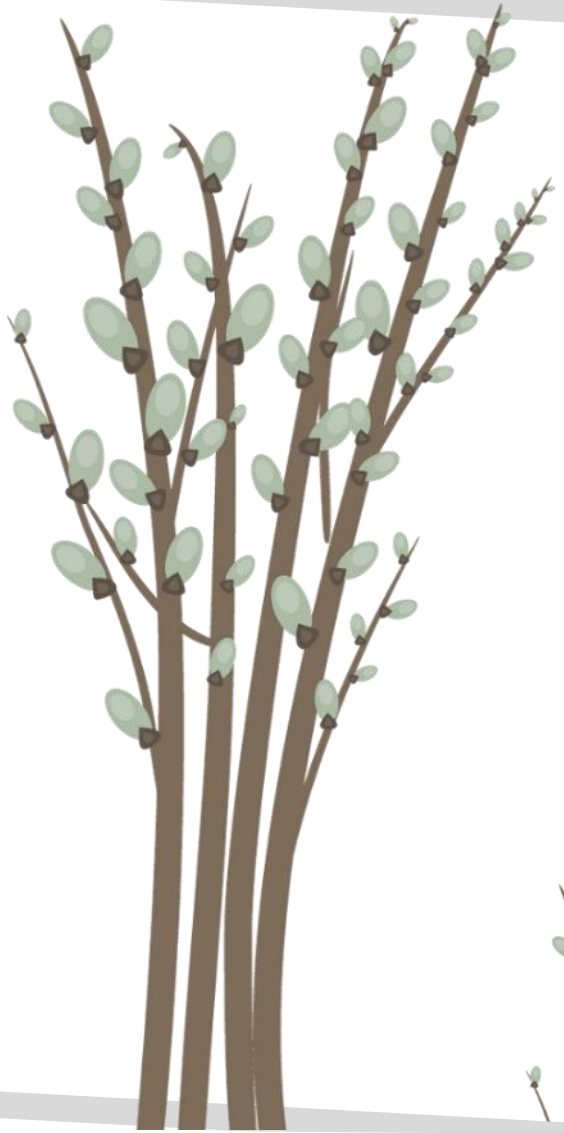
Source: EPA Greenhouse Gas Emissions Inventory Operation Guidelines

2

Understanding Greenhouse Gas Inventory

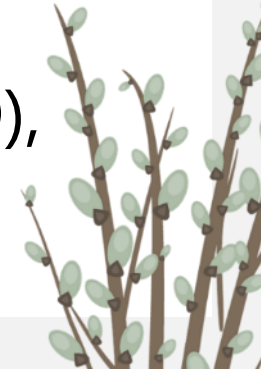
The types of greenhouse gases, the definition of inventory, the purpose of inventory, who needs to check and common inventory specifications, and establish the basic concept of greenhouse gas inventory



01

What are greenhouse gases?

- Greenhouse gases
  - Absorbs radiation at specific wavelengths in the spectrum of thermal infrared radiation from the Earth's surface, the atmosphere itself, or clouds
  - Allows sunlight to pass through the atmosphere, but retains heat energy on the Earth's surface and cannot escape the atmosphere
  - Accumulating more and more will cause global warming
- Types of greenhouse gases
  - Definition source
    - Kyoto Protocol to the Third Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC)
    - Resolution XV of the Seventeenth Meeting of States Parties
    - EPA definition of temperature regulation
  - Species: carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF6) and nitrogen trifluoride (NF3)



What is an interrogation? Why do we need an interrogation?

- Health check-like concept
  - Through regular inspections, we can find out where we can improve and improve
- Find emission hotspots by checking the results
  - Discover parts with reduction potential
  - Promote relevant reductions as

Who needs to check?

- Environmental Protection Agency Announcement "The First Batch of Emission Sources that Should Investigate and Register Greenhouse Gas Emissions"
- Annual greenhouse gas emissions from combustion of more than 25,000 metric tons of carbon dioxide equivalent (CO2e)

Should check the login object

Specific industry process

Electric power, steel, cement, semiconductor, thin film transistor liquid crystal display, petroleum refining industry

or

Emission Threshold:

Direct emissions from fossil fuel combustion in other industries reached 25,000 metric tons of CO2 e

Frequency and duration

frequency:

The first batch of emission sources that should be checked and registered should be checked and registered once a year

the term:

At the end of August every year, complete the inventory and registration work of the previous year

Inquiry login specification

Check boundaries:

The control number is used to check and register the emissions of the registered unit and the entire plant (field)

Data correctness:

Subject to third party verification

FSC's "Sustainable Development Roadmap for Listed Overseas Companies" Disclosure

check schedule

The first stage

The consolidated statement subsidiary of the listed counter company with a capital of 5 billion to 10 billion yuan has completed the investigation of individual companies.

The second stage

1. The consolidated financial statements subsidiaries of listed counter companies with a capital of more than 10 billion yuan and the steel and cement industries have completed the investigation
2. Capital 5 billion to 10 billion Yuan listed counter company disk

Check individual companies

The third stage

1. The consolidated statement subsidiary of the listed counter company with a capital of 5 billion to 10 billion yuan has completed the investigation
2. Listed counter companies with a capital of less than 5 billion yuan will check individual companies

The third stage

The consolidated statement subsidiary of listed companies with a capital of less than 5 billion yuan completed the inventory check

2023 2024 2025 2026 2027 2028 2029

Verification schedule

The first stage

Listed companies with a capital of more than 10 billion yuan and the steel and cement industries Verification completed
More than 110 million yuan and consolidated statements of steel and cement subsidiaries

More than 110 million yuan and consolidated statements of steel and cement subsidiaries completed the verification 250-10 billion yuan individual companies completed the verification

1.50-10 billion yuan Consolidated statement subsidiary company completed the verification Below 250 million yuan individual company completed the verification

5 billion yuan Under the consolidated newspaper Subsidiary complete verification

Stakeholders in multinational corporations or domestic industrial supply chains

- **Consensus on progress towards net-zero emission targets for multinational corporations or domestic industries**
  - Disclose the greenhouse gas emission information of its upstream suppliers or downstream customers
  - Incorporate the disclosure of emissions information into the corporate procurement specification as an index item

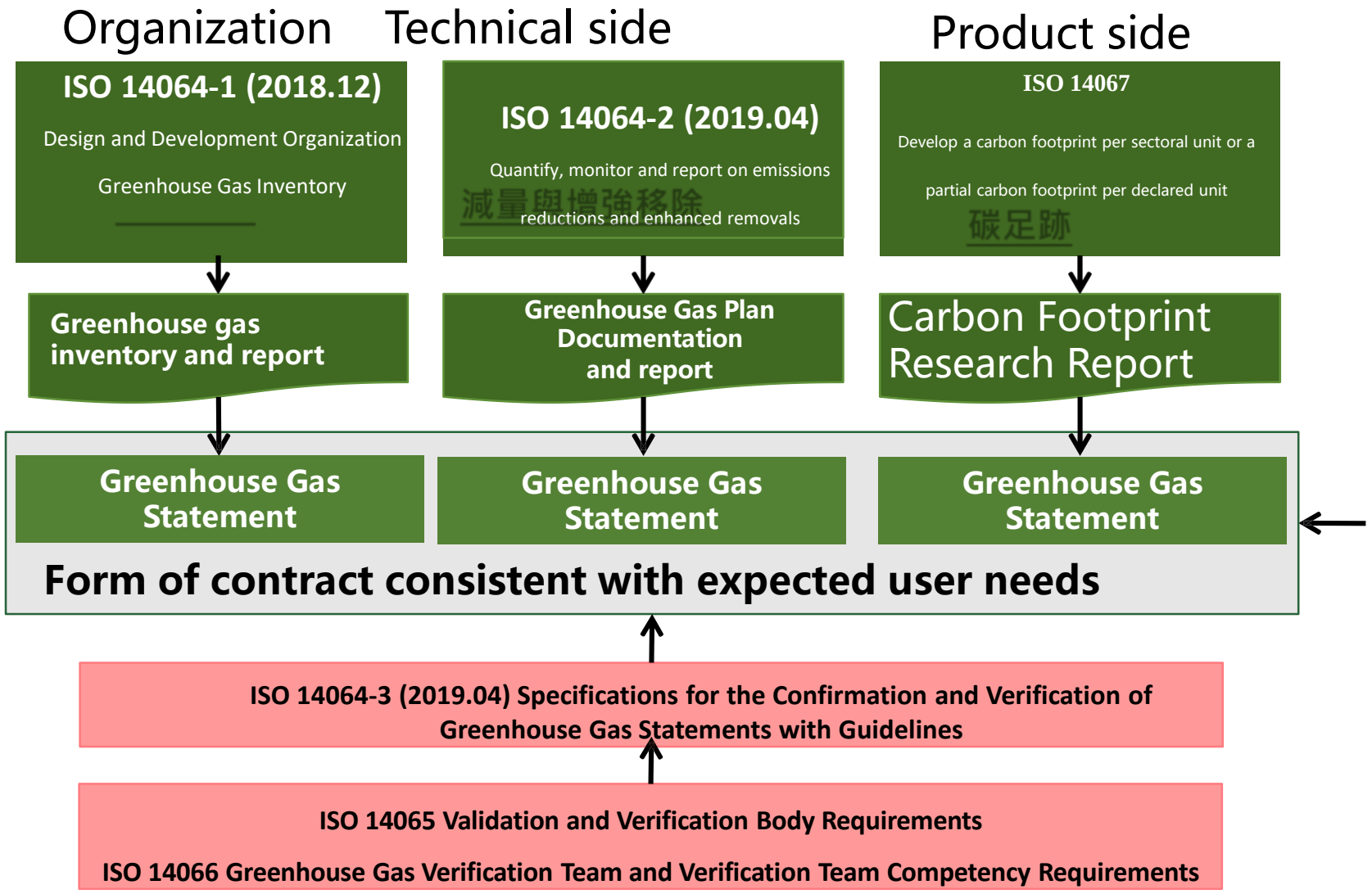
Carbon neutral goals committed by giant companies

company	carbon neutral goal
Apple	2018 announced 100% adoption of green electricity. Before 2030, global business operations, supply chains and products will achieve net zero emissions.
Meta	The electricity used for business operation is 100% renewable energy. To achieve full supply chain, employee commuting and business travel in 2030 net zero emissions.
Microsoft	In 2030, we will not only need carbon neutrality, but also achieve negative carbon emissions.
Amazon	Use 100% renewable energy in 2025, achieve zero carbon emissions for 50% of goods in 2030, and achieve carbon emission in 2040 neutralize.
Google	Data centers and parks have zero carbon emissions, and will achieve comprehensive zero carbon emissions in 2030.

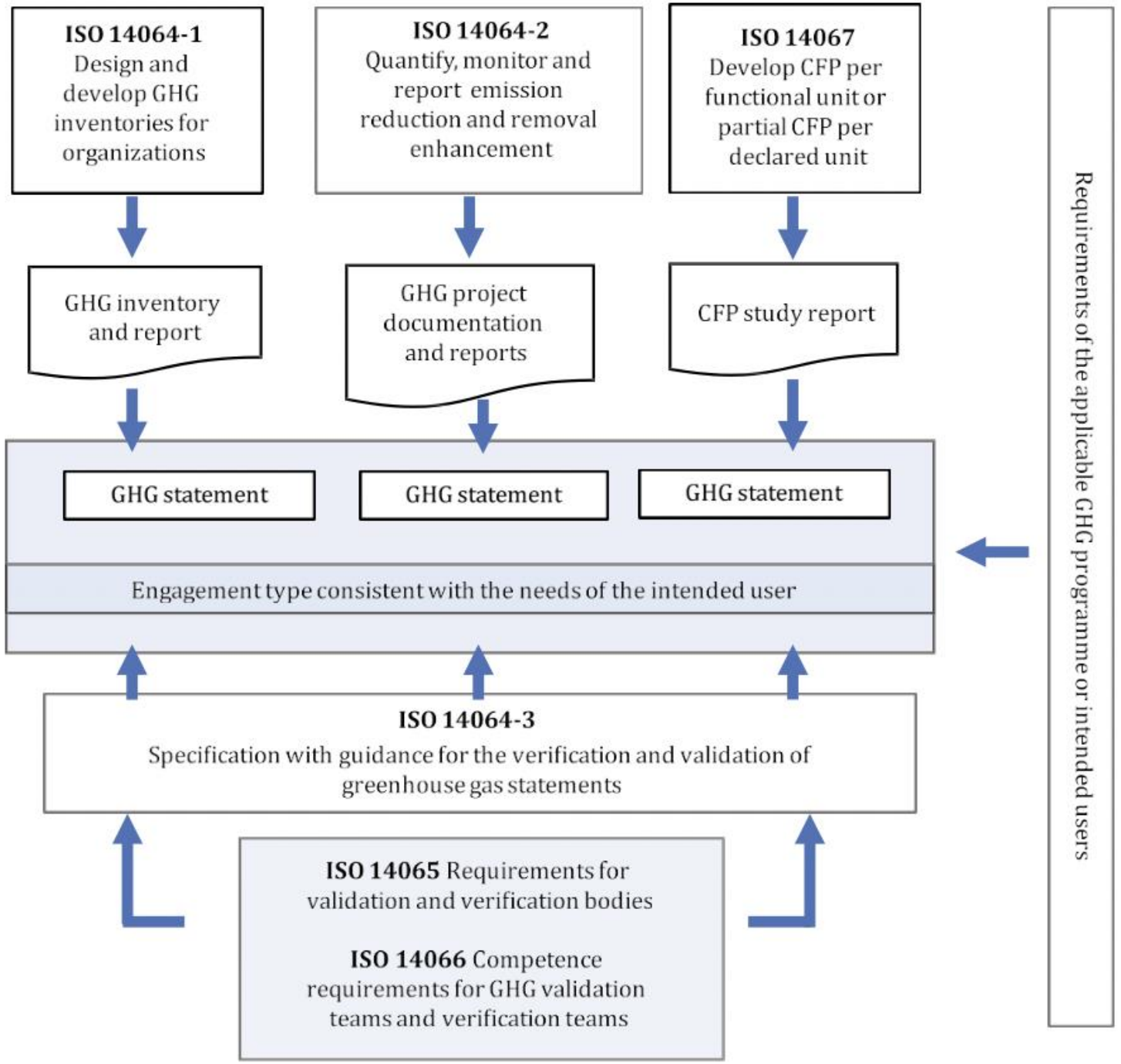
Participants in voluntary greenhouse gas reduction management, voluntary disclosure or other requirements

- Allow investors to evaluate companies based on their disclosure of greenhouse gas emissions
  - Carbon Disclosure Project (CDP) and the Dow Jones Sustainability Index (DJSI)
- ESG report: Consider greenhouse gas inventory information as one of the indicators for relevant information disclosure
  - Climate finance disclosure
    (Task Force on Climate-related Financial Disclosures, TCFD)
  - Sustainable Accounting Standards
    (Sustainability Accounting Standards Board, SASB)
- Setting of reduction goals
  - Science Based Targets Initiative (SBTi)
- Basis for voluntary GHG reduction management operations: Greenhouse Gas Inventory

Correlation among ISO 1406X series standards



適用的溫室氣體方案或預期使用者之要求事項

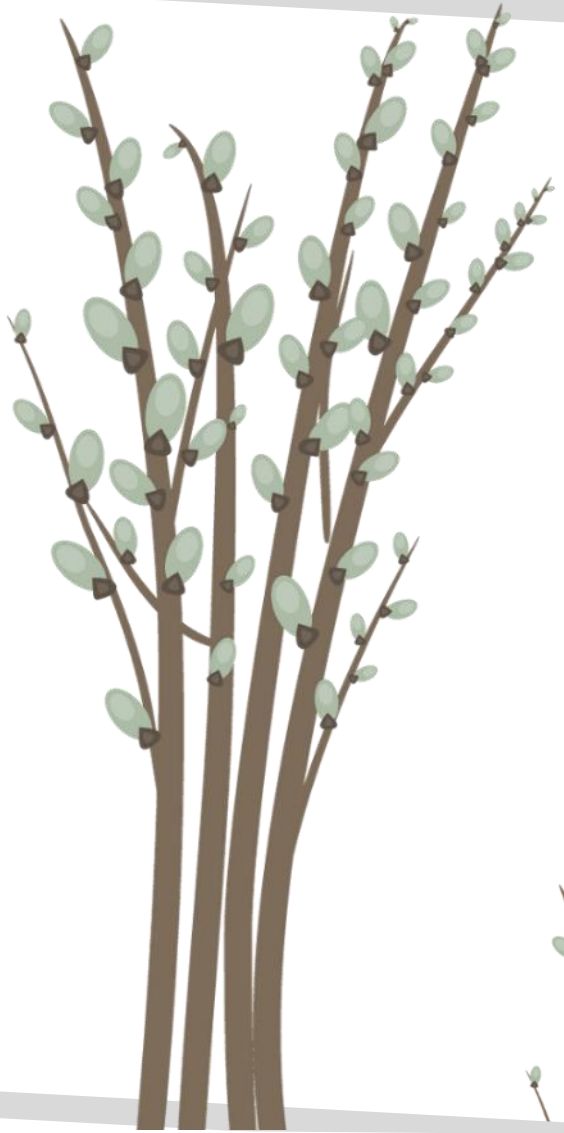

ISO 14064-1
Design and develop GHG inventories for organizations
ISO 14064-2
Quantify, monitor and report emission reduction and removal enhancement
ISO 14067
Develop CFP per functional unit or partial CFP per declared unit
GHG inventory and report
GHG project documentation and reports
CFP study report
GHG statement
GHG statement
GHG statement
Engagement type consistent with the needs of the intended user
ISO 14064-3
Specification with guidance for the verification and validation of greenhouse gas statements
ISO 14065 Requirements for validation and verification bodies
ISO 14066 Competence requirements for GHG validation teams and verification teams
Requirements of the applicable GHG programme or intended users

3

ISO 14064-1:2018 Description

Registration of regulations, terminology,

basic procedures and check results



ISO 14064-1:2018 Description

01

ISO 14064-1

Regulatory Catalog

02

Terms and Definitions

03

Basic procedures for greenhouse gas inventory operations

04

Verification, logging or disclosure of interrogation results

01 ISO 14064-1 regulation catalog

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Introduction
1 Scope
2 Normative references
3 Terms and definitions
- 3.1 Terms relating to greenhouse gases
- 3.2 Terms relating to the GHG inventory process
- 3.3 Terms relating to biogenic material and land use
- 3.4 Terms relating to organizations, interested parties and verification

4 Principles
- 4.1 General
- 4.2 Relevance
- 4.3 Completeness.
- 4.4 Consistency
- 4.5 Accuracy
- 4.6 Transparency

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1 範圍
2 規範性參考
3 術語和定義
- 3.1 與溫室氣體有關的術語
- 3.2 與溫室氣體清單過程相關的術語
- 3.3 與生物材料和土地利用有關的術語
- 3.4 與組織、相關方和驗證有關的術語

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- 4.1 概述
- 4.2 相關性
- 4.3 完整性
- 4.4 一致性
- 4.5 準確性
- 4.6 透明度

ISO 14064-1 Regulatory Catalog

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- 5.2 Reporting boundaries
  - 5.2.1 Establishing reporting boundaries
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  - 5.2.3 Indirect GHG emissions
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  - 6.2.3 Selection or development of GHG quantification model
- 6.3 Calculation of GHG emissions and removals
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  - 6.4.1 Selection and establishment of base year
  - 6.4.2 Review of base-year GHG inventory

5 溫室氣體清單邊界
- 5.1 組織邊界
- 5.2 報告界限
  - 5.2.1 建立報告界限
  - 5.2.2 直接溫室氣體排放和清除
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  - 5.2.4 溫室氣體清單類別

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  - 6.2.1 概述
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- 6.4 基準年溫室氣體清單
  - 6.4.1 基準年的選擇和建立
  - 6.4.2 審查基準年溫室氣體清單

ISO 14064-1 Regulatory Catalog

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- 7.1 GHG emission reduction and removal enhancement initiatives
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9 GHG reporting
- 9.1 General
- 9.2 Planning the GHG report
- 9.3 GHG report content
  - 9.3.1 Required information
  - 9.3.2 Recommended information
  - 9.3.3 Optional information and associated requirements

10 Organization's role

Annex A (informative) Process to consolidate data

7 減緩活動
- 7.1 溫室氣體減排和清除增強舉措
- 7.2 溫室氣體減排或增強清除項目
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10 組織的作用

附錄 A（資料性附錄） 整合數據的過程

Terms and Definitions

3.1 Terms related to greenhouse gases

1. Greenhouse gas(GHG)

   Natural and man-made atmospheric gas components1 absorb and emit radiation at specific wavelengths within the infrared radiation spectrum emitted by the Earth's surface, atmosphere, and clouds.

   - ✓ Remark 1. Greenhouse Gas List Refer to latest Intergovernmental Panel of Experts on Climate Change (IPCC) evaluation report
   - ✓ Remark 2. Water vapor and ozone are Anthropogenic as well as natural greenhouse gases, although not included as recognized greenhouse gases due to difficulty 1 Separated in most cases from human-induced global warming components attributable to presence.

2. Source of greenhouse gases
   The process of releasing greenhouse gases (3.1.1) into the atmosphere.
3. Greenhouse gas sink
   The process of removing greenhouse gases (3.1.1) from the atmosphere.

4. Greenhouse gas reservoir

Components other than the atmosphere that have the ability to accumulate greenhouse gases (3.1.1), store them and release them.

Remarks 1. Oceans, soils, and forests are examples of components that can be used as repositories.

Remark 2. Greenhouse gas capture and storage is one of the processes of forming a greenhouse gas reservoir.

5. Greenhouse gas emission

Release of greenhouse gases (3.1.1) into the atmosphere.

6. Greenhouse gas removal

Removal of greenhouse gases (3.1.1) from the atmosphere by greenhouse gas sinks (3.1.3).

7. Greenhouse gas emission factor

Coefficient related to greenhouse gas activity data (3.2.1) for greenhouse gas emissions (3.1.5).

Note: GHG emission factors may contain an oxidizing component.

8 Greenhouse gas removal factor

Coefficient related to greenhouse gas activity data (3.2.1) for greenhouse gas removal (3.1.6).

Note: GHG removal factor may contain an oxidizing component

9. Direct greenhouse gas emission

Greenhouse gas emissions (3.1.5) from greenhouse gas sources (3.1.2) owned or controlled by the fabric (3.4.2).

Note: This standard uses the concepts of ownership or control (financial or operational control) to establish organizational boundaries.

10. Direct greenhouse gas removal

GHG removal (3.1.6) from GHG sinks (3.1.3) owned or controlled by an organization (3.4.2).

11. Indirect greenhouse gas emission

greenhouse gas emissions (3.1.5) resulting from the operations and activities of the organization (3.4.2),
The emissions are from sources of greenhouse gases that are not owned or controlled by the organization (3.1.2).
Remarks: These emissions are usually generated in upstream or downstream industrial chains.

12. Global warming potential

Index based on radiative properties of greenhouse gases (3.1.1)
Measure the pulse emission per unit mass of a specific greenhouse gas in the atmosphere on the same day after the radiation shock, after a selected time limit, relative to the equivalent unit of carbon dioxide (CO2) 。

13. Carbon dioxide equivalent

Unit for comparing the radiative impact of a greenhouse gas (3.1.1) relative to carbon dioxide.
Note: CO2 equivalent is calculated by multiplying the mass of a specific greenhouse gas by its global warming potential (3.1.12) 。

3.2 Terminology related to the greenhouse gas inventory process

1. Greenhouse gas activity data

   Quantitative measure of an activity that results in greenhouse gas emissions (3.1.5) or greenhouse gas removal (3.1.6).

   Example: energy, fuel or electricity consumed, quantity of materials produced, services provided, area of affected land.

2. Primary data

   A quantitative value obtained by direct measurement or calculation based on direct measurement of a process or activity.

   Note: Raw data may include GHG emission factors (3.1.7) or GHG removal factors (3.1.8) and/or GHG activity data.

3. Site-specific data

   Raw data (3.2.2) acquired within organizational boundaries (3.4.7).

   Note: All field-specific data are raw data, but not all raw data are field-specific data.

4. Secondary data

   Data obtained from sources other than raw data (3.2.2).

   Note: Such sources may include databases and published literature verified by responsible agencies.

3.2.5 Greenhouse gas statement

Inappropriate use: the term GHG assertion

a true and objective statement about the subject matter of which it is provided (3.4.9) or corroborated (3.4.10).

Note 1. A GHG statement can be presented at a point in time or over a period of time.

Remark 2. The greenhouse gas statement put forward by the responsible person (3.4.3) must be clearly identifiable, and can be evaluated or measured by the verifier (3.4.11) or the verifier (3.4.12) according to appropriate criteria.

Remark 3. The GHG statement can be in the form of a GHG report (3.2.9) or a GHG plan (3.2.9) proposed.

3.2.6 Greenhouse gas inventory

Greenhouse gas sources (3.1.2) and greenhouse gas sinks (3.1.3), and their quantified greenhouse gas emissions (3.1.5) and temperature

List of chamber gas removal (3.1.6)

7. Greenhouse gas project

Conditions for changing the GHG baseline to result in a reduction in GHG emissions (3.1.5) or removal of GHGs

(3.1.6) Incremental activities.

Note: CNS 14064-2 (ISO 14064-2) provides information on how to determine and use greenhouse gas baselines.

8. Greenhouse gas program

Voluntary or mandatory international, national or national sub-system or scheme to register, measure or manage greenhouse gas emissions (3.1.5), greenhouse gas emissions (3.1.5), Gas removal (3.1.6), GHG emission reduction or GHG removal increment.

9. Greenhouse gas report

Communicate GHG-related information from an organization (3.4.2) or GHG program (3.2.7) to its intended users

(3.4.4) A single document for communication.

Note: A GHG report may include a GHG statement (3.2.5).

10. Base year

For comparison of GHG emissions (3.1.5) or GHG removals (3.1.6) or other relevant hourly For informational purposes, a specific historical period is identified.

11. Greenhouse gas reduction initiative

Non-structured greenhouse gas program (3.2.7), undertaken by an organization (3.4.2) on an individual or continuous basis to reduce or prevent direct or indirect greenhouse gas emissions (3.1.5) or to enhance direct or indirect Greenhouse gas removal (3.1.6), the specific activity or initiative implemented.

12. Monitoring

Ongoing or periodic assessment of GHG emissions (3.1.5), GHG removals (3.1.6) or other GHG-related data.

13. Uncertainty

Parameters associated with quantitative results can characterize the dispersion of values and can be reasonably measured as quantitative values.

Note: Uncertainty information is generally a quantitative estimate illustrating the dispersion of values and a qualitative statement of possible causes of the dispersion

14.Significant indirect greenhouse gas emission initiative (Significant indirect GHG emission)

Greenhouse gas emissions (3.1.5) that are quantified and reported by the organization (3.4.2) and that meet the materiality criteria set by the organization.

3.3 Terms related to biological source materials and land use

1. **Biomass**

   Materials of biological origin, except materials buried in geological formations and materials transformed into fossil materials.

   Note: Biomass includes organic materials (living and non-living), such as trees, grains, grasses, tree branches, algae, animals, compost and wastes of biological origin.

2. **Biogenic carbon**

   Carbon produced from biomass (3.3.1).

3. **Biogenic CO_2**

   Carbon dioxide obtained from the oxidation of biomass carbon (3.3.2).

4. **Anthropogenic biogenic GHG emission**

   Greenhouse gas emissions (3.1.5) from materials of biological origin as a result of human activities.

5. **Direct land use change**

   Alteration of land within relevant boundaries for human use.

Note: The relevant boundary is the reporting boundary (3.4.8).

3.3.6 Land use

Human use or management of the land within the relevant

boundaries.

Note: The relevant boundary is the reporting boundary (3.4.8).

3.3.7 Non-anthropogenic biogenic GHG emission

Greenhouse gas emissions (3.1.5) from materials of biological origin resulting from **natural disasters** (e.g. wildfire or insect infestation) or **natural evolution** (e.g. growth, decomposition).

3.4 Terms related to organizations, stakeholders and verification

1. **Facility**
   A single installation, an assembly of installations or a production process (stationary or mobile) that can be defined within a single geographical boundary, organizational unit or production process.

2. **Organization**

   A person or group of persons with its own functions, responsibilities, authorities and relationships to achieve its goals.

   Note: The concept of organization includes (but is not limited to) sole proprietor, company, body corporate, firm, enterprise, authority, partnership, academic association, charity or public facility, or any part or combination of the above, whether independent Or joint stock, public or private.

3. **Responsible party**

   The person or persons responsible for presenting the GHG statement (3.2.5) and supporting information for the GHG (3.1.1).

   Note: The responsible person can be an individual or a representative of a group (3.4.2) or project, and can be employed to verify

   (3.4.11) or certifier (3.4.12) group.

4. **Intended user**

A person or organization (3.4.2) identified by the reporter of GHG-related information as a person or group that relies on such information to make decisions.
Note: Intended users can be customers (3.4.5), responsible persons (3.4.3), the organization itself, managers of GHG programmes (3.2.8), regulators, financial groups or other affected stakeholders,
Example: Local groups, government departments, general public or non-governmental organisations.

5. **Client**

organization (3.4.2) or person requesting verification (3.4.9) or confirmation (3.4.10).

6. **Intended use of the GHG inventory**

primary objective defined by an organization (3.4.2) or program to identify its GHG emissions (3.1.6) and GHG removals (3.1.6) in line with the needs of its intended users (3.4.4) Purpose.

7. **Organizational boundary**

activity or facility within an organization (3.4.2) that can exercise operational or financial control or the classification of an equity stake

8. **Reporting boundary**

Resulting from GHG emissions (3.1.5) or GHG removals (3.1.6) reported within the organization's boundaries (3.4.7) and significantly as a result of the organization's (3.4.2) operations and activities Classification of indirect emissions.

9. **查證(verification)**
The process of evaluating a statement based on historical data and information to determine whether the statement is true and correct and meets the criteria.

10. 確證(validation)
The process of evaluating the reasonableness of assumptions, constraints and methods to support a statement about the results of future activities.

11. 查證者(verifier)
competent and impartial person with responsibility for performing verification (3.4.9) and reporting

12. 確證者(validator)
Competent and impartial person with responsibility for performing assurance (3.4.10) and reporting

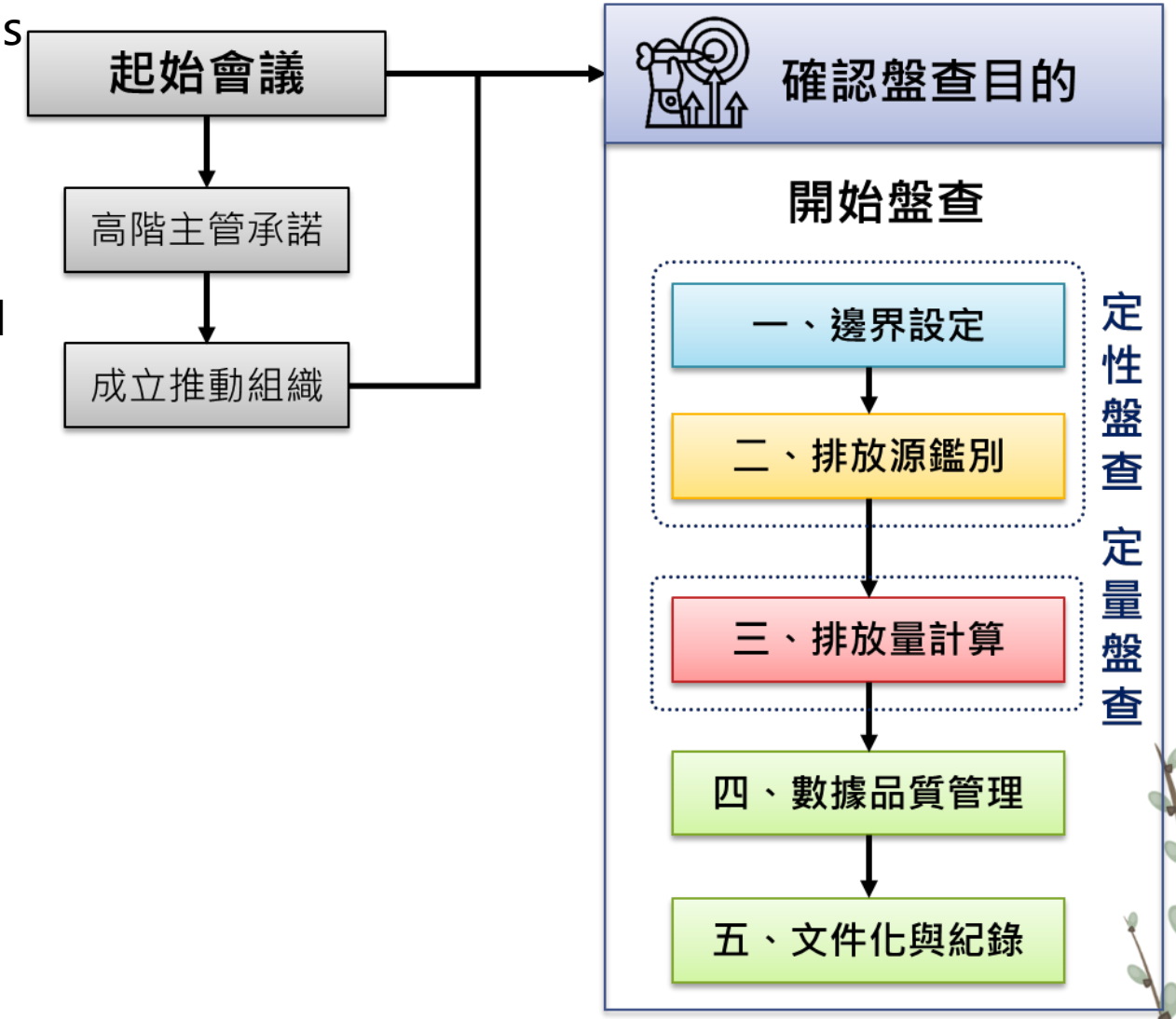
13. 保證等級(level of assurance)
Reliability of Greenhouse Gas Statement (3.2.5) 。

03 Basic procedures for greenhouse gas inventory operations

- ✓kickoff meeting
- ✓Confirm the objects to be checl and the check specifications tha must be met or referred to
- ✓boundary setting
- ✓Identification of emission sourc
- ✓Calculation of emissions
- ✓Documentation and Records

kickoff meeting

- Calculation of greenhouse gas emissions is the core basis for carbon reduction
- Inventory of energy and resource consumption from all operating activities of the enterprise
- The data to be collected and consolidated across different departments within the organization
- Cross-departmental cooperation is required
- Ideal practice: hold kick-off meeting
- The Commitment of Corporate Executives
- Form a promotion group
- Cohesively execute the consensus
- Ensure that the inventory operation is promoted smoothly



Confirm the objects to be checked and the check specifications that must be met or referred to

- Examine the standards that the business belongs to at this stage or in the future to meet
- Draft regulations or notices issued by government agencies
- International Supply Chain Requirements
- Voluntary participation in relevant international carbon reduction initiatives

盤查對象	說明	須符合或參考之盤查規範
(一)環保署公告納管事業	據以掌握我國溫室氣體排放情形，為下階段溫室氣體管理預作準備	• 溫室氣體排放量盤查登錄管理辦法； • 本指引第三篇內容。
(二)金管會指定揭露對象	揭露溫室氣體排放量等資訊，落實企業永續發展責任	• 同屬金管會及環保署納管事業，應依環保署規範及本指引辦理； • 非環保署納管事業，於國內部分則依金管會規範辦理，國外部分依當地國規範，倘當地國未規範者依國際標準執行。
(三)跨國企業或國內產業供應鏈中之利害關係人[註]	廠商要求	• 溫室氣體盤查議定書(GHG Protocol)； • 企業價值鏈（範疇三）標準[3]； • ISO 14064-1:2018； • CNS 14064-1:2021。
(四)自願性參與者	瞭解自身溫室氣體排放情況	• 溫室氣體盤查議定書(如GHG Protocol)； • 企業價值鏈（範疇三）標準； • ISO 14064-1:2018； • CNS 14064-1:2021。

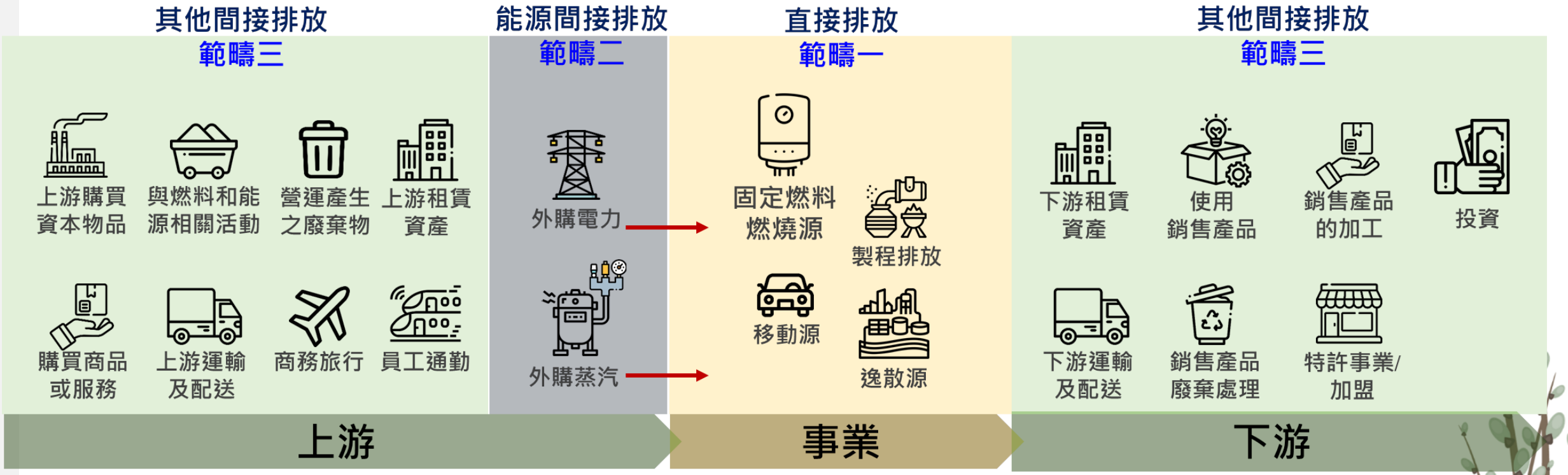
註：上游供應廠商、下游客戶或國際產業公協會。

Boundary setting

- According to the aforementioned norms to be followed, define the scope to be checked
- The entire enterprise group, a single business or subsidiary, a certain office building, a specific production process, a specific product or service
- Enterprises that have been approved by the Environmental Protection Agency
- The inspection boundary of managed enterprises is set to the geographical boundary covered by the control number issued by the Environmental Protection Agency
- And according to the operation control law, it is divided into units or procedures of direct emissions or energy indirect emissions.
- The FSC checks the border
- to be consistent with financial statements
- There is no regulation on whether the subsidiary’ s greenhouse gas emissions should be included in the statistics by the financial control method, the operation control method or the equity ratio method.
- , requiring that all subsidiaries within the enterprise must be consistent.
- For those who meet other inspection specifications, the boundary setting may be different
- Carbon Disclosure Project (CDP)
- It is up to the enterprise to decide whether to set the boundary to be inspected based on the financial control law, the operation control law or the equity ratio method.
- The policy guidelines of government agencies or the goal or schedule of net-zero emission reduction in the international supply chain may gradually adjust the inventory boundary according to different stages

Identification of emission sources

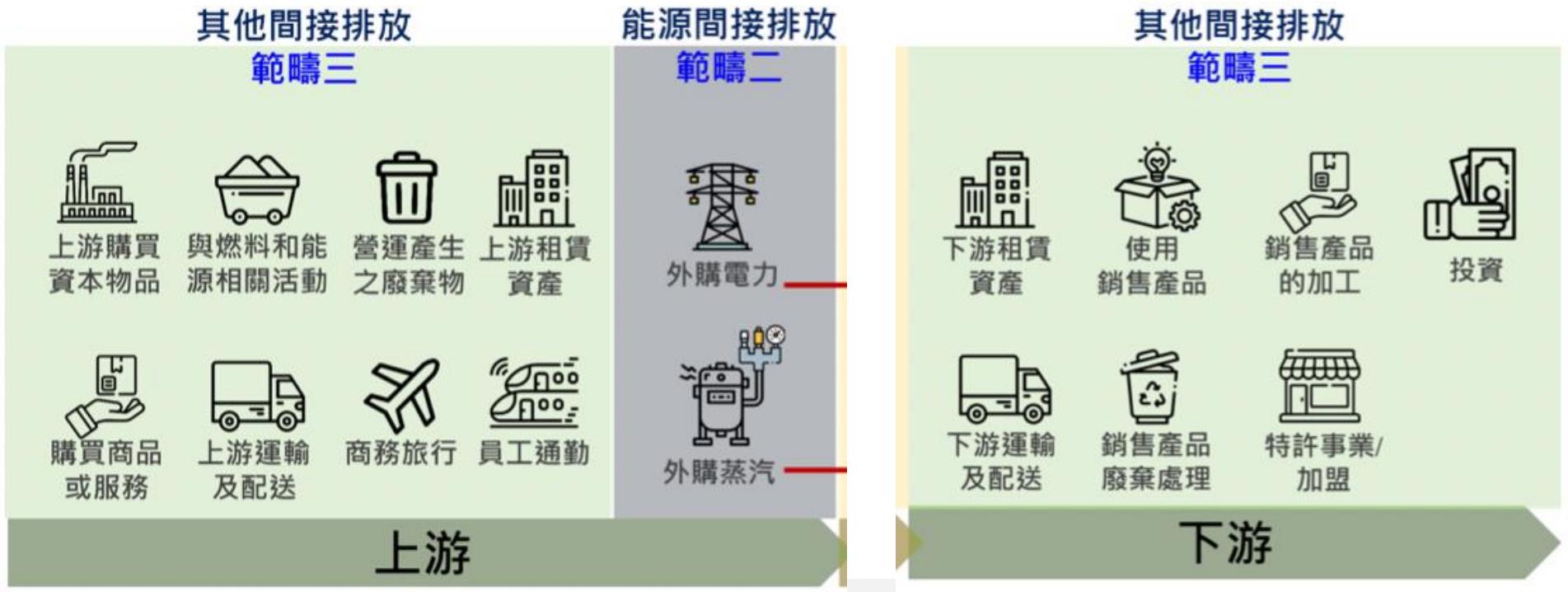
- Greenhouse Gas Emission Category
- Direct emissions, energy indirect emissions, and other indirect emissions
- Types of emission sources included in each emission category



Direct Greenhouse Gas Emissions (Scope 1)

- Refers to direct emissions from a process or facility
- Fossil fuels are used in factory boilers, process operations or employee cafeterias
- Emissions from raw materials
- Emissions from the use of fossil fuels in transport
- And fugitive discharge of refrigerants from air conditioners and drinking water equipment
- Direct emissions of ISO14064-1:2018 or CNS 14064-1:2021
- Includes land use and land-use change and forestry
- Among them, land use and land use change and forestry are not required by the Environmental Protection Agency

- Energy Indirect Greenhouse Gas Emissions (Scope 2)
- Refers to indirect emissions from energy utilization using electricity or steam
- Other indirect greenhouse gas emissions (Scope 3)
- Greenhouse gas emissions from business activities
- The source of emissions is not owned or controlled by the undertaking
- e.g. leasing, outsourcing, employee commuting, business travel
- Other indirect emissions from activities such as upstream and downstream transportation and distribution.



Applicable inspection scope for each inspection object

Check scope / Check object	Direct Emission	Indirect Emissions	
		Energy Indirect Emissions	Other Indirect Emissions
(1) The Environmental Protection Agency announces the management business	○	○	×
(2) Targets designated by the FSC	○	○	×
(3) Stakeholders in the supply chain of multinational enterprises or domestic industries Note 1	○	△	△
(4) Voluntary participants	○	△	△

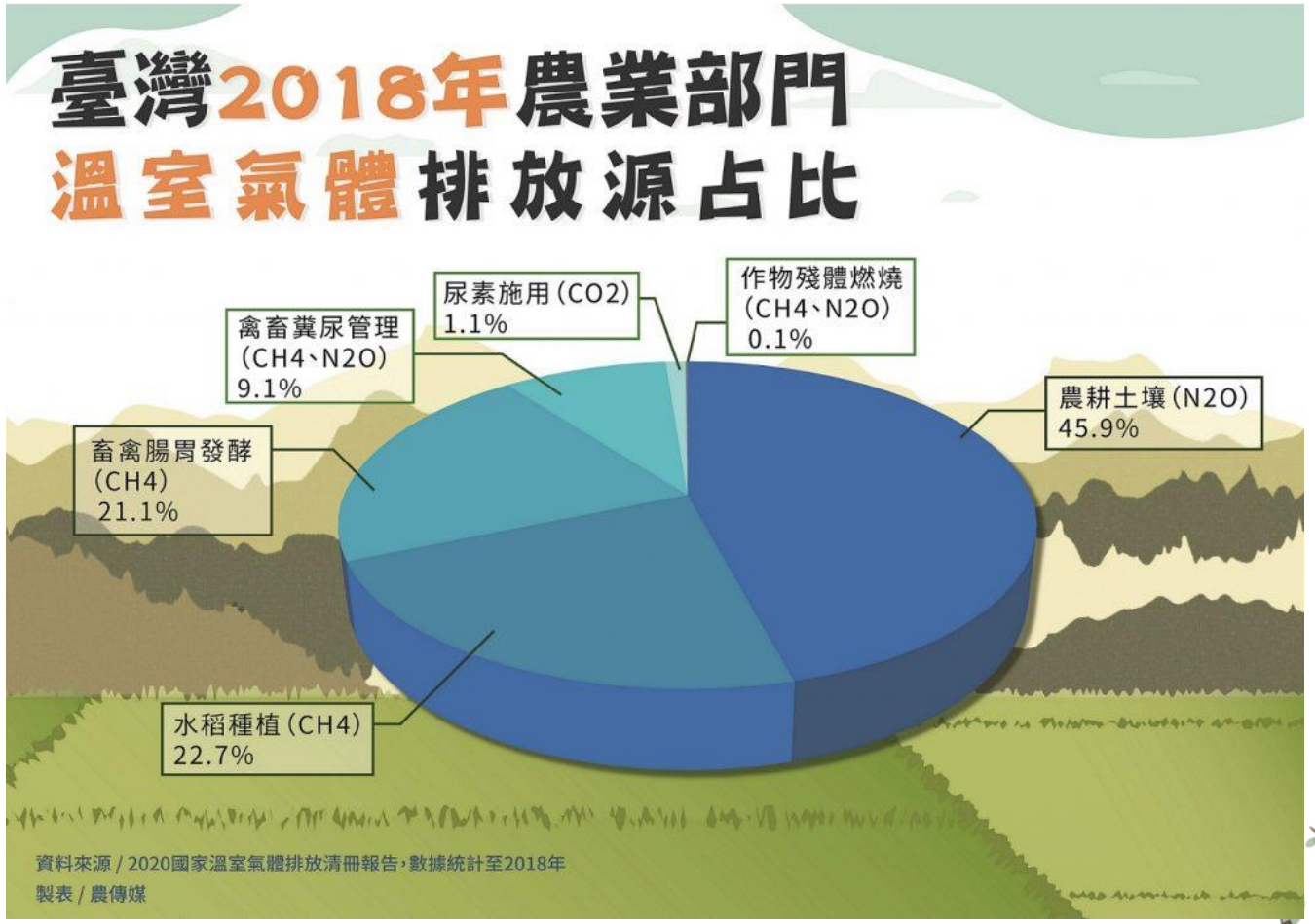
○ indicates that it must be implemented; △ indicates that it depends on the purpose of the investigation; x indicates that it does not need to be implemented (not necessary, but it can also be included if the business needs it).
Note 1: Upstream suppliers, downstream customers or international industry associations.
Note 2: For the classification comparison between the Environmental Protection Agency and ISO14064-1:2018 (or CNS14064-1:2021) and the Greenhouse Gas Inventory Protocol (GHG Protocol), please refer to Appendix 1.

Emission calculation and documentation

- Calculation of greenhouse gas emissions within the boundary
- Deciding how to calculate emissions
- Emission coefficient method, mass balance method and direct monitoring method
- Collect activity data
- Choose an Appropriate Emission Factor
- Calculate Greenhouse Gas Emissions

Collect activity data

- direct discharge
- Collect usage or purchase of fuel and process input materials
- Fuel: such as natural gas, coal, fuel oil
- Process Input Materials
- Such as coke, fluorine-containing gas, etc.
- Fertilizers, pesticides, etc.
- information acquisition
- Purchasing documents
- It is better if the instrument directly measures the usage of fuel or materials



資料來源：農傳媒
https://www.agriharvest.tw/archives/61765

Energy indirect emissions

- Outsourced electricity or outsourced steam
- The acquisition of activity data will be based on the electricity or steam charge records provided by suppliers (public electricity sales companies or other electricity or steam suppliers).
- other indirect emissions
- Refer to CNS 14064-1:2021, ISO 14064-1:2018 or GHG Protocol's corporate value chain (category 3) standards
- Select appropriate data according to the items to be quantified
- For example, the activity data of business trips can be counted using the travel statistics table or the transportation expense receipts written off by accounting
- Activity data on waste generated in operations, recoverable waste disposal volume, etc.

Choose an Appropriate Emission Factor

- Greenhouse gas emission factor of fuel
- You can refer to the latest version of the emission factor released by the designated information platform of the Environmental Protection Agency
- When an enterprise has its own factory-related parameters (such as calorific value or carbon content) to calculate emissions, it should provide relevant certification documents (such as test reports or information provided by suppliers) before use.
- The emission coefficients of purchased electricity and purchased steam for energy indirect emissions shall, in principle, use the electricity carbon emission coefficients and steam emission coefficients provided by the supplier for the current year.
- For other indirect emission emission coefficients, select the appropriate emission coefficients according to the quantification category
- Business trips can choose appropriate emission factors according to the type of transportation they take
- If you take the Taiwan High Speed Rail or Taiwan Railway, you can check the carbon footprint emission coefficients on the official websites
- For the waste generated in operation, please inquire about the carbon footprint emission coefficient of the unit that assists in the disposal
- Information such as carbon footprint emission factors can be found on the Environmental Protection Agency's product carbon footprint information website

Calculate Greenhouse Gas Emissions

- Differences of seven greenhouse gases in the degree of greenhouse effect and climate shock
- Global warming potential (GWP)
- Individual GHG emissions converted to metric tons of carbon dioxide equivalent (CO2e)
- Global warming potential is assessed on a hundred-year basis
- Carbon dioxide GWP set at 1
- Compare the effect of each greenhouse gas on surface warming over a period of time (usually 100 years)
- The 100-year GWP of methane (CH4) is 21: Taking 100 years as a comparison time, the global warming effect of methane is 21 times that of carbon dioxide
- Summarize the greenhouse gas emission equivalents of each emission source

Documentation and Records

- Record the methods, data, procedures, systems, assumptions and estimates related to the inventory
- As an internal record, and to provide external verification or verification requirements.
- Boundary setting and adoption principles for business decisions
- Identification of Greenhouse Gas Emission Sources
- Quantification method of emissions from each emission source
- Selection of Quantitative Data
- Relevant procedures for quality management and information management of greenhouse gas emissions inventory

04 Verification, registration or disclosure of interrogation results

- According to its inventory standard business inspection results
- Verified by a third-party inspection agency
- The Environmental Protection Agency designated information platform to log in
- Complete the inventory and login operation on the designated information platform before the end of August every year
- The annual inventory emission information of managed enterprises is disclosed on the information platform designated by the Environmental Protection Agency
- According to the requirements of the Financial Supervisory Commission to disclose
- The inspection boundary must be consistent with the scope of the financial statements
- Emissions information will be disclosed in its annual report.
- Responding to supply chain requirements of multinational companies or other voluntary inspections
- Decide whether to verify, log or disclose according to its specifications or its own wishes

盤查對象		查證	登錄[註1]	揭露[註2]
(一)環保署公告納管事業		○	○	○
(二)金管會指定揭露對象		○	×	○
(三)跨國企業或國內產業供應鏈中之利害關係人[註4]		△	△	△
(四)自願性參與者	碳標籤	○	○	○
	碳中和	△	△	△
	CDP	×[註3]	○	○
	SBTi	×[註3]	○	○
	自我檢視排放量	×	×	×

○表示必須執行；△表示視其盤查目的；×表示無須執行（非必要）。

註 1：登錄是指將盤查之訊登載於電子化系統上，泛指各類系統平台，不局限於國家溫室氣體登錄平台。

註 2：揭露泛指公開於任何網站、平台或文件上，可查找相關排放資訊、減量目標或評等結果。

註 3：CDP 未要求盤查數據須查證，但查證與否會影響評分結果；SBTi 未強制要求數據須經查證，但經查證其減量目標較易審核通過。

註 4：上游供應廠商、下游客戶或國際產業公協會。

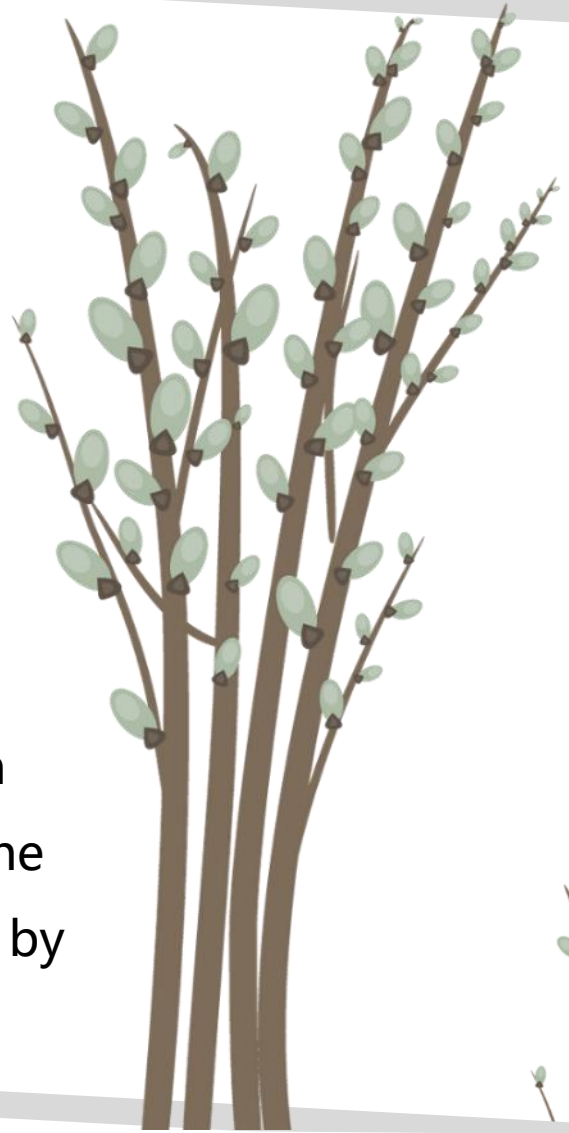
CDP：Carbon Disclosure Project

SBTi：Science Based Targets Initiative

4

Inventory and case description

Explain the simple inventory process, the greenhouse gas emission calculation tool provided by the Environmental Protection Agency, the complete inventory model, and illustrate the calculation of emissions by schools and agricultural enterprises with actual cases



4 Inventory and case description

1. Self-calculation of small and medium-sized manufacturing and service industries

2. The Environmental Protection Agency announced that it should check the inventory operation procedures of the emission sources of the registered greenhouse gas emissions

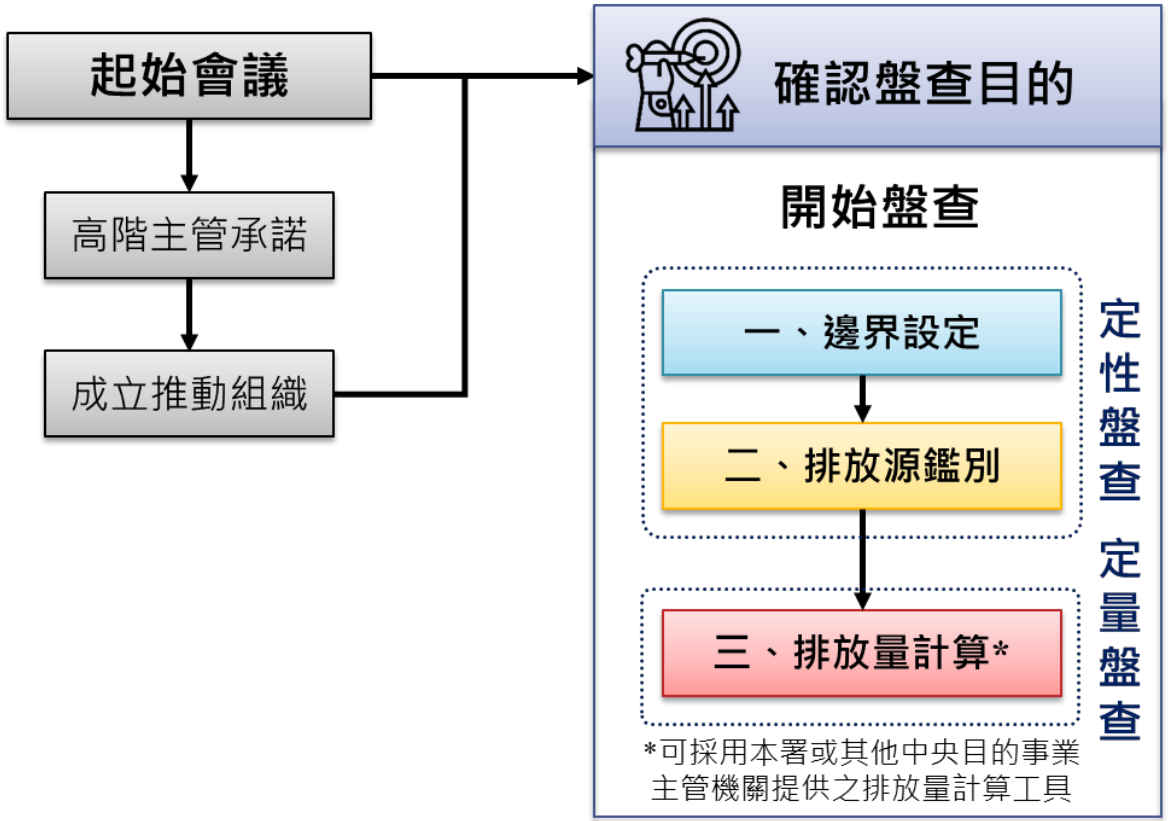
3. ISO14064-1:2018 Inquiry Operation Procedures and Cases

Simple Calculation Tool for Greenhouse Gas Emissions

- Understand your own greenhouse gas emissions
- Simplified inventory procedures and trial calculation tools
- EPA National Greenhouse Gas Logging Platform Emission Calculation Tool https://ghgregistry.epa.gov.tw/ghg_rwd/Main/Index
- The carbon emission allowance provided by the Industrial Bureau of the Ministry of Economic Affairs is easy to calculate
- http://pj.ftis.org.tw/CFC/CFC/Index
- The carbon emission estimation tool provided by the Small and Medium-sized Enterprise Division of the Ministry of Economic Affairs: https://scmp.itri.org.tw/smepass/WebPage/calaprobably.aspx
- Refining its greenhouse gas inventory work
- The Environmental Protection Agency announced the inspection procedures to be followed by the objects under management

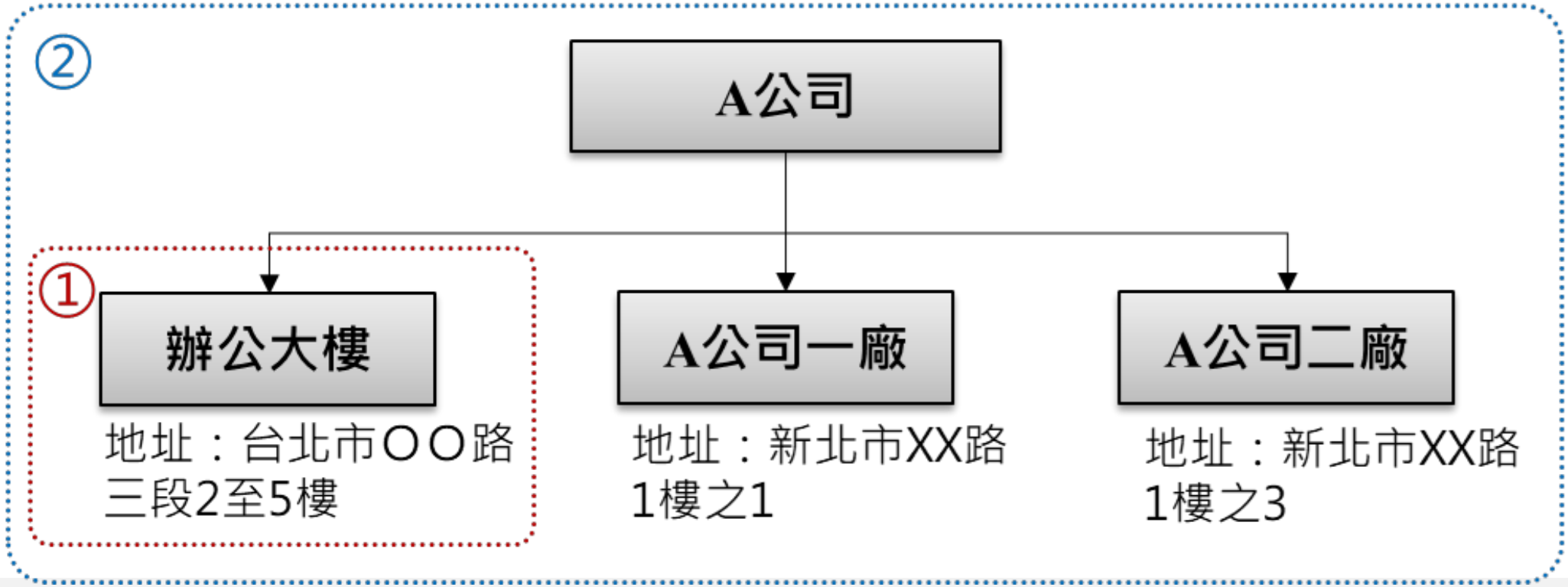
01 Small and medium-sized manufacturing and service industries

- small and medium manufacturing
- boundary setting
- Identification of emission sources
- Calculation of emissions
- service industry
- boundary setting
- Identification of emission sources
- Calculation of emissions



01-1 Small and medium-sized manufacturing industry (1) Boundary setting

- Small and medium-sized manufacturing industries can set inspection boundaries based on demand
- Take the enterprise or a single factory as the inspection boundary
- Take a single address as the boundary: Company A can regard its office building, the first factory or the second factory as a single inspection boundary
- Take company A as the boundary of the investigation



Small and medium-sized manufacturing industry (2) Identification of emission sources

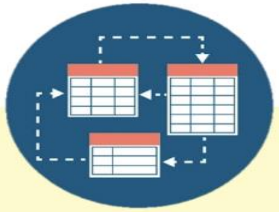
- Major sources of greenhouse gas emissions
- Related equipment or facilities used by electricity
- Some sources of emissions come from emergency generators, boilers, and official vehicles that use fossil fuels (such as liquefied petroleum gas, natural gas, heavy oil, gasoline, diesel, or coal, etc.)
- Refrigeration or air-conditioning equipment (refrigerants used) and fire extinguishers with fluorine-containing gases.
- A small portion of emissions come from the manufacturing process
- Surface treatment of metals and their products by carburizing, use of specific gas cylinders or carbon dioxide welding, etc.
- Other sources of indirect greenhouse gas emissions
- Such as employee commuting, business travel, and cargo transportation or distribution, etc.

Small and medium-sized manufacturing industry (3) Calculation of emissions

- Emissions from emission sources are in annual units
- First collect the annual consumption of fossil fuels, refrigerants, purchased electricity and purchased steam from various emission sources
- Preliminary estimate of greenhouse gas emissions from fossil fuel combustion and energy indirect emissions throughout the year
- Greenhouse gas emissions calculation tool, easy calculation of greenhouse gas emissions

盤查指引與試算工具

盤查作業指引.pdf
試算工具



溫室氣體排放量盤查登錄作業

新手上路
公開資訊及查詢
系統登入

認證及查驗機構管理

合格認證機構
查驗機機構許可申請
合格查驗機構
查驗管理系統登入
認證管理系統登入

抵換專案

減量方法查詢
減量方法作業申請
抵換專案案件查詢
系統登入

排放源帳戶

註銷額度公告
系統登入

Common Greenhouse Gas Emission Sources and Activity Data Sources of Small and Medium Manufacturing Industries

category	Emission pattern	Emission source (corresponding activity/equipment type)	Raw (combustible) materials	Activity Data Sources
direct discharge	Stationary Fuel Combustion Source	• Power generation equipment, such as: emergency generators; • Heating equipment, such as: boilers, heating furnaces, etc.; • Restaurant gas stove use, such as: natural gas or liquefied petroleum gas.	• Diesel, natural gas, barreled gas.	Receipts for purchases or fuel expenses, etc.
	Sources of Process Emissions	• Carbon dioxide welding, acetylene cutting; • Surface treatment of metal and its products by carburizing.	• Carbon dioxide, acetylene, etc. • carbon dioxide, methane, etc.	Purchase quantity and weight of steel cylinders, etc.
	mobile combustion source	Emissions caused by the combustion of fuel used in transportation equipment, such as official vehicles and shuttle vehicles (not leased).	Petrol and diesel.	Fuel receipts, fuel card records, etc.
	fugitive emission source	• Refrigerants for freezing, refrigerating or air-conditioning equipment; • Fire Extinguisher Emission of CO2 or fluorinated gases.	• Refrigerant. • fire extinguisher.	• Refrigerant annual filling quantity; • Number of fire extinguishers.
Energy indirect emissions	purchased electricity	• Mechanical equipment that uses electricity, such as ice water hosts, air-conditioning equipment, lighting, photocopiers, or electric vehicles, includes renewable energy and non-renewable energy.	• Electricity from non-renewable sources. • Renewable energy electricity.	Electricity fee receipt, green electricity transfer supply receipt據。
	outsourced steam	Use steam or heat mechanical equipment.	• steam.	Bills of charge or traffic records.

Example 1 (Small and Medium Manufacturing)

- proposition
- Factory A has its office located in the factory building
- The factory has a gas boiler that uses natural gas as fuel
- Several stackers (using diesel) are used to move related goods
- Install 3 air-conditioning units in the office
- In addition to purchasing electricity from Taipower (public electricity sales industry)
- Obtain renewable energy certificates and electricity through transfer.
- Please check the operation process according to the above
- Identify the 111-year greenhouse gas emission sources of Factory A
- Activity Data Information
- Calculate its greenhouse gas emissions.

Step 1. Sources of activity data of raw (combustion) materials and their consumption

- According to the table of common sources of greenhouse gas emissions and their activity data in small and medium-sized manufacturing industries
- Identify the sources of greenhouse gas emissions from Factory A
- The source of activity data and the consumption of each raw (fuel) material are shown in the table below.

project	direct discharge			indirect emissions		
				energy indirect		
Emission source	Gas boiler (natural gas)	Transport equipment (diesel)	Refrigerant filling (R410A)	Factory electricity	Office electricity	Renewable Energy Vouchers and Electricity
Activity Data Sources	natural gas bill	Fuel record (receipt)	Purchase receipt (annual fill)	Taipower electricity bill	Taipower electricity bill	Renewable energy certificate or green power transfer receipt
Usage amount	99 thousand cubic meters	0.33 fairness	0.002 metric tons	14,987 thousand degrees	3,490 kWh	5 thousand degrees

再生能源憑證(Renewable Energy Certificate, REC)

Step 2 - Calculate emissions using the online GHG emissions calculator

- conditional analysis
- Use the greenhouse gas emission calculation tool to calculate its direct and energy indirect greenhouse gas emissions
- For the renewable energy certificates and electricity used by factory A, the emission factor can be regarded as 0, so no emission is generated
- The electricity purchased from Taipower (public electricity sales company) needs to calculate its energy indirect greenhouse gas emissions.
- Instructions
- 1. Add the aforementioned raw (combustible) materials and their consumption, and initially calculate the greenhouse gas emissions, using the preset coefficients of the Environmental Protection Agency to calculate

排放量試算

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	E（燃料燃燒）	050002	天然氣	99.0000	千立方公尺/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	1.8790358400	公噸/千立方公尺	溫室氣體排放係數管理表6.0.4	186.0245	1	186.0245
CH_4	預設	0.0000334944	公噸/千立方公尺	溫室氣體排放係數管理表6.0.4	0.0033	25	0.0825
N_2O	預設	0.0000033494	公噸/千立方公尺	溫室氣體排放係數管理表6.0.4	0.0003	298	0.0894

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。

儲存

The first data is completed as follows

排放量試算列表

新增資料 | 匯出csv | 匯出統計表csv | 返回首頁

序號	範疇別	排放型式	原燃物料代碼	原燃物料名稱	產生 CO_2	產生 CH_4	產生 N_2O	產生 HFCs	產生 PFCs	產生 SF_6	產生 NF_3	活動數據 (小數4位)	活動數據單位	屬生質能源	排放當量(公噸 CO_2e/年) 不含生質 (小數4位)	生質排放當量 (公噸 CO_2e/年) (小數4位)	皿
1	直接	燃料燃燒	050002	天然氣	v	v	v					99.0000	千立方公尺/年	否	186.1964	0.0000	刪除

註：本排放量試算，係數來源採用溫室氣體排放係數管理表6.0.4版。

總排放當量彙總(公噸CO_2e/年)：186.196

排放量試算列表

新增資料 | 匯出csv | 匯出統計表csv | 返回首頁

序號	範疇別	排放型式	原燃物料代碼	原燃物料名稱	產生 CO_2	產生 CH_4	產生 N_2O	產生 HFCs	產生 PFCs	產生 SF_6	產生 NF_3	活動數據 (小數4位)	活動數據單位	屬生質能源	排放當量(公噸 CO_2e/年)不含生質 (小數4位)	生質排放當量(公噸 CO_2e/年) (小數4位)	刪
1	直接	燃料燃燒	050002	天然氣	v	v	v					99.0000	千立方公尺/年	否	186.1964	0.0000	刪除
2	直接	移動	170006	柴油	v	v	v					0.3300	公秉/年	否	0.8600	0.0000	刪除
3	直接	逸散	GG1814	冷媒－R410a，R32/125 (50/50)				v				0.0020	公噸/年	否	4.1760	0.0000	刪除
4	間接	電力使用	350099	其他電力	v							14,987.0000	千度/年	否	7,628.3830	0.0000	刪除
5	間接	電力使用	350099	其他電力	v							3,490.0000	千度/年	否	1,776.4100	0.0000	刪除
6	間接	電力使用	GG3502	REC登載電力使用-電證合一	v							5,000.0000	千度/年	否	0.0000	0.0000	刪除

註：本排放量試算，係數來源採用溫室氣體排放係數管理表6.0.4版。

總排放當量彙總(公噸CO_2e/年)：9,596.025

Calculation results direct list

Downloadable CSV file archive

溫室氣體排放型式排放量統計表

排放類型	排放源型式	各排放型式排放當量（公噸CO_2e/年）（小數4位）	各排放型式占比(%)（小數2位）
直接	固定(燃料燃燒)	186.1964	1.94
	製程	0.0000	0.00
	移動	0.8600	0.01
	逸散	4.1760	0.04
	小計	191.2324	1.99
能源間接	外購電力	9,404.7930	98.01
總排放當量彙總（公噸CO_2e/年）（小數3位）		9,596.025	100.00

註1：各排放型式占比(%)：此值由七種溫室氣體總量與各排放型式計算四捨五入取至小數2位，可能會出現四捨五入進位的些許誤差。

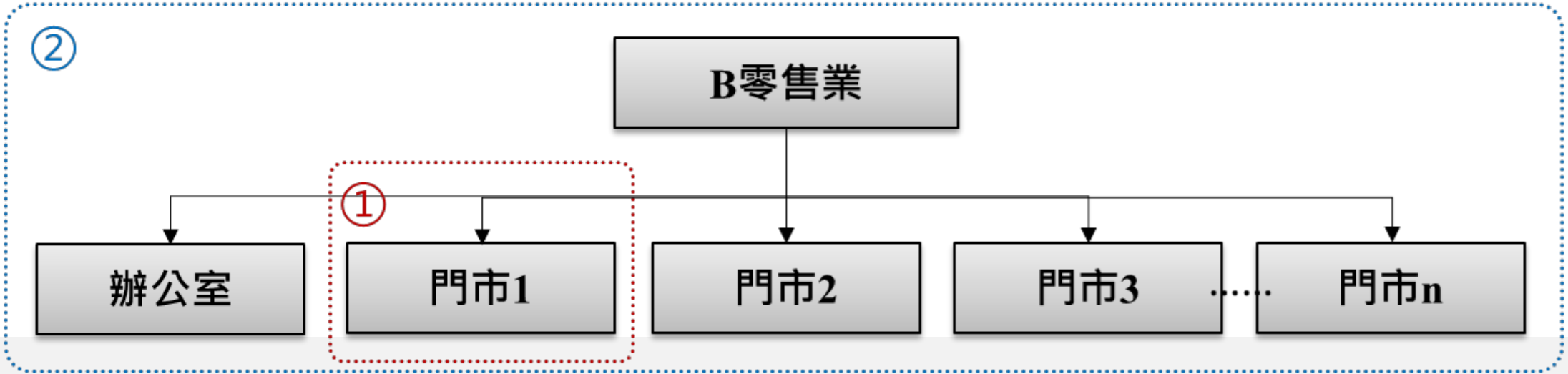
註2：依事業排放量統計及使用習慣，本署將電力排碳係數之單位由「公斤 CO2 e/度」轉換為「公噸 CO2 e/千度」，於本平台試算工具輸入使用電力活動數據的單位應為「千度/年」。

01-2 Service Industry _ Characteristics of Carbon Inventory

- ✓ Inception meeting held
- ✓ Deciding to check the boundaries
- ✓ The service industry is not yet under the management of the Environmental Protection Agency
- ✓ If the supply chain does not require the adoption of specific inventory specifications, it can be compared with small and medium-sized manufacturing industries to simplify its greenhouse gas inventory procedures to boundary setting, emission source identification, and emission calculation.
- ✓ Main emission types of service industry
- ✓ Indirect energy emissions in office space, leased storage space, upstream and downstream logistics and transportation, leased cloud servers
- ✓ If logistics and transportation are emission sources owned by the service industry, this part is classified as direct emissions or energy indirect emissions.
- ✓ Description of other indirect emissions
- ✓ Service industries disclose other indirect emissions in public CSR reports
- ✓ Contribute to the planning of follow-up service industry reduction actions

Service Industry (1) Boundary Setting

- service sector boundary setting
- Select the appropriate inspection boundary according to its inspection purpose
- Therefore, the service industry can use the "single business base under the enterprise" or "enterprise" as the boundary for inspection.
- The current common boundary setting of the service industry mostly takes the "enterprise" as the unit for inspection



Service Industry (2) Identification of Emission Sources

- ✓ Statistical Classification of Industries by the Accounting and Accounting Office of the Executive Yuan
- ✓ Service industries include accommodation and catering, publishing/video production/communication and information and communication services, finance and insurance, compulsory social security real estate, professional/scientific and technical services, support services, education, healthcare and Social work service industry and art, entertainment and leisure service industry, etc.
- ✓ Secondary sources of emissions: direct greenhouse gas emissions
- ✓ Emergency generators and official vehicles using fossil fuels (such as natural gas, gasoline and diesel, etc.)
- ✓ Refrigeration or air conditioning equipment (refrigerants used) or fire extinguishers with fluorine-containing gases
- ✓ Main sources of emissions: energy indirect emissions and other indirect emissions
- ✓ Energy indirect emissions mainly come from related equipment or facilities using electricity
- ✓ Other indirect emissions, according to the CSR report
- ✓ Employee commuting, business travel, and cargo transportation or distribution with high availability
- ✓ It is difficult to obtain data on other indirect emissions
- ✓ Refer to ISO 14064-1:2018 or CNS 14064-1:2021 to identify indirect emissions that need to be checked.
- ✓ Direct greenhouse gas emissions, such as emergency generators using fossil fuels (such as natural gas, gasoline, diesel, etc.), official vehicles, and refrigeration or air-conditioning equipment (refrigerant used) or fire extinguishers with fluorine-containing gases should also be included.

(3) Calculation of Emissions Common sources of greenhouse gas emissions in the service industry and their activity data sources

category	Emission pattern	Emission source (corresponding activity/equipment type)	Raw (combustible) materials	activity data source
direct discharge	fixed fuel combustion source	• Power generation equipment, such as: emergency generators; • Restaurant gas stove use, such as: natural gas or liquefied petroleum gas.	• Diesel, natural gas, barreled gas	• Receipts for purchases or fuel charges
	mobile combustion source	• Emissions caused by the combustion of fuel used in transportation equipment, such as: official vehicles, shuttle vehicles (not leased), and operating vehicles of logistics companies2, etc.	Petrol and diesel	Fuel receipts, fuel card records
	fugitive emission source	• Refrigerants for freezing, refrigerating or air-conditioning equipment; • Fire Extinguisher Emission of CO2 or fluorinated gases.	• Refrigerant; • fire extinguisher.	• Annual filling volume of refrigerant; • Number of fire extinguishers.
Energy indirect emissions	purchased electricity	• Mechanical equipment that uses electricity, such as ice water hosts, air-conditioning equipment, lighting, photocopiers, or electric vehicles, includes renewable energy and non-renewable energy.	• Electricity from non-renewable sources. • Renewable energy electricity.	• Electricity receipt • Green Power Transfer Receipt。

2 The property rights of the vehicle are owned and controlled (owned) by the logistics operator

other indirect emissions

Emission source (corresponding activity/equipment type)	Raw (combustible) materials	Activity Data Sources
• Upstream and downstream transportation and distribution: upstream and downstream transportation and distribution of goods, such as emissions from leased vehicles Note 1 (vehicles not owned by the enterprise performing the inventory); • Business travel; employee commuting.	• upstream and downstream • Gasoline, diesel or electricity used in transportation and distribution, business travel, employee commuting, etc.	• fuel consumption; • Transportation distance or transportation fee amount (according to the type of transportation).
• Discharge of waste generated during operation, such as: general waste (landfill, incineration or biological treatment), recyclables (transportation discharge)。	• Disposal of emissions from transportation or burial of waste generated during operations.	• Waste removal volume. • The distance of the waste removal route.
• Emissions from upstream leased assets, such as: leased drinking water dispensers, chilled water hosts or photocopiers, etc.	• Emissions caused by related maintenance such as leakage of refrigerants from leased water dispensers and chilled water hosts.	• Refrigerant replenishment for leased drinking water dispensers, ice water hosts, photocopiers, etc.

Note 1: If it is a long-term lease by a company and pays for oil, it can be included in direct emissions under operational control considerations.

Example 2 (finance and insurance industry)

- ✓E Bank has a total of 20 branches in Taiwan
- ✓The main business model is to handle various deposits and loans for customers in its branches, entrust managers with trust information deposits, and handle domestic foreign exchange and other businesses
- ✓The main source of greenhouse gas emissions is the equipment using electricity in the branch
- ✓Chilled water hosts, air-conditioning equipment, lighting, photocopiers, etc.;
- ✓Bank E provides official vehicles for senior executives to facilitate inspections of branches
- ✓In order to expand business, employees often have business trips, and considering the convenience, most of them use high-speed rail as a means of transportation.
- ✓Identify E-Bank
- ✓ 111 years of greenhouse gas emission sources and their activity data information
- ✓Calculate its greenhouse gas emissions.

Step1. Collect the activity data source and consumption of each raw (fuel) material

project	direct discharge		indirect emissions	
			energy indirect	other indirect
Emission source	Official vehicle oil (gasoline)	Refrigerant filling (R410A)	Branch electricity	Employee Business Travel
activity data source	Refueling records of each branch (receipt) aggregation	Branch purchases According to (annual filling volume)	Branch Electricity single collection	travel statistics or Accounting write-off documents
Usage amount	56,213 liters (=56.213 justice)	10 kg (=0.01 metric ton)	14,211,223 degrees (=14,211 thousand degrees)	High-speed rail mileage: 5,430,879 km

Step2-Use the online greenhouse gas emissions calculation tool to calculate "direct emissions and energy indirect emissions"

排放量試算

返回首頁

*：必填欄位

範疇別	直接
溫室氣體排放來源 *	燃油
原燃物料代碼 *	170001 代碼查詢
原燃物料名稱	車用汽油
活動數據 * (小數4位)	56.213 活動數據單位： 公秉/年
是否屬生質能源 *	否

返回排放量試算列表　下一頁　清空

排放量試算

返回首頁

*：必填欄位

範疇別	直接
溫室氣體排放來源 *	逸散/含氟氣體
原燃物料代碼 *	GG1814 代碼查詢
原燃物料名稱	冷媒－R410a，R32/125（50/50）
活動數據 * (小數4位)	0.01 活動數據單位： 公噸/年
是否屬生質能源 *	否

返回排放量試算列表　下一頁　清空

排放量試算列表

新增資料 | 匯出csv | 匯出統計表csv | 返回首頁

序號	範疇別	排放型式	原燃物料代碼	原燃物料名稱	產生 CO_2	產生 CH_4	產生 N_2O	產生HFCs	產生PFCs	產生 SF_6	產生 NF_3	活動數據 (小數4位)	活動數據單位	屬生質能源	排放當量 (公噸 CO_2e/年) 不含生質 (小數4位)	生質排放當量 (公噸 CO_2e/年) (小數4位)	畫
1	直接	移動	170001	車用汽油	v	v	v					56.2130	公秉/年	否	132.7456	0.0000	刪除
2	直接	逸散	GG1814	冷媒－R410a，R32/125 (50/50)				v				0.0100	公噸/年	否	20.8800	0.0000	刪除
3	間接	電力使用	350099	其他電力	v							14,211.2230	千度/年	否	7,233.5125	0.0000	刪除

註：本排放量試算，係數來源採用溫室氣體排放係數管理表6.0.4版。

總排放當量彙總(公噸CO_2e/年)：7,387.138

溫室氣體排放型式排放量統計表

排放類型	排放源型式	各排放型式排放當量（公噸CO_2e/年）（小數4位）	各排放型式占比(%)（小數2位）
直接	固定(燃料燃燒)	0.0000	0.00
	製程	0.0000	0.00
	移動	132.7456	1.80
	逸散	20.8800	0.28
	小計	153.6256	2.08
能源間接	外購電力	7,233.5125	97.92
總排放當量彙總（公噸CO_2e/年）（小數3位）		7,387.138	100.00

註1：各排放型式占比(%)：此值由七種溫室氣體總量與各排放型式計算四捨五入取至小數2位，可能會出現四捨五入進位的些許誤差。

註2：依事業排放量統計及使用習慣，本署將電力排碳係數之單位由「公斤 CO2 e/度」轉換為「公噸 CO2 e/千度」，於本平台試算工具輸入使用電力活動數據的單位應為「千度/年」。

Step 3 - Calculating other indirect GHG emissions

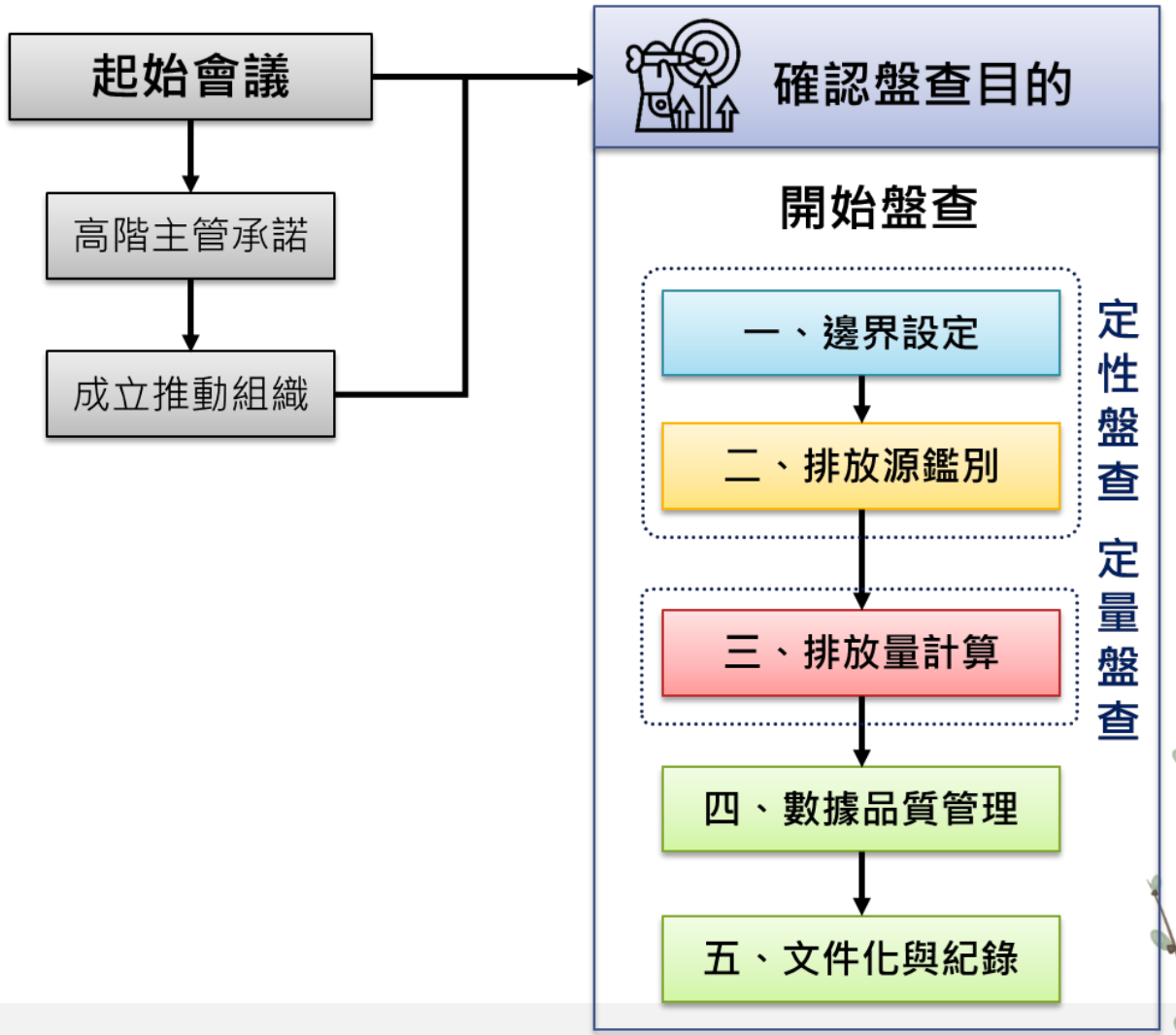
- This sample business travel takes the high-speed rail as an example
- Calculation of other indirect emissions from employee business travel
- Carbon Footprint Emission Coefficient of Passenger Transportation Between Stations Using Taiwan High Speed Rail or Carbon Footprint of Transportation Services
- (32 grams of CO2e/person-emissions per kilometer (per person-km)), as explained below.

5,430,879 公里 × 32 克 CO_2e/每人-每公里 = **173.7885 公噸 CO_2e**

- 合計E 銀行 111 年
  - 直接排放量為 153.6265 公噸 CO2e

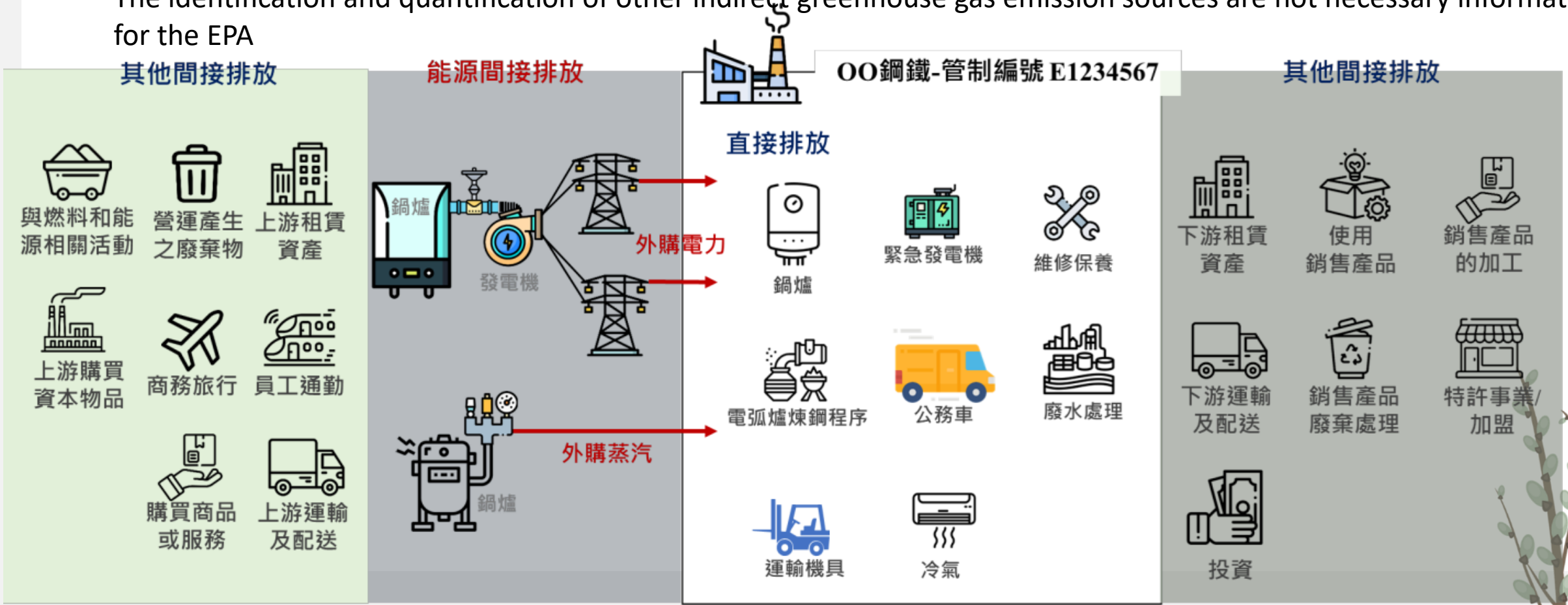
02-Environmental Protection Agency announces that the inventory operation procedures for the emission sources of registered greenhouse gas emissions should be checked

1. Boundary setting
2. Identification of emission sources
3. Calculation of Emissions
4. Data Quality Management
5. Documentation and Records



1. Boundary setting

- All emission sources that the enterprise can control its operation are included in the inventory boundary
- Avoid double counting, omission or misleading situations when aggregating emission data
- After the inventory boundary is set, the enterprise shall classify the emission sources within the inventory boundary
- Direct GHG emissions, energy indirect GHG emissions, and other indirect GHG emissions
- The Environmental Protection Agency announced that the management business only needs to identify and quantify direct and energy indirect greenhouse gas emission sources at this stage
- The identification and quantification of other indirect greenhouse gas emission sources are not necessary information for the EPA



Direct and Indirect Energy Description

(1) Direct greenhouse gas emissions refer to direct emissions from processes or facilities

Such as: emissions from factory boilers or process operations, and fugitive emissions of refrigerants from fixed fuel combustion sources owned or controlled by the organization, process emissions, transportation emissions, or air-conditioning equipment.

(2) Energy indirect greenhouse gas emissions

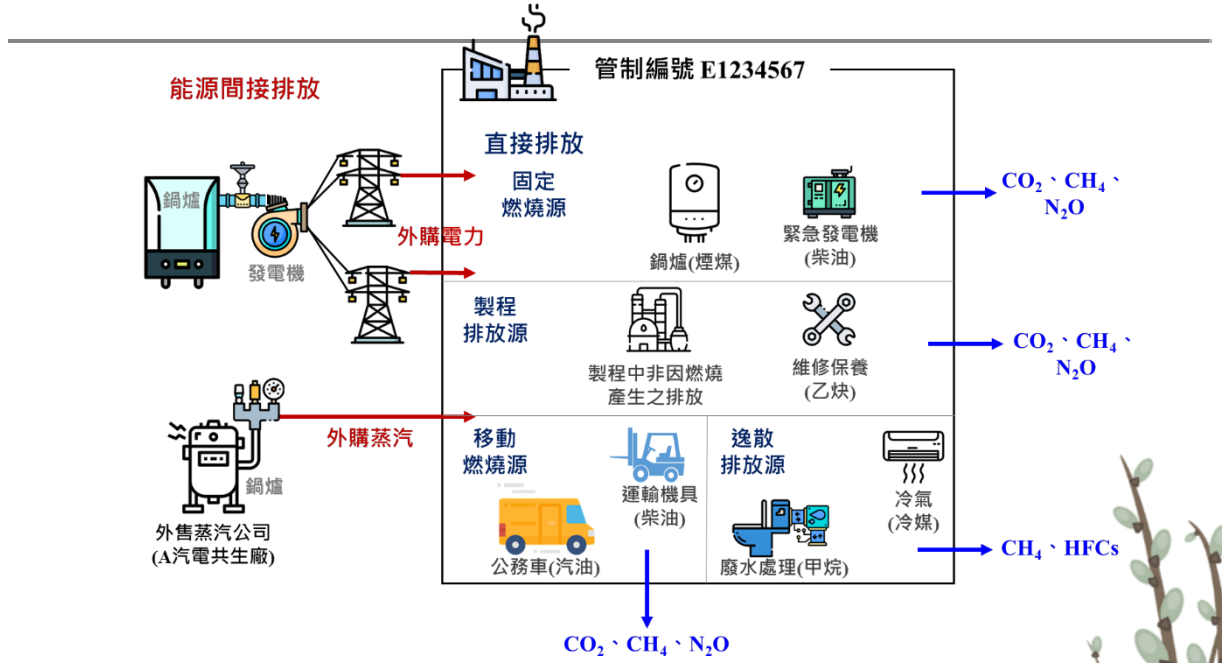
Refers to indirect emissions from energy utilization using electricity or steam.

(3) Other indirect greenhouse gas emissions (non-essential)

Refers to the greenhouse gas emissions generated by business activities, which are not self-owned or controllable by the business, such as other indirect emissions from leasing, outsourcing business, employee commuting and other activities.

2. Identification of emission sources

- Identify emission sources that emit greenhouse gases within the scope of boundary setting
- According to Article 3 of the Measures for the Administration of Inquiry and Registration
- Environmental Protection Agency Announces Greenhouse Gas Types of Managed Enterprises
- carbon dioxide (CO2)
- Methane (CH4)
- Nitrous oxide (N2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulfur hexafluoride (SF6)
- Nitrogen trifluoride (NF3)
- Other substances announced by the central competent authority



(1) Source types of direct greenhouse gas emissions

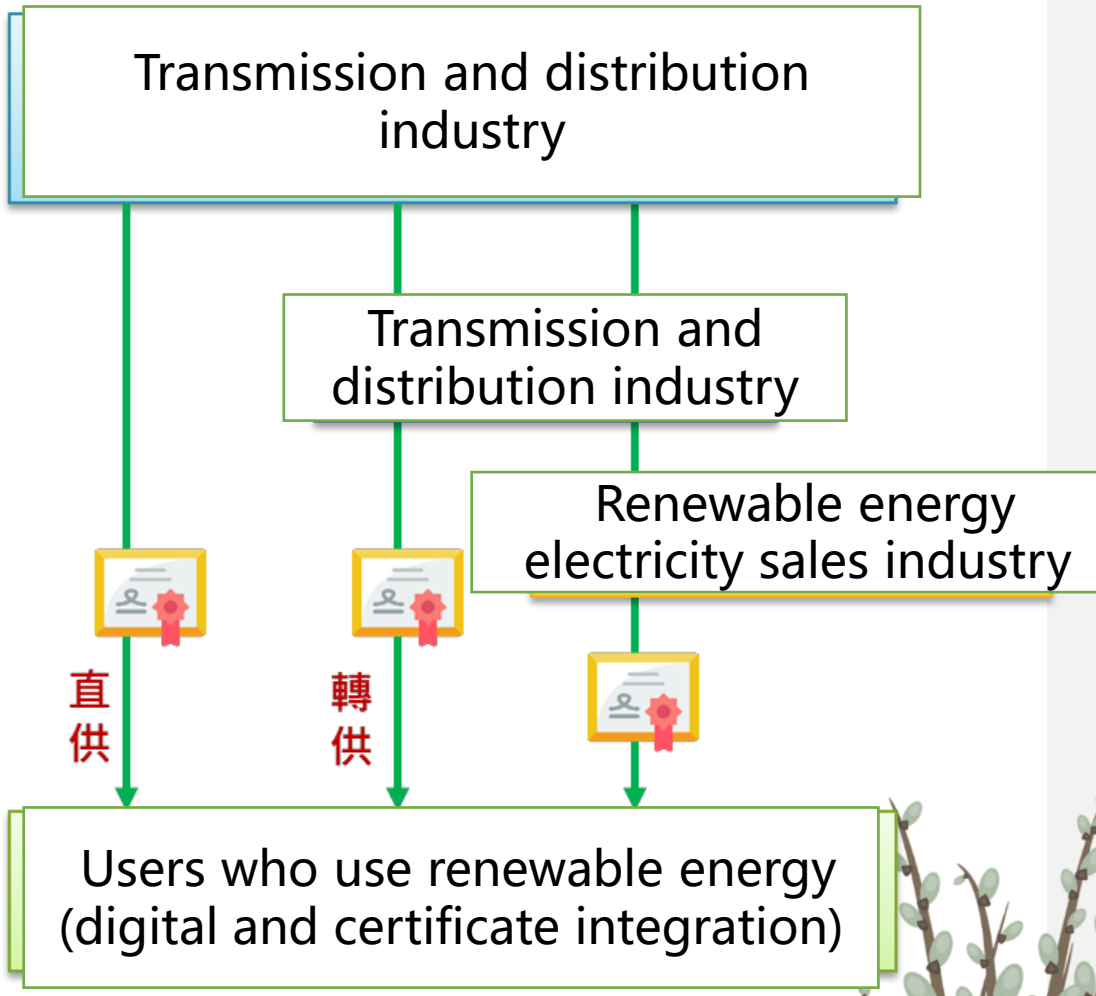
- Stationary fuel combustion source: refers to the fuel combustion of stationary equipment
- Boilers, furnaces, steam turbines, heating furnaces, incinerators and diesel generators, etc.
- Sources of Process Emissions: Emissions from physical or chemical processes
- Carbon dioxide (CO2) produced by the catalytic cracking process in the oil refining process, perfluorocarbons (PFCs) produced when cleaning pipelines or etching in the wafer manufacturing process of the semiconductor industry, and smelting coal in the steelmaking process of the iron and steel industry (as a reducing agent) emissions, etc.
- Mobile combustion source: refers to the fuel combustion of transportation equipment
- Forklifts, cars, trucks and other means of transport.
- Fugitive Emission Sources: Intentional and Unintentional Emissions
- Methane emitted from equipment joints, seals, packing leakage, refrigerant escape, wastewater treatment plants or gas processing equipment, etc.

(2) Source types of energy indirect greenhouse gas emissions

- Purchased electricity
  - ✓ Public electricity sales industry: refers to the electricity provided by the public electricity sales industry (that is, Taiwan Power Co., Ltd.) 。
  - ✓ Others: The source of electricity is provided by non-public electricity sales industry 。
  - ✓ Renewable energy electricity and certificates
    - ✓ Types of renewable energy certificates issued by the Bureau of Standards, Inspection and Quarantine of the Ministry of Economic Affairs
      - ✓ According to Article 3 of the "Renewable Energy Development Regulations"
      - ✓ Including solar energy, biomass energy, geothermal energy, ocean energy, wind power, non-pumped hydraulic power, domestic general waste and general industrial waste
      - ✓ Enterprises can use the above-mentioned renewable energy certificates and the certificate type should be integrated with electronic certificates 。
      - ✓ Renewable energy certificates for biomass energy, domestic general waste and general industrial waste, etc., because the emission coefficient cannot be regarded as "0" for calculation
      - ✓ If a business uses renewable energy certificates such as biomass energy, domestic general waste, and general industrial waste, it shall calculate the emission factor by itself according to the type and composition ratio of the biomass energy and waste before using it.
    - ✓ Managed enterprises can obtain the renewable energy certificate of electronic certificate integration in the following ways

The method of obtaining renewable energy certificates for managed enterprises

- ✓ Renewable energy power generation industry direct supply or switch to renewable energy
  - Refers to the source of electricity provided by renewable energy through direct supply or transfer from the power transmission and distribution industry 。
- ✓ Renewable energy electricity sales industry
  - Renewable energy electricity sales industry supplies green electricity
- ✓ Emission sources that are not production facilities, such as offices and dormitories, are included in the enterprise inventory boundary
  - ✓ When identifying greenhouse gas emissions from purchased electricity, it should be divided into
    - ✓ Emissions from electricity used in the production process (electricity used in the process
    - ✓ Electricity emissions not used in the production process (electricity used in non-processes, such as: electricity used in offices and dormitories)



Direct discharge

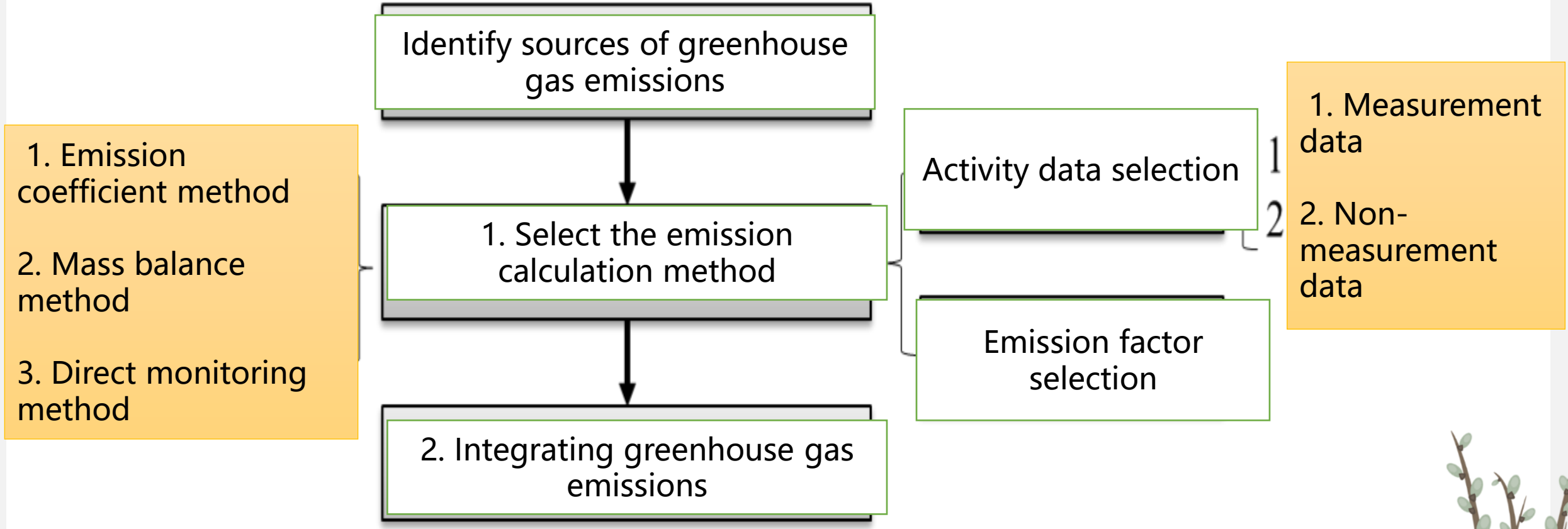
Emission pattern	Main emission sources (use of raw (combustion) materials)
Stationary Fuel Combustion Source	• Power generation equipment (fuel is coal, oil, natural gas, etc.), such as: turbine generator； • Steam or heat generation equipment (fuel is coal, oil, natural gas, etc.), such as: steam-electric cogeneration equipment, etc.； • Heating facilities (fuel is coal, oil, natural gas, biomass fuel, etc.), such as: heaters, boilers, kilns, furnaces, incinerators and other fuel-burning equipment or machines, etc.
Sources of Process Emissions	• Process facilities with physical or chemical reactions, such as: cement process (limestone), iron and steel process (metallurgical coal), etc.； • cutting or repairing (acetylene)； • Greenhouse gas emissions not caused by combustion in process operations, such as: light oil cracking, aromatics plants, hydrodesulfurization plants, etc.
mobile combustion source	• Emissions caused by the combustion of fuel (such as gasoline or diesel) used in transportation equipment, such as stackers, cranes, official vehicles, fuel tankers, trains, ships, aircraft, etc.
fugitive emission source	• Refrigerant escape from air-conditioning or refrigeration equipment (R410A, etc.； • Escape from storage tanks, pipelines, pumps or valves of fuel oil and natural gas； • Emissions from the use of solvents during cleaning； • Due to annual repairs, such as: pneumatic valve unloading, pipeline or well sinking, storage tank cleaning, etc.； • Abnormal discharge, such as emergency shutdown or pressure relief discharge, etc.； • Use of fire extinguishers (carbon dioxide, sodium bicarbonate) or sprayers, e.g. dry powder fire extinguishers;

Indirect Energy

Category	Emission pattern	Main emission sources (use of raw (combustion) materials)
Energy indirect emissions	Purchased electricity	• Mechanical equipment that uses electricity, including: general outsourced electricity and outsourced renewable energy. Direct emissions are counted if electricity is used that is self-produced within the boundary.
	Outsourced steam	• Mechanical equipment that uses steam or heat is counted as direct emissions if it uses steam or heat that is self-produced within the boundary.

3. Calculation of Emissions

- Calculation steps of greenhouse gas emissions



(1) Select the emission calculation method

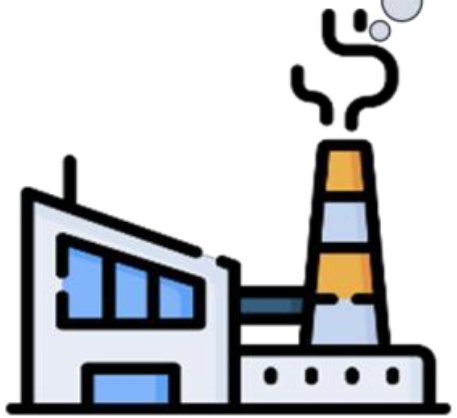
1. Emission factor method: the most common quantification method

- Use activity data such as raw (fuel) material usage or product output to multiply their corresponding emission coefficients
- Emission calculation method: Multiply the amount of various greenhouse gas emissions by its global warming potential (G

排放量 =

燃料或物料投入或輸入量 × 排放係數 × GWP

(活動數據)



Fuel Input

Process Material Input

Consider other factors:
Two examples: Combustion oxidation factor, process emission conversion factor, etc.

Note: The oxidation factor of fuel combustions is 1.

Emission coefficient method: (1) fuel combustion

Annual greenhouse gas emissions (metric tons CO2e) = annual activity data × emission coefficient × 4.1868 × 10-9 × lower calorific value × warming potential

- ✓ Annual activity data (metric tons, kilometres, or thousand cubic meters)
  - ✓ Measuring data: use instruments to measure raw (combustion) material consumption as annual activity data, such as: coal feeder records fuel coal consumption, gaseous fuel flow meter records data, and scale measurement data for each batch.
  - ✓ Non-measurement data: Since there is no actual consumption or purchase volume documents, it is pushed back through other supporting data. For example: the purchase amount pushes back the original (fuel) material usage
- ✓ Emission factors (kgCO2/TJ, kgCH4/TJ, kgN2O/TJ)
  - ✓ According to IPCC 2006, the greenhouse gas emission coefficients of various fuels (including carbon dioxide, methane and nitrous oxide)
  - ✓ The enterprise develops the greenhouse gas emission coefficients of various fuels by itself, and this coefficient can only be used after being approved by the Environmental Protection Agency
- ✓ **4.1868×10^{-9}**
  - ✓ is the unit conversion factor, 1 kcal = 4.1868 × 10-9 TJ.
- Lower calorific value (kcal/kg, kcal/liter or kcal/m3)
  - The lower calorific value refers to the calorific value when the fuel is completely burned and the water vapor in the combustion product exists in the gaseous state, also known as net heat.
- Warming Potential (GWP)

Warming potential

Greenhouse gases	Lifetime (years)	Timing of Global Warming Potential Assessments		
		20年	100年	500年
methane	12 (12)	72 (62)	25 (23)	7.6 (7)
Nitrous oxide	114 (114)	289 (275)	298 (296)	153 (156)
HFC-23 (Hydrofluorocarbons)	270 (260)	12,000 (9400)	14,800 (12,000)	12,200 (10,000)
HFC-134a (Hydrofluorocarbons)	14 (13.8)	3,830 (3,300)	1,430 (1,300)	435 (400)
sulfur hexafluoride	3200 (3,200)	16,300 (15,100)	22,800 (22,200)	32,600 (32,400)
Perfluorotributylamine (PFTBA)			7,100[7][8]	

The information in parentheses refers to the TAR [6])

Example of Emission Factor Method

- Question: Company A uses fuel oil for 110 years with 1,000 fair
  - ✓ How much greenhouse gas emissions (in metric tons of CO2e) are produced?
  - ✓ Use the fuel oil emission coefficient of IPCC and the preset lower calorific value of this guideline.

CO2 emission coefficient (kgCO2/TJ)	CH4 emission factor (kgCH4/TJ)	N2O emission coefficient (kgN2O/TJ)	Lower calorific value (kcal/L)
77,400	3	0.6	9600

- ✓ Annual greenhouse gas emissions (metric tons CO2e) = Annual Activity Data × Emission factor × **4.1868× 10^{-9}×** lower calorific value × warming potential
- ✓ CO_2 annual emissions = 1,000(kiloliter)× 77,400 ($kgCO_2/TJ$) × 4.1868×10^{-9}× 9600(kcal/L)× 1= 3,110.9599 公噸 CO_2e
- ✓ CH_4 年排放量= 1,000(公秉)× 3 ($kgCH_4/TJ$) ×4.1868×10^{-9}× 9600(kcal/L)×25= 3.0145 公噸 CO_2e
- ✓ N_2O 年排放量= 1,000(公秉)× 0.6 (kgN_2O/TJ) ×4.1868×10^{-9}× 9600(kcal/L)× 298= 7.1866 公噸 CO_2e

Annual Greenhouse Gas Emissions =3,110.9599 + 3.0145 + 7.1866 = **3,121.1610 公噸 CO_2e**

Example 3 (chain retail business)

- C The entire Taiwanese operating base of the retail industry includes 1,200 stores and 1 office building
  - Greenhouse gas emission sources include equipment using electricity in stores (such as: commercial refrigeration or refrigeration equipment, air-conditioning equipment, lighting, etc.) and office building electricity,
  - Outsourced disposal of store waste and entrusted logistics companies to deliver goods to each store for transportation emissions.
- According to the above-mentioned inventory operation process, identify the 111-year-old C retail industry
  - Greenhouse gas emission sources and their activity data information
  - Calculate its greenhouse gas emissions 。

Step 1 - Identify sources of GHG emissions from C retail outlets and offices

Project	Direct discharge	Indirect emissions		
		Energy indirect	Other indirect	
Emission source	commercial frozen or refrigerated Equipment (R134A)	Store and Office Building electricity	Distribution from logistics center to store Send to transport (diesel)	Store abandoned disposal
Activity Data Sources	Refrigerant purchase receipt (annual fill volume)	Collection of electricity bills for stores and office buildings	Conversion of transportation distance to fuel consumption	Outsourced waste removal volume statistics
Usage amount	5 metric tons	188,193 thousand degrees	4,593 kiloliters	8,329 mt

Step 2 - Use the online greenhouse gas emissions calculation tool to calculate "direct emissions and energy indirect emissions"

排放量試算

返回首頁

*：必填欄位

範疇別	直接
溫室氣體排放來源 *	逸散/含氟氣體
原燃物料代碼 *	GG1835 代碼查詢
原燃物料名稱	HFC-134a/R-134a，四氟乙烷HFC-134a/R-1
活動數據 * (小數4位)	5 活動數據單位： 公噸/年
是否屬生質能源 *	否

返回排放量試算列表　下一頁　清空

排放量試算

返回首頁

*：必填欄位

範疇別	間接
溫室氣體排放來源 *	電力
原燃物料代碼 *	350099 代碼查詢
原燃物料名稱	其他電力 台電電力
活動數據 * (小數4位)	188193 活動數據單位： 千度/年
是否屬生質能源 *	否

備註：依事業排放量統計及使用習慣，本署將電力排碳係數之單位由「公斤 CO2 e/度」轉換為「公噸 CO2 e/千度」，於本平台試算工具輸入使用電力活動數據的單位應為「千度/年」。

返回排放量試算列表　下一頁　清空

Emissions trial calculation list

新增資料 | 匯出csv | 匯出統計表csv | 返回首頁

序號	範疇別	排放型式	原燃物料代碼	原燃物料名稱	產生 CO_2	產生 CH_4	產生 N_2O	產生HFCs	產生PFCs	產生 SF_6	產生 NF_3	活動數據（小數4位）	活動數據單位	屬生質能源	排放當量(公噸CO_2e/年)不含生質（小數4位）	生質排放當量(公噸CO_2e/年)（小數4位）	備
1	直接	逸散	GG1835	HFC-134a/R-134a，四氟乙烷 HFC-134a/R-1				v				5.0000	公噸/年	否	7,150.0000	0.0000	刪除
2	間接	電力使用	350099	其他電力	v							188,193.0000	千度/年	否	95,790.2370	0.0000	刪除

Note: For this trial calculation of emissions, the source of the coefficient is Greenhouse Gas Emission Coefficient Management Table Version 6.0.4

"Summary of total emission equivalent (metric tons CO2e/year): 102,940.237

Greenhouse gas emission type emission statistics table

Emission type	Type of emission sources	Emission equivalent of each emission type (metric tons CO2e/year) (4 decimal places)	Proportion of emission type (%) (2 decimal places)
Direct	Stationary (fuel burning)	0.0000	0.00
	Process	0.0000	0.00
	Move	0.0000	0.00
	Escape	7,150.0000	6.95
	Subtotal	7,150.0000	6.95
Energy indirect	Purchased electricity	95,790.2370	93.05
Summary of total emission equivalents (metric tons CO2e/year) (3 decimal places)		102,940.237	100.00

Note 1: The proportion of each emission type (%): This value is rounded to 2 decimal places by calculating the total amount of seven greenhouse gases and each emission type, and there may be some errors in rounding up. Note 2: According to the statistics of industrial emissions and usage habits, the Department has converted the unit of the electricity carbon coefficient from "kg CO + kWh" to "public factory CO2/kWh", and input the unit of electricity activity data into the trial calculation tool on this platform should be 'thousand degrees/year'

Step 3 - Calculate other indirect GHG emissions

✓ For the transportation from the logistics center to the retail outlets, the emissions are calculated based on the amount of diesel used. Calculation method

- Annual greenhouse gas emissions (metric tons CO2e) = annual activity data × emission factor × 4.1868 × 10-9 × lower calorific value × warming potential

- Diesel emission coefficient provided by IPCC and the preset lower calorific value of this guideline.

CO2 emission coefficient (kgCO2/TJ)	CH4 emission system (kgCH4/TJ)	N2O emission coefficient (kgN2O/TJ)	Lower calorific value (kcal/L)
74,100	3.9	3.9	8,400

✓Annual CO2 emission = 4,593(g)× 74,100 (kgCO2/TJ)× 4.1868×10-9× 8,400(kcal/L)× 1= 11,969.5040 metric tons CO2e

✓CH4 annual emissions = 4,593 (community) × 3.9 (kgCH4/TJ) × 4.1868 × 10-9 × 8,400 (kcal/L) × 25 = 15.7500 metric tons of CO2e

✓Annual N2O emissions = 4,593 (g) x 3.9 (kgN2O/TJ) x 4.1868 x 10-9 x 8,400 (kcal/L) x 298 = 187.7400 metric tons of CO2e

Annual emissions of greenhouse gases5 = 12,172.9940 metric tons of CO2e from distribution and transportation from logistics centers to stores

- Emissions from retail waste treatment
  - Calculated based on waste disposal volume
    - Annual GHG emissions (metric tons CO2e) = annual activity data × emission factor
  - Assume that waste in this example is treated by incineration
    - Waste incineration treatment has an emission factor of 0.36 metric tons CO2e/metric ton of waste
    - Annual GHG emissions from retail waste disposal = 8,329 metric tons × 0.36 metric tons CO2e/metric ton = 2,998.4400 metric tons CO2e
- C Retail 111 years
  - Total direct emissions 7,150 metric tons CO2e
  - Total energy indirect emissions 94,472.886 metric tons CO2e
  - Other indirect emissions are 15,171.434 metric tons CO2e.

Emission coefficient method: (2) process emissions

- Definition: chemical or electrolytic reduction of some metal ores, thermal decomposition of substances, etc.
  - Such as: processes using carbonates (calcium carbonate CaCO3, magnesium carbonate MgCO3), or manufacturing processes of steel, iron and non-ferrous metals
  - The greenhouse gas emissions can be calculated by the input of raw materials or the output of products.
- emissions formula
- Annual greenhouse gas emissions (metric tons CO2e) = annual activity data × emission factor × warming potential
  - Annual activity data (metric tons, kilometers, or thousand cubic meters)
    - Measurement data: The amount of raw materials used is measured by instruments as annual activity data, such as: the data obtained by weighing scales for each batch of materials.
    - Non-measurement data: Since there is no actual consumption or purchase volume documents, it is pushed back through other supporting data. For example: the purchase amount pushes back the usage amount.
  - Emission factor (metric tons CO2/per unit input material or output product)
    - Calculate the emission factor of the raw material by chemical balance formula

Example Process Emissions

- Question
  - Limestone is used in the prevention and control equipment of exhaust gas desulfurization technology in company B's plant
  - Limestone purchases of 50 metric tons in 110
  - How much greenhouse gas emissions (in metric tons of CO2e) are produced?
- Calculate
  - 石灰石吸收煙氣中 SO_2 的化學平衡式$CaCO_3 + SO_2 + 2H_2O \rightarrow CaSO_3 \cdot 2H_2O + CO_2$
  - $CaCO_3$ 分子量 100，CO_2 分子量 44，表示 1 mole $CaCO_3$ 產生 1 mole CO_2
  - 排放係數計算如下：

$$CO_2\text{排放係數} = \frac{1\text{mole } CO_2\text{之分子量}}{1\text{mole } CaCO_3\text{之分子量}} = \frac{44}{100} = 0.44 \text{ 公噸 } CO_2/\text{公噸 } CaCO_3$$

  - 溫室氣體年排放量 = $50\ (ton) \times 0.44 \frac{\text{公噸}CO_2}{\text{公噸 } CaCO_3} = 22.0000 \text{ 公噸}CO_2$

Emission coefficient method: (3) Calculation of outsourced electricity emissions

- Emissions formula
  - Annual greenhouse gas emissions (metric tons CO2e) = annual activity data × emission factor × warming potential
  - Activity data (thousand degrees)
    - Measuring data: Use instruments to measure electricity consumption as annual activity data, such as: electricity meter record data (electricity bill receipt).
    - Those who use direct or transferred renewable energy should also collect relevant bills for charges.
- Emission factor
  - The source of electricity is a public electricity retailer
    - The emission factor is based on the electricity carbon emission factor announced by the Energy Bureau (metric tons of CO2e/kWh).
    - In principle, the electricity carbon emission coefficient of the year of the inventory is used. If the electricity carbon emission coefficient of the current year has not been announced when the inventory is carried out, the electricity carbon emission coefficient of the previous year can be used.
  - The source of electricity is not a public electricity retailer
    - The emission factor shall adopt the verified emission factor of the current year provided by the supplier
  - For those who use renewable energy for self-generation and self-use, or those who use renewable energy certificates such as solar energy, geothermal energy, ocean energy, wind power, and non-pumped storage hydraulic power, the emission factor is 0 metric tons of CO2e/kWh.
  - Those who adopt renewable energy certificates such as biomass energy, domestic general waste, and general industrial waste, etc., shall calculate their emission factors according to the types and composition ratios of biomass energy and waste before using them.
- Warming Potential (GWP)
  - The Environmental Protection Agency regulates that the global warming potential (GWP) should adopt a centennial scale, and the referenced version is the IPCC AR4 assessment report.
  - The unit of the emission coefficient is "metric ton CO2e/kWh", which means that the emission coefficient has taken the warming potential (GWP) into consideration, so there is no need to multiply the warming potential (GWP).

Examples of Emissions from Purchased Electricity

- E Corporation 109 years
  - 2,000 kilowatt-hours of electricity purchased by the public electricity sales industry
  - 2,000 kilowatt-hours of power transferred from renewable energy power generation companies (supported by the purchased electronic certificate, each certificate is 1,000 kilowatt-hours)
  - How much greenhouse gas emissions (in metric tons of CO2e) are produced?
  - In 2019, the carbon emission coefficient of electric power was 0.502 metric tons CO2e/kWh, and the emission coefficient of electric certificate integration certificate was 0 metric ton CO2e/kWh
  - In 2019, the carbon emission coefficient of electric power was 0.502 metric tons CO2e/kWh, and the emission coefficient of electric certificate integration certificate was 0 metric ton CO2e/kWh
- Illustrate
  - Annual greenhouse gas emissions = 2,000 kWh × 0.502 metric tons CO2e/kWh + 2,000 kWh × 0 metric tons CO2e/kWh (renewable energy certificate coefficient) = 1,004.0000 metric tons CO2e

Emission coefficient method: (4) Calculation of outsourced steam emissions

- Annual greenhouse gas emissions (metric tons CO2e) = annual activity data × emission factor × warming potential
- Annual activity data (metric tons)
  - Measurement data: use instruments to measure steam consumption as annual activity data, such as: flow meter records the consumption of steam input (charge receipt
  - Non-measurement data: Since there is no actual consumption or purchase volume documents, other supporting data are used to push back, such as: the purchase amount pushes back the usage
- Emission factor
  - The steam emission factor shall adopt the emission factor provided by the supplier. (The unit of emission coefficient is metric ton CO2e/metric ton, or the emission coefficients of three types of greenhouse gases, such as: metric ton CO2/metric ton, metric ton CH4/metric ton and metric ton N2O/metric ton)
  - Steam suppliers should calculate their steam emission coefficients using the heat-first method. For detailed calculation methods, please refer to Appendix VI of this guideline.
- Warming Potential (GWP)
  - The Environmental Protection Agency regulates that the global warming potential (GWP) should adopt a centennial scale, and the referenced version is the IPCC AR4 assessment report, and ISO14064-1:2018 references AR6
- If the unit of the aforementioned emission coefficient is "metric ton CO2e/metric ton", it means that the emission coefficient has taken the global warming potential (GWP) into consideration, so there is no need to multiply the global warming potential (GWP)

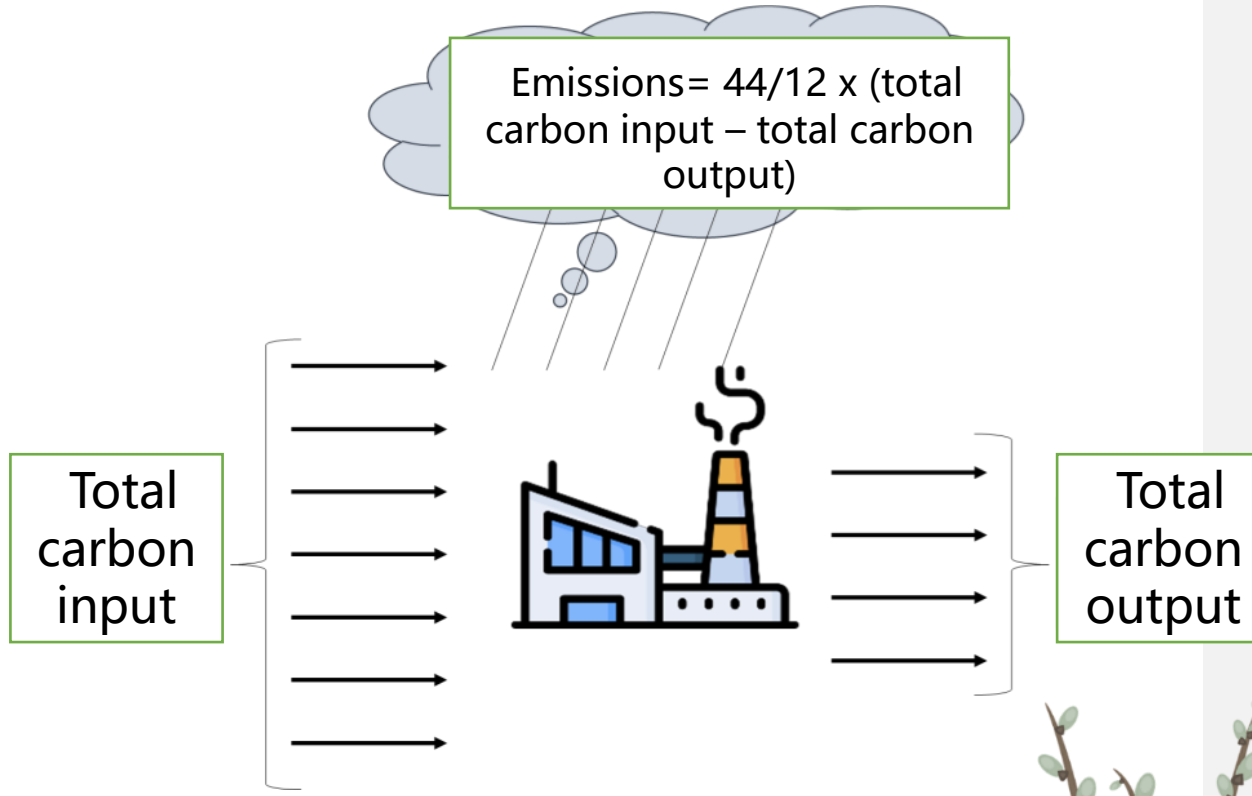
Example of Purchased Steam Emissions

- E Corporation 109 years
  - Purchased 2,500 metric tons of steam from YY steam plant, and the steam emission coefficient of YY steam plant in 2010 was 0.30867 metric tons CO2e/metric ton
    - How much greenhouse gas emissions (in metric tons of CO2e) are generated?
- Illustrate
  - Annual greenhouse gas emissions =

2,500 metric tons × 0.30867 metric tons CO2e/metric ton = 771.6750 metric tons CO2e

2. Mass balance method

- Definition
- Refers to the balance of the quality of materials and energy in and out, production, consumption and conversion in processes or chemical reactions.
- Reason for adoption
  - It is often difficult to link emissions directly to a single material input in steel plant manufacturing processes or chemical industry manufacturing processes
  - Because its products or wastes contain a lot of carbon (such as: organic chemicals, carbon black, etc.) 。
    - Therefore, using carbon input and output to calculate emissions is closer to the actual situation



References :EUROPEAN COMMISSION. Guidance Document:The Monitoring and Reporting Regulation–General guidance for installations, 2022.02.

Mass balance method: (1) fuel combustion

- Principle description
  - Calculation of fuel combustion by mass balance method, only for calculation of CO2 emissions
  - Enterprises should still use the emission factor method to calculate CH4 and N2O emissions from fuel combustion.
- **Formula: Annual CO2 emissions (metric tons CO2) = annual activity data × 44/12 × carbon content**
- Annual Activity Data
  - Measurement data: use instruments to measure the consumption of raw materials and fuels as annual activity data, such as: the measurement data obtained from weighing scales for each batch of raw (fuel) materials.
  - Non-measurement data: Since there is no actual consumption or purchase volume documents, other supporting data are used to push back, such as: the purchase amount pushes back the usage.
- 44/12
  - The molecular weight ratio of carbon dioxide (CO2) to carbon (C) is 3.6667 metric tons CO2/metric ton C .
- Carbon content (%)
  - The carbon content is expressed in mass percentage, and the test report should be provided if the self-tested value is adopted
  - Those who have not tested themselves can use the carbon content provided by the supplier, and should attach the test report or supporting materials provided by the supplier.

Examples of fuel combustion emissions

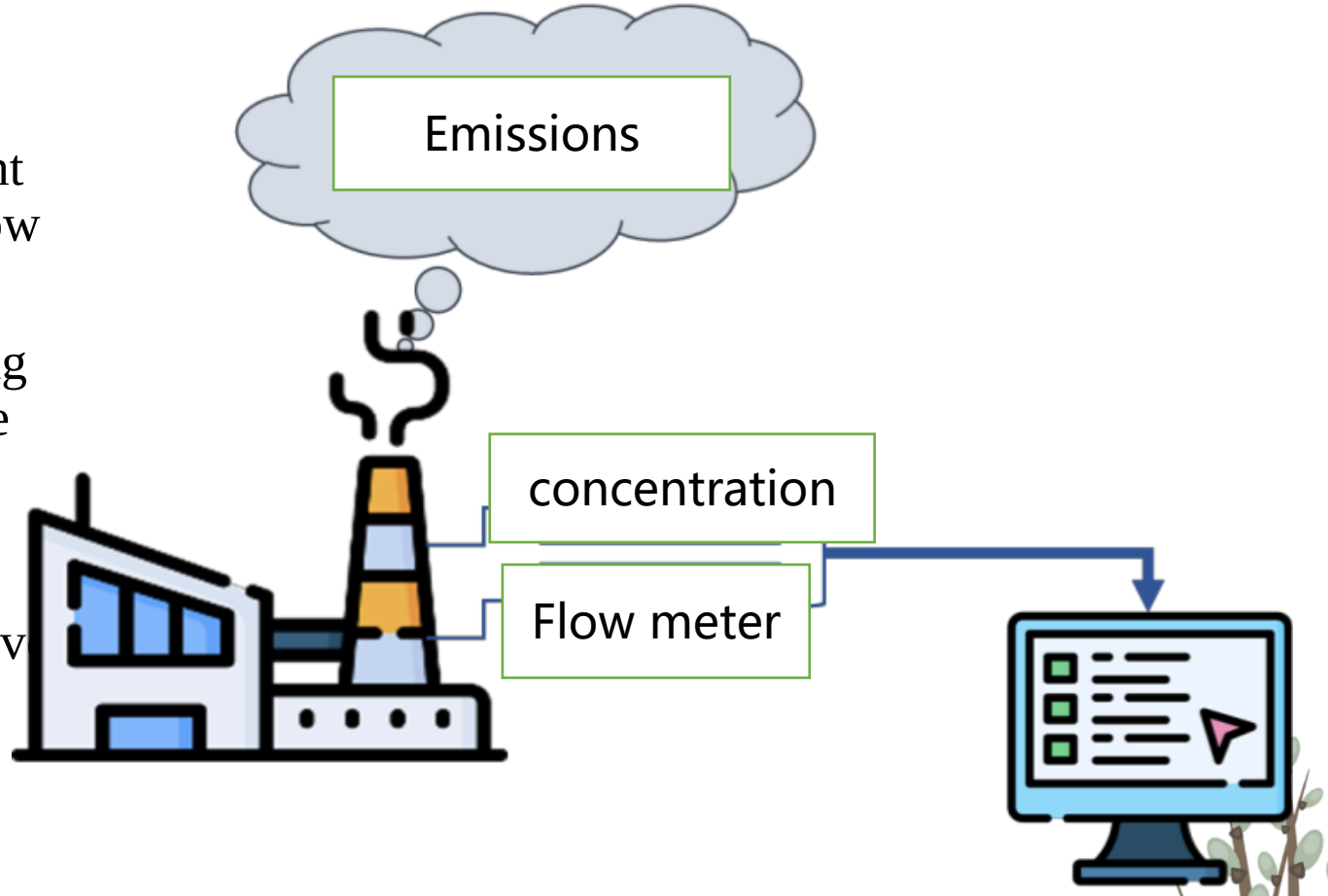
- Company B used 5,000 metric tons of sub-bituminous coal in 2010, how much greenhouse gas emission (in metric tons of CO2e) would it produce?
- Among them, the IPCC's sub-bituminous coal emission coefficient, the low-level calorific value announced by the Environmental Protection Agency, and the carbon content of company B's self-test are quoted, as shown in the following table .

CO2 emission factor (kgCO2/TJ)	CH4 emission factor (kgCH4/TJ)	N2O emission factor (kgN2O/TJ)	lower calorific value (kcal/kg)	carbon content (%)
96,100	1	1.5	4,900	53.8

- Illustrate
- **Annual CO2 emissions = annual activity data × 44/12 × carbon content**
  - Annual CO2 emission=5,000(metric tons) × 44/12 × 53.8(%) = 9,863.3333 metric tons CO2*e*
- Annual greenhouse gas emissions (metric tons CO2e) = annual activity data × emission coefficient × 4.1868 × 10-9 × lower calorific value × warming potential
- CH4 annual emissions=5,000(metric tons)×1 (kgCH4/TJ)×4.1868×10-9× 4,900(kcal/kg)×25= 2.5644 metric tons CO2e
- Annual N2O emissions = 5,000 (metric tons) × 1.5 (kgN2O/TJ) × 4.1868 × 10-9 × 4,900 (kcal/kg) × 298= 45.8517 metric tons CO2e
- Annual Greenhouse Gas Emissions = 9,863.3333 + 2.5644 + 45.8517 = 9,911.7494 metric tons CO2e

3. Direct monitoring method

- Calculate the emissions based on the results of continuous emission monitoring or regular sampling, and measure the concentration of greenhouse gas emissions
- The method of calculating the emission amount based on the exhaust gas concentration and flow rate (as shown in Figure 3-8).
- If there is direct monitoring or regular sampling and measurement of CO2 emissions during the inventory operation, and the amount . If the measuring instrument has regular external calibration, it is recommended to use direct monitoring or regular sampling data. To improv the accuracy of quantitative results and credibility.



(2) Summary of greenhouse gas emissions

- The aforementioned emissions calculation formula is converted into metric tons of carbon dioxide equivalent (metric tons CO2e) using warming potential (GWP)
- Enterprises should summarize the calculation results of each emission source
  - Aggregated emissions should be expressed in metric tons of CO2e and rounded to the third decimal place
  - The inventory is displayed with the third decimal place, or the three decimal places of scientific notation.
- The three greenhouse gases CO2, CH4 and N2O produced by biomass fuel combustion should be quantified
  - The IPCC has stated that the CO2 produced by the combustion of biomass fuels is part of the natural cycle reaction and will not increase the concentration of CO2 in the atmosphere. It only needs to be quantified and listed separately, and does not need to be summarized in the total emissions
  - CH4 and N2O should be quantified and aggregated into total emissions.

4. Data Quality Management

- ✓ Management Purpose
  - ✓ By establishing an enterprise internal inventory information management system to confirm the inventory quality and uncertainty risks of greenhouse gas-related data, so as to improve and ensure the accuracy of greenhouse gas inventory results
- ✓ Management Principles
  - ✓ Qualitative: 1. Confirm that the boundary scope is relevant to the purpose of the inspection, 2. The emission source has been completely identified, 3. The excluded items should be transparently stated
  - ✓ Quantitative: 1. Whether the activity data reference is correct, and save the calculation formula and supporting documents, 2. Whether the emission coefficient is consistent with the activity data unit.
- ✓ Data quality management: Confirm that its inventory management procedures can effectively identify errors, reduce uncertainties and improve data quality, so as to achieve the goal of continuous improvement, and it is also a reference for inspection agencies to judge data quality.

(1) Calculate the data error level of emission sources

- Data Error Level Scoring for Emission Sources
- Activity Data Error Level (A1)
  - Instrument calibration error level (A2)
  - Emission calculation parameters (calorific value or carbon content) error level (A3)
  - Data error level of emission sources (A) = A1 × A2 × A3

Project	1 point	2 point	3 point
Activity Data Error Level (A1)	continuous monitoring	regular sampling	Estimate yourself
Instrument calibration error level (A2)	The data obtained from the instrument measurement performed more than once a year by external schools	The data obtained from the instrument measurement performed by the external school less than once a year	Estimated data other than measurements
Emission calculation parameter error level (A3)	In-house development parameters, parameters obtained from mass balance, or parameters experienced in the same process/equipment	Manufacturer supplied parameters or area announcement parameters	National Announcement Parameters or International Announcement Parameters

(2) Determining the scoring interval based on the error level of the emission source

- After the emission source calculates its data error level, determine the scoring range of the emission source
  - For example: if the data error level is 6, its scoring range is 1.
  - The data quality distribution of emission sources in the plant can be grasped.

Data Error Level(A1 × A2 × A3)	1 to 9	10 to18	19 to 27
Scoring range	1	2	3

(3) Calculation of emissions inventory levels

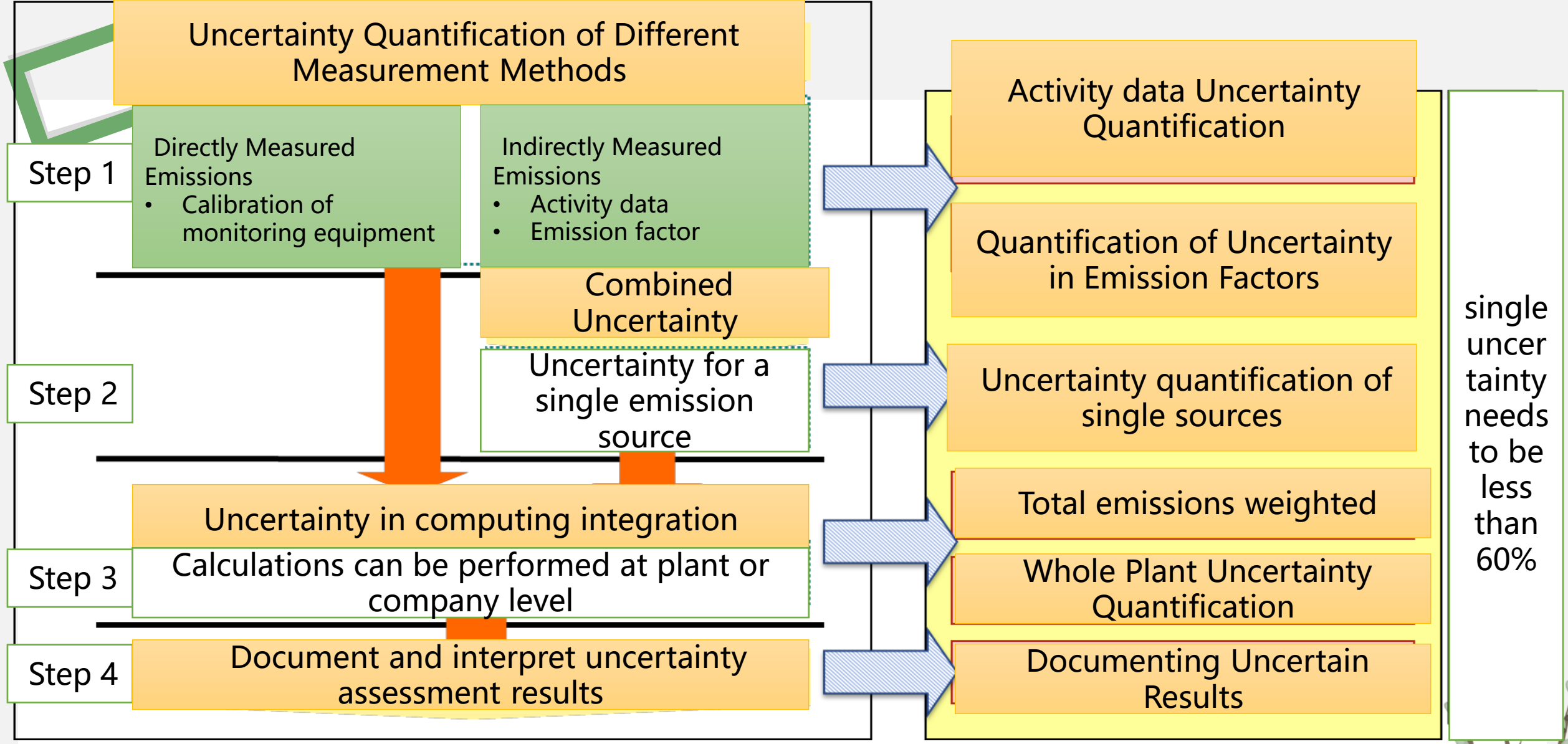
- Calculate the overall average score for the emissions inventory level
  - After calculation and judgment, the product of the error level of each emission source and the proportion of the total emission is accumulated and summed up
  - The supplier checks the quality of the inventory data by himself, and serves as a reference for the direction of future inventory data refinement.

Emissions Inventory Level Overall Average Score $\sum_{1}^{n}$(Data error level of emission source × proportion of total emission)	1 to 9	10 to18	19 to27
inventory level	first level	Second level	Third level

Quantitative Analysis of Uncertainty

- Activity Data Uncertainty
- The source of activity data is instrument measurement, such as electric meters, oil gauges, gas meters and other instruments
- Activity data uncertainty upper and lower limits = ± error value (%) × expansion factor = ± error value (%) × 2
- Uncertainty of emission coefficients: The upper and lower limits of uncertainty of the emission coefficients of each raw (fuel) material provided by IPCC.

Project	sources of uncertainty
activity data	1. Statistical method 2. Instrument Calibration Records 3. Statutory tolerance 4. Recommended by international organizations
Emission Factor Note	1. In-house uncertainty value 2. Uncertainty values disclosed by suppliers, industrial unions, etc. 3. IPCC Announcement Suggested Values



Source: GHG Protocol guidance on uncertainty assessment in GHG inventories and calculating statistical parameter uncertainty.

5. Documentation and Records

1) Establish an emission inventory

- 1. Basic business information;
- 2. Boundary setting;
- 3. Identification of emission sources;
- 4. Quantification of emissions (including activity data and management of emission coefficients) and summary of plant-wide greenhouse gas emissions
- 5. Data quality management.

(2) Writing an investigation report

1. Purpose and business introduction

2. Boundary setting

3. Identification of emission sources

4. Quantification of Emissions

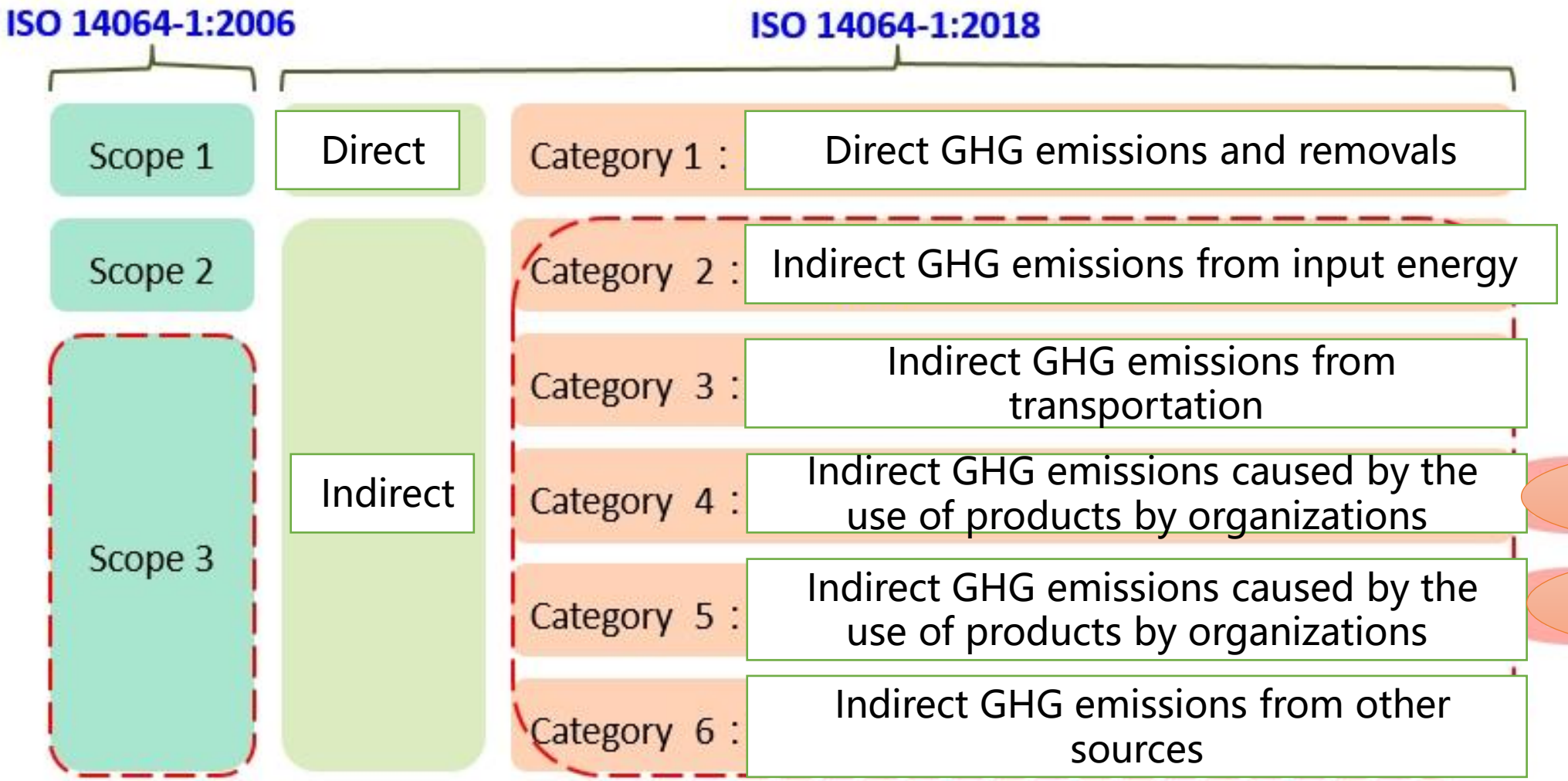
4-1. Emission calculation method 4-2. Activity data collection and data source description 4-3. Emission coefficient and its source and selection of related parameters 4-4. Biomass emission description 4-5. Summary of greenhouse gases in the whole plant emissions

5. Data Quality Management

4 ISO14064-1:2018 Inspection work

1. Classification and Identification of Emission Sources and Identification of Significance
2. Quantification method and reference emission coefficient
3. School Case: Case Study of Nanhua University
4. Case of agricultural cooperatives: Gukeng Organic

1. ISO14064-1:2018 emission source classification



Significance Assessment Guidelines for Major Indirect Greenhouse Gas Emission Sources

- ✓ For categories 2 to 6, significance evaluation criteria need to be designed and screened
- ✓ Not all categories are calculated, high scorers are included

Score	Occurrence frequency (A)	Carbon Reduction Opportunities (B)	Activity Data Sources (C)	Emission factor (D)
3	Happens at least once a week	have control	Accounting/ERP	EPA Bulletin Factor
2	happens at least once a season	Need to cooperate with other units	Estimate	International Emission Factor Simpro
1	Occurs less than three times per year	no chance at all	Unable to get data/ Difficulty obtaining data	unavailable

- ✓ EPA Environmental Protection Agency, Simpro emission factor collection software

Case Study of Significance Assessment of Major Indirect Greenhouse Gas Emission Sources

categ ory	category	Subcategory	A	B	C	D	total score	significance evaluation
1	Energy Direct Emission Sources	1.1 Direct emissions from stationary combustion sources	-	-	-	-	-	include
		1.2 Direct emissions from mobile combustion sources	-	-	-	-	-	include
		1.3 Direct Emissions from Manufacturing Processes	-	-	-	-	-	include
		1.4 Direct Emissions from Fugitive Emission Sources	-	-	-	-	-	include
		1.5 Direct emissions from land use, land-use change and forestry	0	0	0	0	0	Non-significant (no land-related use)
2	Energy Indirect Sources of Emissions	2.1 Indirect emissions from imported electricity include greenhouse gas emissions from the production and consumption of imported electricity by the organization concerned.	3	2	3	3	11	include
3	Transport indirect sources of emissions	3.1 Emissions from upstream raw material transportation	0	0	0	0	0	Non-significant (no raw material)
		3.2 Emissions from downstream product transportation (calculated up to first-order customers)	0	0	0	0	0	Non-distinctive (no product)
		3.3 Emissions from employee commuting Includes transport-related emissions from employees' homes to their workplaces	3	2	1	3	9	non-significant
		3.4 Emissions from customers and visitors visiting transportation	3	2	1	3	9	non-significant

Significance Assessment Form for Major Indirect Greenhouse Gas Emission Sources

4	Material/ Service Indirect Sources of Emissions	4.1 Greenhouse gas emissions generated by the organization's purchase of commodities (energy)	2	3	3	3	11	Included, energy purchases only
		4.2 Greenhouse gas emissions from capital goods manufacturing and processing	0	0	0	0	0	Non-distinctive (no lease)
		4.3 Emissions from disposal of solid and liquid wastes depend on the nature of the waste and its treatment. Typical disposal types are landfill, incineration, biological treatment or recycling processes	3	3	3	3	12	include
		4.4 Greenhouse gas emissions from capital goods leasing	0	0	0	0	0	non-significant
		4.5 Greenhouse gas emissions from services such as tutoring, cleaning, maintenance, postal delivery, banking, etc.	2	2	1	1	6	non-significant
5	Product uses indirect emission sources	5.1 Emissions or removals during the product use phase, including the total expected life-cycle emissions from all relevant products sold	0	0	0	0	0	Non-distinctive (no product)
		5.2 Greenhouse gas emissions from customer leasing.	0	0	0	0	0	Non-distinctive (no product, no lease)
		5.3 Greenhouse gas emissions from product disposal	0	0	0	0	0	Non-significant (no product, no waste)
		5.4 Greenhouse gas emissions from equity debt, investment debt, plan funds and other investments	0	0	0	0	0	Non-significant (no equity debt, investment debt, program funds

2. Quantification method (category 1)

1. Stationary emission sources (category 1)

(1) Emergency generators, boiler diesel

Greenhouse gas emissions (CO2e) = (activity data * CO2 emission factor * CO2 global warming potential) + (activity data * CH4 emission factor * CH4 global warming potential) + (activity data * N2O emission factor * N2O global warming potential)

2. Mobile emission sources (category 1)

(1) Official car (gasoline)

Greenhouse gas emissions (CO2e) = (activity data*CO2 emission factor*CO2 global warming potential) + (number of activities

According to *CH4 emission coefficient*CH4 global warming potential) + (activity data*N2O emission coefficient*N2O global warming potential)

(2) Equipment (gasoline, diesel)

Greenhouse gas emissions (CO2e) = (activity data*CO2 emission factor*CO2 global warming potential) + (number of activities

According to *CH4 emission coefficient*CH4 global warming potential) + (activity data*N2O emission coefficient*N2O global warming potential)

Quantification methods (category 1))

3. Fugitive Emission Sources (Category 1)

(1) Refrigerant escape from refrigeration and air-conditioning equipment

Greenhouse gas emissions (CO2e) =

Quantity of specific equipment * original filling volume of specific equipment * emission factor of specific equipment * GWP value

Device name	Common equipment	Emission factor (emission rate) (%)
Household freezing and refrigeration equipment	household refrigerator	0.1-0.5
Independent commercial refrigeration and refrigeration equipment	commercial refrigerator	1-15
Medium and large refrigerated and refrigerated equipment	Large freezer and cold room	10-35
Freezing and refrigeration equipment for transportation	Low temperature home delivery	15-50
Industrial freezing and refrigeration equipment, including food processing and refrigeration	Industrial Cryogenic Equipment	7-25
Chiller	Chiller	2-15
Residential and commercial building air conditioners	air conditioner	1-10
mobile air cleaner	car air conditioner	10-30

Quantification methods (category 2)

1. Purchased Electricity (Category 2)

According to the announcement of the Energy Bureau, the carbon emission coefficient of electric power in 2021 = 0.509 kgCO2e/degree)

2. Greenhouse gas emissions (CO2e) = electricity consumption (kWh/year) * power announced by the Energy Bureau

Quantification Methods (category 3)

✓Definition：

1. Employee commuting includes employees traveling from their homes to their workplaces, transport-related emissions

2 Emissions from business or employee travel and transportation

✓ Calculation formula

✓Greenhouse gas emissions (CO2e) = transportation distance (km) * number of employees (p) * number of working days (days) * carbon footprint emission coefficient of transportation mode

✓The emission factor can be found in the product carbon footprint database of the Environmental Protection Agency

(1) Passenger car for private use (gasoline) (2014): 0.115 $kgCO_2e$/person-extended kilometer (pkm)

(2) Robotic bicycle (gasoline) (2014): 0.0951 $kgCO_2e$/person-extended kilometer (pkm)

(3) Taiwan's railway transport service (Electrical Multiple Units) (2015): 0.054 $kgCO_2e$/person-km (pkm)

(4) High-speed rail transport service (2018): 0.034 $kgCO_2e$/person-km (pkm)

環保署產品碳足跡資料庫 (EPD Product Carbon Footprint Database) https://cfp-calculate.tw/cfpc/WebPage/LoginPage.aspx

Quantification methods (category 4)

- ✓Item 1: Upstream emissions from energy use
  - ✓Indirect greenhouse gas emissions from products used by the organization
- ✓Calculation formula

Greenhouse gas emissions (CO2e) =Electricity consumption (kWh/year)*electricity indirect carbon footprint (2019) (kgCO2e/kwh)

Greenhouse gas emissions (CO2e) =Upstream emissions of purchased diesel (liter/year)*diesel (unburned, 2019) (kgCO2e/liter)

Greenhouse gas emissions (CO2e) =Upstream emissions of purchased gasoline (liter/year)*motor gasoline (unburned, 2019) (kgCO2e/liter)

✓Emission factors from the EPA's Product Carbon Footprint Database.

(1) Indirect carbon footprint of electricity (2019): 0.0923 kgCO2e/degree.

(2) Diesel (unburned, 2019): 0.733 kgCO2e/liter.

(3) Motor gasoline (unburned, 2019): 0.66 kgCO2e/liter.

Quantification methods (category 4)

✓Item 2: Waste Disposal - Indirect Greenhouse Gas Emissions from Products Used by the Organization

✓Calculation formula)

Greenhouse gas emissions (CO2e) = Waste disposal (incineration) (metric ton/year) * Waste incineration treatment service (Miaoli County Waste Incineration Plant) (kgCO2e/metric ton))

Greenhouse gas emissions (CO2e) = Waste transportation (tons/year) * incineration plant destination (km) * waste is removed and transported by diesel-powered garbage trucks for general waste (kgCO_2e/tkm (tkm)

Greenhouse gas emissions (CO2e) = Fertilization of organic waste (metric ton/year)* Fermentation-free conversion of organic waste to fertilizer treatment service (kgCO_2e/metric ton (mt)

✓EPD Product Carbon Footprint Database

- ✓If recyclables and waste are transported by the same manufacturer, the waste transport emission coefficient is used.

(1) Waste incineration treatment service (Miaoli County Waste Incineration Plant): 340 kgCO2e/metric ton)

(2) Removing and transporting general waste with diesel-powered garbage trucks: 1.31 kgCO_2e/tkm

(3) Organic waste ferment-free conversion fertilizer treatment service: 48.30 kgCO_2e/metric ton (mt)

IPCC 2006 Suggested Values of Uncertainty Factors for Activity Data)

Source	Thoroughly establish a complete data statistics system		Thoroughly establish a complete data statistics system	
	Measure	Infer	Measure	Infer
Energy industry	Less than 1%	3-5%	1-2%	5-10%
Commercial, residential (fuel consumption)	3-5%	5-10%	10-15%	15-25%
Industrial combustion (energy intensive industry)	3-5%	3-5%	10-15%	5-10%
Other industries)	3-5%	5-10%	10-15%	15-20%
Biofuel (lack of source information)	10-30%	20-40%	30-60%	60-100%

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Uncertain analysis results of greenhouse gas emission data (category 1 and category 2)

Emission source	Emissions (metric tons CO2e)	Proportion (%)	Uncertainty analysis				
			Activity data		Emission factor		Integrated uncertainty (%)
			Uncertainty (±%)	Source	Uncertainty(±%)	Source	
Gasoline	15	0.3	±5.0%	IPCC provides activity data recommendations (other industries have not yet established a sound statistical inference to 5%)	+5.34% -2.60%	Calculated by citing the 95% confidence interval of the IPCC 2006 emission coefficient	+7.31% -5.63%
Diesel fuel	49	1.1	±5.0%	IPCC provides activity data recommendations (other industries have not yet established a sound statistical inference to 5%)	+0.94% -2.02%	Calculated by citing the 95% confidence interval of the IPCC 2006 emission coefficient	+5.09% -5.39%
Car gasoline	10	0.2	±5.0%	IPCC provides activity data recommendations (other industries have not yet established a sound statistical inference to 5%)	+5.34% -2.60%	Calculated by citing the 95% confidence interval of the IPCC 2006 emission coefficient	+7.31% -5.63%
Car diesel	69	1.5	±5.0%	IPCC provides activity data recommendations (other industries have not yet established a sound statistical inference to 5%)	+0.94% -2.02%	Calculated by citing the 95% confidence interval of the IPCC 2006 emission coefficient	+5.09% -5.39%
Solvents, sprays, and refrigerants	273	6	±15.0%	IPCC provides activity data recommendations (other industries have not yet established a sound statistical inference to 15%)	±7.0%	The uncertainty factor of the IPCC emission coefficient is set at ±7.0%	±16.55%
Outsourcing electricity	4,107	90.8	±1.0%	Meter grade A (error ± 0.5% * 2 (safety factor) = ± 1.0%	±7.0%	The uncertainty factor of the IPCC emission coefficient is set at ±7.0	±7.07%
Uncertainty analysis Emissions (metric tons CO2e)	4,522.49	100.0	Total Uncertainty (%)				±6.50%

3. School Case: Case Study of Nanhua University

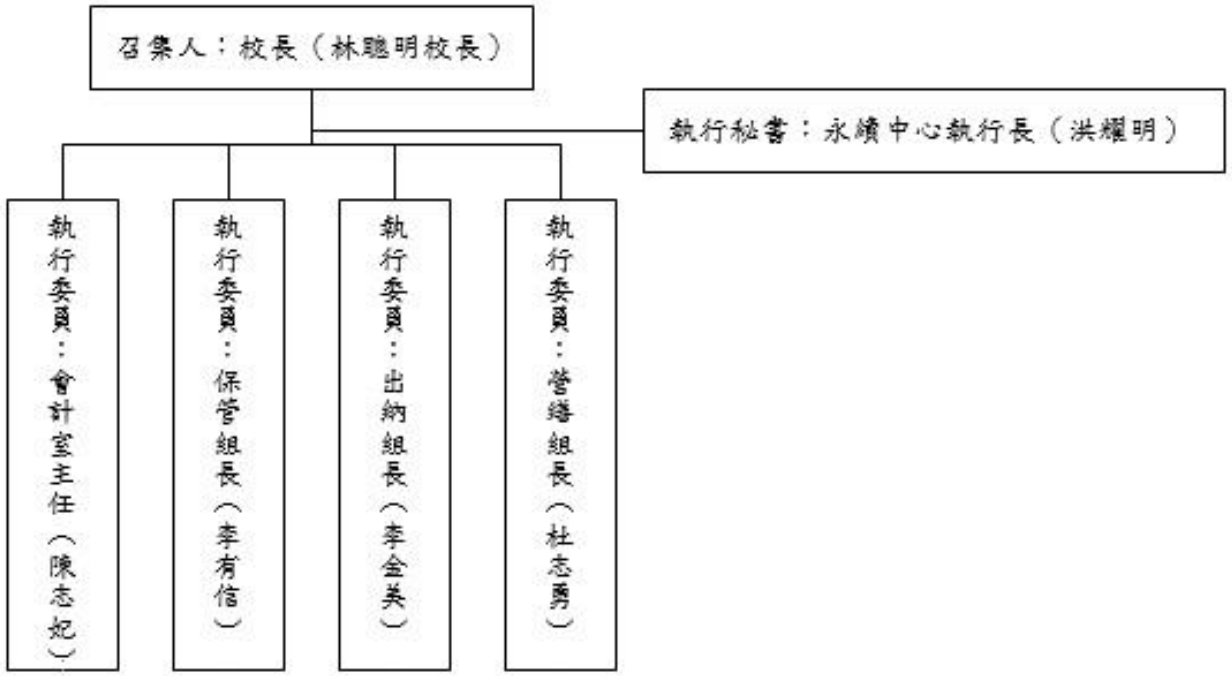
Basic Information (1)

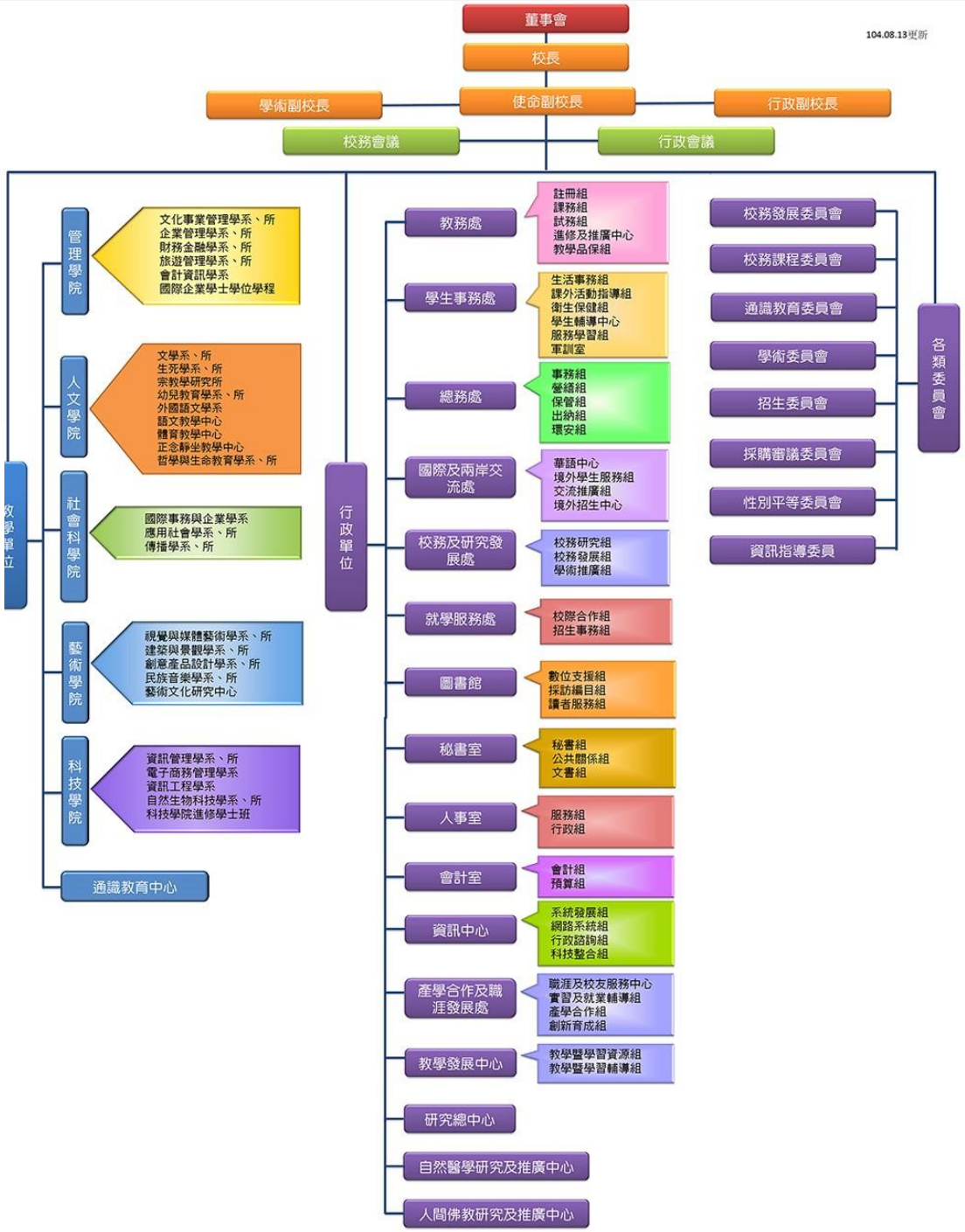
- Fill in the company profile and basic information

School name	南華大學
Headmaster	林聰明
Total number of the staff and students	6,106 人
School address	嘉義縣大林鎮南華路一段 55 號
Greenhouse Gas Manager	洪耀明
Contact number	05-2721001#5342
Email	hongyaoming@gmail.com

Basic Information (2)

- Company organization chart, greenhouse inventory promotion organization chart

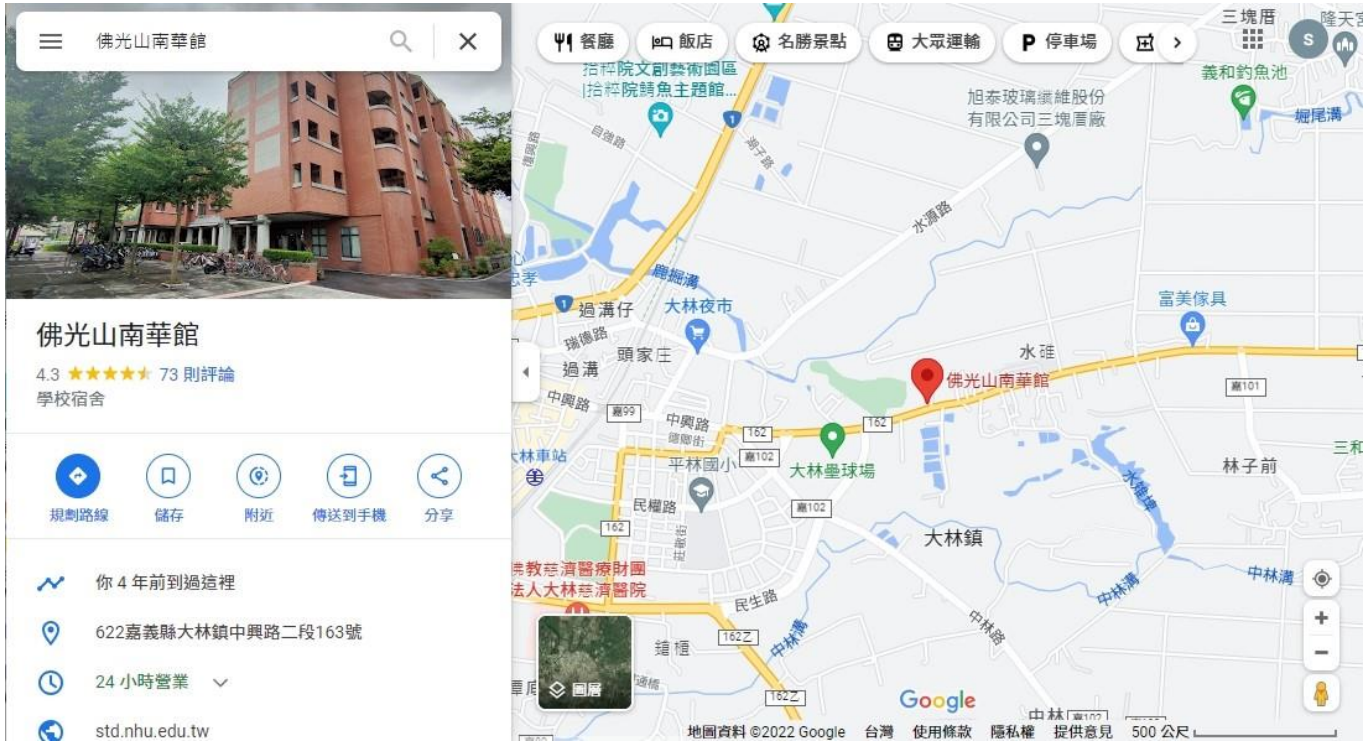




Defining the Boundary (1)

- The organizational boundary adopts the definition of operation control in ISO14064-1:2018. The scope of the inspection boundary is: administrative building (Sungkyunkwan), teaching building (Xuehui Building, Xuehaitang, Zhongdao Building, Miaoyin Building), library (Wu Wu Zang), Zhengxing Center, faculty dormitory (Yunshuiju), student dormitory (Wenhui Building, Lize Building, Yuanqi Building, Seven Villages, Nine Villages, Nanhua Pavilion).
- Among them, Xingxue Memorial Hall and Xueshe are the Board of Directors of Fo Guang Shan and are not affiliated with Nanhua University. The cabin has been demolished. Student restaurants (Yunshuiju, Wenhui Building), subcontractors (Xuehui Building 7-11, Yuanqi Building 7-11) part of the electricity bills are paid by the student cafeteria and subcontractors, and the rest of the buildings belong to the school’s organizational boundaries.

Defining the Boundaries (2)



Data creation_Category 1

- Project

  Gasoline equipment : Official vehicles (gasoline), boilers, generators, farm implements (gasoline)

  Diesel equipment): official vehicles (diesel), farm implements (gasoline)

  Refrigerant equipment) : air conditioner, ice water host, water dispenser, refrigerator, official vehicle refrigerant, heat pump water heater, vending machine

  Others : ethanol, methanol, carbon dioxide gas cylinders (for biotechnology experiment), carbon dioxide fire extinguishers

- Collection method：

  Oil bills and invoices, manufacturer purchase receipts, and equipment nameplate labels

- Precautions：

Refrigerant equipment requires equipment nameplate labels to record the type of the refrigerant and the original capacity of the refrigerant

Data creation _Category 1

- Stationary combustion:

  Boilers, generators, agricultural implements (gasoline)

- Mobile combustion

  Official vehicles (gasoline), official vehicles (diesel), agricultural implements - trucks (gasoline), agricultural implements - trucks (diesel).

- Dissipation

  Air conditioner, ice water host, water dispenser, refrigerator, official car refrigerant, heat pump water heater, vending machine

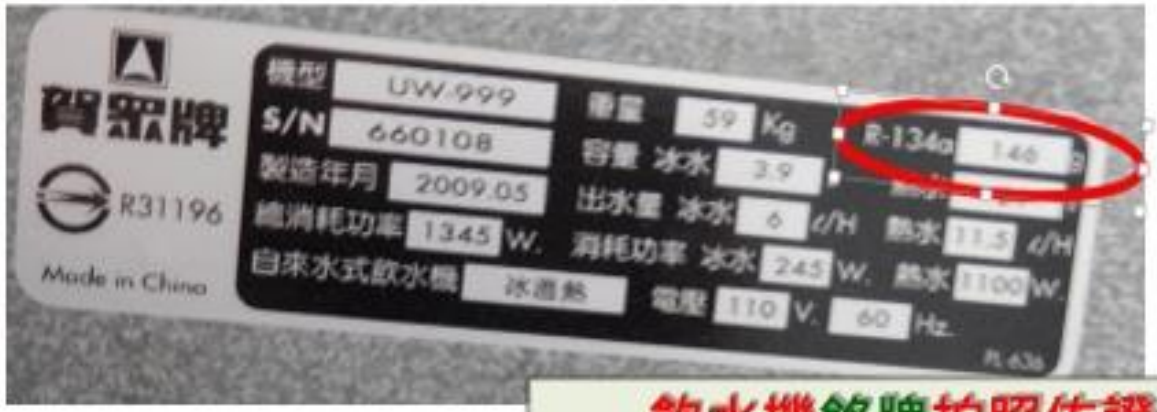
- Other

  Methanol, ethanol, carbon dioxide gas cylinders (for biotechnology experiments), carbon dioxide fire extinguishers)

Data Creation_Category 1

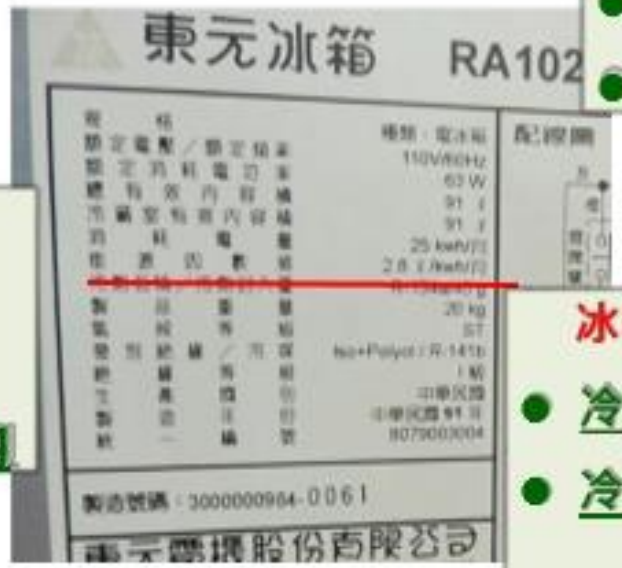
冷氣銘牌拍照佐證

- 冷媒種類：R-22
- 冷媒填充量：1.55kg



飲水機銘牌拍照佐證

- 冷媒種類：R-134a
- 冷媒填充量：146 g =0.146kg



冰箱銘牌拍照佐證

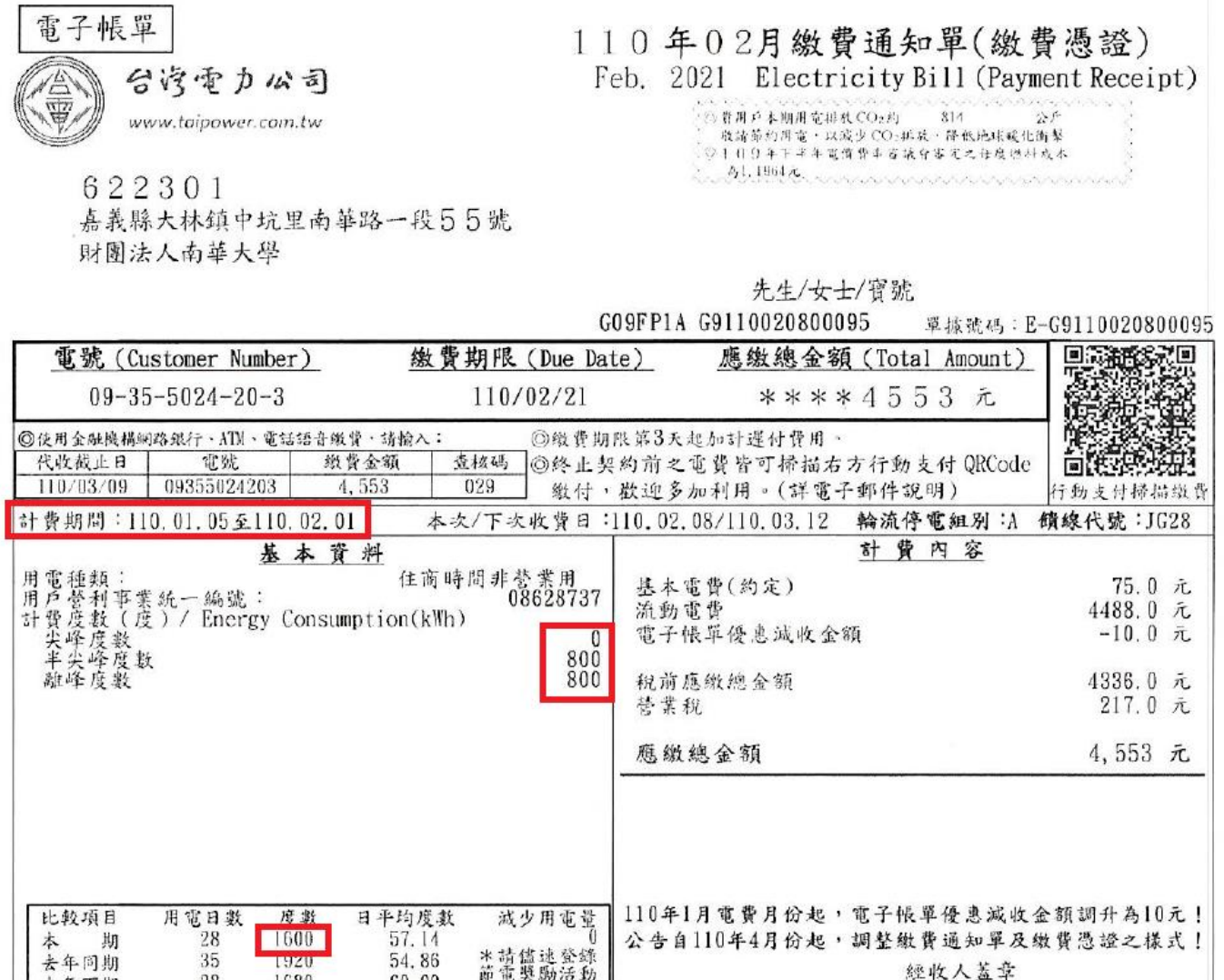
- 冷媒種類：R-134a
- 冷媒填充量：45 g =0.045kg

Data creation _Category 2-1

- Item: purchased electricity
- Collection method: Taipower telephone bill
- Note: Actual date 2021/1/1-2021/12/31.

Data creation _ Category 2

- Billing hours are 110/01/05 to 110/02/01.
- The power consumption quota is 1600 degrees.
- The electricity consumption from 110/01/01 to 110/01/04 needs to be supplemented by the previous bill.



電子帳單

台灣電力公司
www.taipower.com.tw

110年02月繳費通知單(繳費憑證)
Feb. 2021 Electricity Bill (Payment Receipt)

622301
嘉義縣大林鎮中坑里南華路一段55號
財團法人南華大學

先生/女士/寶號
G09FP1A G9110020800095 單據號碼：E-G9110020800095

電號 (Customer Number)	繳費期限 (Due Date)	應繳總金額 (Total Amount)
09-35-5024-20-3	110/02/21	＊＊＊＊4553 元

◎使用金融機構網路銀行、ATM、電話語音繳費，請輸入：

代收截止日	電號	繳費金額	查核碼
110/03/09	09355024203	4,553	029

◎繳費期限第3天起加計遲付費用。
◎終止契約前之電費皆可掃描右方行動支付 QRCode 繳付，歡迎多加利用。(詳電子郵件說明)

行動支付掃描繳費

計費期間：110.01.05至110.02.01　本次/下次收費日：110.02.08/110.03.12　輪流停電組別：A　饋線代號：JG28

基本資料

用電種類：住商時間非營業用
用戶營利事業統一編號：08628737
計費度數(度) / Energy Consumption(kWh)
尖峰度數 0
半尖峰度數 800
離峰度數 800

計費內容

基本電費(約定)	75.0 元
流動電費	4488.0 元
電子帳單優惠減收金額	-10.0 元
稅前應繳總金額	4336.0 元
營業稅	217.0 元
應繳總金額	4,553 元

比較項目	用電日數	度數	日平均度數	減少用電量
本期	28	1600	57.14	0
去年同期	35	1920	54.86	＊請儘速登錄節電獎勵活動

110年1月電費月份起，電子帳單優惠減收金額調升為10元！
公告自110年4月份起，調整繳費通知單及繳費憑證之樣式！

經收人蓋章

Create emission source identification table

廠區/製程別	活動/設施	排放源	範疇別				可能產生溫室氣體種類								排放源類別				說明
			1	2	3	4	CO_2	CH_4	N_2O	HFCs/物種		PFCs/物種		SF_6	固定式燃燒	移動式燃燒	逸散	製程	
全校區大樓	用電設施	外購電力		V			V	V	V										
校外宿舍	用電設施	外購電力		V			V	V	V										
校區廠商	用電設施	外購電力		V			V	V	V										
全校區大樓	發電機	柴油	V				V	V	V						V				
各宿舍	鍋爐	柴油	V				V	V	V						V				
全校區大樓	公務車	汽油	V				V	V	V							V			
全校區大樓	公務車	柴油	V				V	V	V							V			
全校區大樓	農用機具	汽油	V				V	V	V							V			
全校區大樓	農用機具	柴油	V				V	V	V							V			
全校區大樓	公務車	冷媒R134a	V							V	R134a						V		
全校區大樓	冷水主機	冷媒R-22	V							V	R22						V		
全校區大樓	冷水主機	冷媒R134a	V							V	R134a						V		
宿舍	冷氣機	冷媒R-22	V							V	R22						V		
全校區大樓	冷氣機	冷媒R-32	V							V	R32						V		
全校區大樓	冷氣機	冷媒R-410a	V							V	R410a						V		
宿舍	飲水機	冷媒R-22	V							V	R134a						V		
全校區大樓	飲水機	冷媒R134a	V							V	R22						V		
全校區大樓	自動販賣機	冷媒R134a	V							V	R134a						V		
學海堂-生技系	冰箱	冷媒R134a	V							V	R134a						V		
學海堂-生技系	冰箱	冷媒R143a	V							V	R143a						V		
學海堂-生技系	冰箱	冷媒R508a	V							V	R508a						V		
學海堂-生技系	實驗用	甲醇	V				V										V		
學海堂-生技系	實驗用	乙醇	V				V										V		
全校區大樓	氣體鋼瓶	二氧化碳	V				V										V		
全校區大樓	二氧化碳滅火器	二氧化碳	V				V										V		
宿舍	宿舍冰箱	冷媒R134a	V							V	R134a						V		
宿舍	熱泵熱水器	冷媒R134a	V							V	R134a						V		
宿舍	熱泵熱水器	冷媒R417a	V							V	R417a						V		

Establishment of emission source activity data management table

範疇/類型別	活動設施	排放源	負責單位	來源說明	活動數據1				
					年用量	單位	數據來源	資料存放單位	數據品質
全校區大樓	用電設施	外購電力	餐禮組	台電網站	7,016,800	度	電號查詢	餐禮組	電號查詢
校外宿舍	用電設施	外購電力	餐禮組	台電網站	1,365,729	度	電號查詢	餐禮組	電號查詢
校區廠商	用電設施	外購電力	事務組	廠商收據	254,022	度	收費清單	事務組	抄錶單表
全校區大樓	發電機	柴油	餐禮組	推估	2,326.25	公升	校內外發電機推估表	餐禮組	推估
校外宿舍	發電機	柴油	餐禮組	推估	331.25	公升	校內外發電機推估表	餐禮組	推估
校內宿舍	鍋爐	柴油	餐禮組	推估	3,025.00	公升	校內鍋爐推估表	餐禮組	推估
校外宿舍	鍋爐	柴油	餐禮組	加油站	13000.24	公升	校外鍋爐油單	會計室	油單發票
全校區大樓	公務車	汽油	事務組	加油站	4497.6	公升	油單發票	會計室	油單發票
全校區大樓	公務車	柴油	事務組	加油站	24841.86	公升	油單發票	會計室	油單發票
全校區大樓	農用機具	汽油	環安組	加油站	6,637.84	公升	油單發票	會計室	油單發票
全校區大樓	農用機具	柴油	環安組	加油站	1061.12	公升	油單發票	會計室	油單發票
全校區大樓	公務車	冷媒R134a	事務組	設備清單	0.429	公斤	逸散量	事務組	設備清單
全校區大樓	冷水主機	冷媒R134a	餐禮組	設備清單	36.72	公斤	逸散量	餐禮組	設備清單
全校區大樓	冷水主機	冷媒R-22	餐禮組	設備清單	115.175	公斤	逸散量	餐禮組	設備清單
全校區大樓及宿舍	冷氣機	冷媒R-22	餐禮組	設備清單	0.1772	公斤	逸散量	餐禮組	設備清單
全校區大樓	冷氣機	冷媒R-32	餐禮組	設備清單	0.0077	公斤	逸散量	餐禮組	設備清單
宿舍	冷氣機	冷媒R-410a	餐禮組	設備清單	0.0912	公斤	逸散量	餐禮組	設備清單
全校區大樓	飲水機	冷媒R134a	環安組	設備清單	0.0818	公斤	逸散量	環安組	設備清單
宿舍	飲水機	冷媒R-22	環安組	設備清單	0.0144	公斤	逸散量	環安組	設備清單
全校區大樓	自動販賣機	冷媒R134a	事務組	設備清單	0.0108	公斤	逸散量	事務組	設備清單
全校區大樓及宿舍	冰箱	冷媒R134a	餐禮組	設備清單	0.0323	公斤	逸散量	餐禮組	設備清單
學海堂	冰箱	冷媒R143a	生技系	設備清單	0.0067	公斤	逸散量	生技系	設備清單
學海堂	冰箱	冷媒R508a	生技系	設備清單	0.0006	公斤	逸散量	生技系	設備清單
學海堂	實驗用	甲醇	生技系	友和實易股份有限	4	公升	收據	生技系	收據
學海堂	實驗用	乙醇	生技系	日順儀器有限公司	280	公升	收據	生技系	收據
學海堂	實驗用	乙醇	生技系	弘力化工原料儀器有限公司		公升	收據	生技系	收據
學海堂	實驗用	二氧化碳	生技系	冷研科技有限公司	60	公升	收據	生技系	收據
全校區大樓	二氧化碳滅火器	二氧化碳	餐禮組	設備清單	62.5	公斤	設備清單	餐禮組	設備清單
宿舍	宿舍冰箱	冷媒R134a	餐禮組	設備清單	0.0323	公斤	逸散量	餐禮組	設備清單
宿舍	熱泵熱水器	冷媒R134a	餐禮組	設備清單	0.2295	公斤	逸散量	餐禮組	設備清單

Greenhouse Gas Quantification _ Category 1&2)

Based on the completed form, the activity data is used to quantify the total greenhouse gas emissions in 2021, produce a greenhouse gas report.

Quantitative reference calculation.

Greenhouse gas emissions (CO2e)= activity data x emission factor x global warming potential

Activity data	Emission factor	Global warming potential (GWP)
Electricity: kWh) **(Gasoline: liter, metric)** **(Diesel: liter, metric)** **(Carbon dioxide cylinder: kg)** **(Refrigerant :kg)**	The emission coefficient of electricity coefficient adopts the coefficient announced by Taipower and the Bureau of Energy. The rest of the emission coefficients mostly use the data from the IPCC assessment report	二氧化碳(CO2)：1 (Carbon dioxide (CO2): 1) 甲烷(CH4)：25 (Methane (CH4): 25) 氧化亞氮(N2O)：298 (Nitrous oxide (N2O): 298) 氫氟碳化物 (HFCS)：12~12000 (Hydrofluorocarbons (HFCS): 12~12000) 全氟碳化物 (PFCS)：5700~11900 (Perfluorocarbons (PFCS): 5700~11900) 六氟化硫(SF6)：22200 (Sulfur hexafluoride (SF6): 22200)

Types of Greenhouse Gas Emission Sources and Calculation Method

Stationary emission sources: Refers to fuel combustion of stationary equipment, including boilers (diesel) and purchased electricity.

1.) Emergency generators, boiler diesel

Greenhouse gas emissions (CO_2e)= (activity data* CO_2 emission coefficient* CO_2 global arming potential) + (activity data port CH_4 emission coefficient* CH_4 global warming potential) + (activity data* N_20 emission coefficient* N_2O global warming potential)

2.) Purchased electricity

Greenhouse gas emissions (CO_2)= electricity consumption (kWh/year) * electricity announced by the Energy Bureau * CO_2 emission factor

3.) Carbon dioxide

Greenhouse gas emissions (CO2)= activity data * CO2 emission factor * CO2 global warming potential

Mobile emission sources: refer to fuel combustion of transportation equipment, official vehicles (gasoline), agricultural machinery (gasoline, diesel)

1.) Official car (gasoline)

Greenhouse gas emissions (CO_2e)= (activity data * CO_2 emission factor * CO_2 global warming potential) + (activity data * CH_4 emission coefficient * CH_4 global warming potential) + (activity data * N_2O emission coefficient * N_2O global warming potential)

2.) Agricultural machinery (gasoline, diesel)

Greenhouse gas emissions (CO_2e)= (activity data * CO_2 emission coefficient * CO_2 global current potential) + (activity data * CH_4 emission coefficient * CH_4 global warming potential) + (activity data * N_2O emission coefficient * N_2O global warming potential)

Diffuse emission sources: Refrigeration and air conditioning equipment

1. Refrigerant escape of refrigeration and air conditioning equipment

Greenhouse gas emissions (CO_2e)=number of specific equipment *original filling volume of specific equipment*emission rate of specific equipment* GWP

設

Device name	common equipment	Dissipation rate (%)
Household freezing and refrigeration equipment	household refrigerator	0.3
Independent commercial freezing and refrigerating equipment	Commercial refrigerator	8
Medium and large freezing and refrigerating equipment	Large freezer and cold room	22.5
Cross over with freezing and refrigerating equipment	Commercial refrigerator	32.5
Industrial freezing an refrigeration equipment, including food processing and cold storage	Industrial cryogenic equipment	16
chiller	chiller	8.5
Residential and commercial building air conditioners	Air conditioner	5.5
mobile air cleaner	Single use air conditioner	15

Coefficient management

- Gasoline and diesel use IPCC2006 coefficient

- Taipower announced that the carbon emission coefficient of electric power in 2021= 0.509 kg CO2e/degree

排放源	CO_2排放係數				
	數值			單位	資料來
	預設值	自訂值	計算使用值		預設值
煙煤	2.534856		2.534856	公噸CO_2/公噸	1. 排放係數 = IPCC原始係數 × 燃料熱值 × 碳氧化率 2. 燃料熱值來源為能源局公告 3. *該類燃料無我國熱值時，採用IPCC 2006年出版資料。 4. LPG之係數另乘以能源局公告值 1公斤=1.818公升 5.引用IPCC 2006年版係數
亞煙煤	2.373874		2.373874	公噸CO_2/公噸	
無煙煤	2.922093		2.922093	公噸CO_2/公噸	
褐煤*	1.201787		1.201787	公噸CO_2/公噸	
其他類煤			0.000000	公噸CO_2/公噸	
燃料油	3.110960		3.110960	公噸CO_2/公秉	
天然氣(NG)	2.090427		2.090427	公噸CO_2/千立方公尺	
液化天然氣(LNG)	2.661046		2.661046	公噸CO_2/千立方公尺	
液化石油氣(LPG)	3.186738		3.186738	公噸CO_2/公噸	
汽油	2.263133		2.263133	公噸CO_2/公秉	
煤油	2.558763		2.558763	公噸CO_2/公秉	
柴油	2.606032		2.606032	公噸CO_2/公秉	
航空燃油	2.394850		2.394850	公噸CO_2/公秉	
焦炭	3.135913		3.135913	公噸CO_2/公噸	
煤氣	0.780754		0.780754	公噸CO_2/千立方公尺	
高爐氣	0.845817		0.845817	公噸CO_2/千立方公尺	
煉油氣	2.170437		2.170437	公噸CO_2/千立方公尺	
石油腦	2.393761		2.393761	公噸CO_2/公秉	
石油焦	3.347347		3.347347	公噸CO_2/公噸	
烯烴類	1.718598		1.718598	公噸CO_2/公秉	
芳香烴類	2.700653		2.700653	公噸CO_2/公秉	
其他石油產品	2.762032		2.762032	公噸CO_2/公秉	
台電電力	0.623000	0.509000	0.509000	公噸CO_2/千度	能源局公告98年度電力排放係數
廢棄物-焚化	0.999450		0.999450	公噸CO_2/乾公噸	WBCSD/WRI-Greenhouse Gas
廢棄物-掩埋					
廢水					
車用汽油	2.263133		2.263133	公噸CO_2/公秉	IPCC 2006年版係數
車用柴油	2.606032		2.606032	公噸CO_2/公秉	IPCC 2006年版係數

GWP coefficient management

Refrigerant adopts AR6 GWP value

溫室氣體化學式	AR2 (1995)	AR3 (2001)	AR4 (2007)	AR5 (2014)	AR6 (2021)
CO_2 二氧化碳	1	1	1	1	1
CH_4 甲烷	21	23	25	28	27.9
N_2O 氧化亞氮	310	296	298	265	273
Hydrofluorocarbons,HFCs					
HFC-23/R-23 三氟甲烷，CHF_3	11,700	12,000	14,800	12,400	14,600
HFC-32/R-32 二氟甲烷，CH_2F_2	650	550	675	677	771
HFC-41 一氟甲烷，CH_3F	150	97	92	116	135
HFC-125/R-125，1,1,1,2,2-五氟乙烷，C_2HF_5	2,800	3,400	3,500	3,170	3,740
HFC-134，1,1,2,2-四氟乙烷，$C_2H_2F_4$	1,000	1,100	1,100	1,120	1,260
HFC-134a/R-134a，1,1,1,2-四氟乙烷，$C_2H_2F_4$	1,300	1,300	1,430	1,300	1,530
HFC-143，1,1,2-三氟乙烷，CHF_2CH_2F	300	330	353	328	364
HFC-143a/R-143a，1,1,1-三氟乙烷，$C_2H_3F_3$	3,800	4,300	4,470	4,800	5,810
HFC-152，1,2-二氟乙烷，CH_2FCH_2F	—	43	53	16	22

In 2021, IPCC releases Sixth assessment Report (AR6)

Fill in the inventory data(Category 1)

- Stationary Combustion Unit: Public

4-1-1 Stationary combustion emission sources: including boilers, heaters, combustion furnaces, kilns, ovens, dryers, and other equipment prepared.

能源類別	使用量		溫室氣體排放量			
	數量	單位	CO_2 (公噸/年)	CH_4 (公噸/年)	N_2O (公噸/年)	總溫室氣體 (公噸CO_2e/年)
煙煤		公噸/年	0.00	0.00	0.00	0.00
亞煙煤		公噸/年	0.00	0.00	0.00	0.00
無煙煤		公噸/年	0.00	0.00	0.00	0.00
褐煤		公噸/年	0.00	0.00	0.00	0.00
其他類煤		公噸/年	0.00	0.00	0.00	0.00
燃料油		公秉/年	0.00	0.00	0.00	0.00
天然氣(NG)		千立方公尺/年	0.00	0.00	0.00	0.00
液化天然氣(LNG)		千立方公尺/年	0.00	0.00	0.00	0.00
液化石油氣(LPG)		公噸/年	0.00	0.00	0.00	0.00
汽油	6.64	公秉/年	15.02	0.00	0.00	15.08
煤油		公秉/年	0.00	0.00	0.00	0.00
柴油	18.68	公秉/年	48.69	0.00	0.00	48.85
航空燃油		公秉/年	0.00	0.00	0.00	0.00
焦炭		公噸/年	0.00	0.00	0.00	0.00
煤氣		千立方公尺/年	0.00	0.00	0.00	0.00
高爐氣		千立方公尺/年	0.00	0.00	0.00	0.00
煉油氣		千立方公尺/年	0.00	0.00	0.00	0.00
石油腦		公秉/年	0.00	0.00	0.00	0.00
石油焦		公噸/年	0.00	0.00	0.00	0.00
烯烴類		公秉/年	0.00	0.00	0.00	0.00
芳香烴類		公秉/年	0.00	0.00	0.00	0.00
其他石油產品		公秉/年	0.00	0.00	0.00	0.00
乙炔		公噸/年	0.00	0.00	0.00	0.00
乙烯		公噸/年	0.00	0.00	0.00	0.00
固定式燃燒排放源排放總合：			63.71	0.00	0.00	63.93

- Mobile Combustion Unit: Gongbing

4-1-2 Mobile combustion emission sources: Transportation vehicles owned or controlled by your factory (such as official vehicles, transportation fleets, forklifts, etc.)

Energy category	Usage amount		Greenhouse Gas Emissions			
	quantity	unit	CO_2 (公噸/年)	CH_4 (公噸/年)	N_2O (公噸/年)	總溫室氣體 (公噸CO_2e/年)
motor gasoline	4.51	kiloliter/year	10.21	0.00	0.00	10.58
Diesel for vehicles	25.90	kiloliter/year	67.50	0.00	0.00	68.57
Total emissions from mobile combustion sources			77.71	0.01	0.00	79.15

Fill in the inventory data (Category 1)

- Refrigerant Emission Calculation
- R22 needs to be identified and not included in the calculation

	冷氣		七村	九村	南華館	SUM	冷媒原始擴充量(kg)	排放因子(%)	
2	R22		102	1		103	1.21	5.5	6.8547
3	R22		5	145	323	473	1.3	5.5	33.8195
8									
9	冰水主機								
10	R134a	2				2	216	8.5	36.7200
11	R22	5				5	271	8.5	115.1750
12									
13	飲水機								
14	(賀眾)R134a	20	1	4		25	0.146	0.3	0.0110
15	(龍泉)R134a	78				78	0.3	0.3	0.0702
16	(大同)R134a	1				1	0.2	0.3	0.0006
17	R22		3	3	10	16	0.3	0.3	0.0144

- Dissipation amount of refrigerant type Unit: metric ton

5-4. 溶劑、噴霧劑與冷媒排放源

溶劑、噴霧劑與冷媒等氟氯碳化物的逸散計算填表說明：

1. 工廠在清洗製程中會因使用溶劑而造成逸散，或者使用的空調與冷凍設備因冷媒外洩而須補充，以及滅火器或噴霧器的使用，都會造成二氧化碳或含氟化合物氣體的逸散。
2. 若統計二氧化碳或含氟化合物逸散量有困難，亦可統計該物種之採購量或委外補充量。

使用物種	逸散 /補充量 (公噸/年)	全球暖化潛勢 (GWP)	溫室氣體排放量 (公噸CO_2e/年)
範例：SF_6	10	22,200	222,000.0000
二氧化碳滅火器	0.12	—	0.1225
氫氟碳化物HFC			
三氟甲烷HFC-23/R-23，CHF_3		14,800	0.0000
二氟甲烷HFC-32/R-32，CH_2F_2		675	0.0000
一氟甲烷HFC-41，CH_3F		—	0.0000
1,1,1,2,2-五氟乙烷HFC-125/R-125，C_2HF_5		3,500	0.0000
1,1,2,2-四氟乙烷HFC-134，$C_2H_2F_4$		—	0.0000
1,1,1,2-四氟乙烷HFC-134a/R-134a，$C_2H_2F_4$	0.0386	1,530	59.0555
1,1,2-三氟乙烷HFC-143，CHF2CH2F		—	0.0000
1,1,1-三氟乙烷HFC-143a/R-143a，$C_2H_3F_3$	0.0000	5,810	0.0387
1,2-二氟乙烷HFC-152，CH_2FCH_2F		—	0.0000
1,1-二氟乙烷HFC-152a/R-152a，$C_2H_4F_2$		124	0.0000
一氟乙烷HFC-161，CH_3CH_2F		—	0.0000
1,1,1,2,3,3,3-七氟丙烷HFC-227ea，CF_3CHFCF_3		3,220	0.0000
1,1,1,2,2,3-六氟丙烷HFC-236cb，$CH_2FCF_2CF_3$		—	0.0000
1,1,1,2,3,3-六氟丙烷HFC-236ea，CHF_2CHFCF_3		—	0.0000

Fill in the inventory data (Category 2)

- Electricity consumption
  unit: 1,000 kWh

4.2 Energy ~Electricity & Steam

The power coefficient is not a fixed value, please update the coefficient according to the check year.

Electricity Usage	Usage (outside sales) (thousand degrees/year)	Emission Factor (metric ton/kWh) CO_2	CH_4	N_2O	Power purchased source	Greenhouse gas emissions CO_2 (公噸/年)	CH_4 (公噸/年)	N_2O (公噸/年)	總溫室氣體 (公噸CO_2e/年)
Purchased electricity (Taipower)	8128.507	0.509	0	0	Taipower	4137.41	0.00	0.00	4137.41
Cogeneration plant						0.00	0.00	0.00	0.00
Self-generated electricity for sale (No.1 Unit)					—	0.00	0.00	0.00	0.00
Self-generated electricity for sale (No.12Unit)						0.00	0.00	0.00	0.00
Total emissions from purchased electricity use (Scope 2):						4137.41	0.00	0.00	4137.41
Total emissions from electricity sold outside:						0.00	0.00	0.00	0.00

Greenhouse Gas Emissions (Category 1&2)

- The emission inventory can obtain the Category 1&2 greenhouse gas emissions of the year.

Emission proportion of each category	Category 1	Category 2
Greenhouse gas emissions (metric tons CO_2e/ year)	419.12	4137.41
Proportion of total emissions (%)	9.20	90.80

Data Creation (Category 4)

- Project:

Emissions from Purchased Products (Energy): Purchased Electricity, Purchased Diesel, Purchased Gasoline

Emissions from handling solid and liquid waste: general waste (transportation), general waste (incineration), recyclables transportation (transportation), organic waste (fertilization), medical waste (transportation), medical waste (incineration), laboratory waste (transportation), laboratory waste (incineration)

- Measurement method:

Google map shortest time distance.

- Precautions:

It is recommended to take a screenshot after the measurement. There will be errors in the distance measured by Google map at different time points.

Waste discharge is divided into waste transportation and waste treatment.

Organic waste (transportation) is not included in the calculation due to self-fertilization at Nanhua University

Coefficients and formulas for purchased goods (energy) (Category 4)

- **Buy goods**

Electricity indirect carbon footprint (2019): 0.0923 kgCO2e/degree.

Diesel (unburned, 2019): 0.733 kgCO2e/liter.

Motor gasoline (unburned, 2019): 0.66 kgCO2e/liter.

Greenhouse gas emissions (CO2e) = kWh of electricity consumption (kWh/year) * indirect carbon footprint of electricity (2019) (kgCO2e/kWh)

Greenhouse gas emissions (CO2e) = upstream emissions of purchased diesel (liter/year)*diesel (unburned, 2019) (kgCO2e/liter) Greenhouse gas emissions (CO2e) = upstream emissions of purchased gasoline (liter/year) * motor gasoline (unburned, 2019) (kgCO2e/liter)

Calculation of purchasing commodity (energy) activity data (Category 4)

- The greenhouse gas emission of purchased goods (energy) is 742.09 metric tons CO2e/year.

Upstream emissions from purchased electricity (degrees/year)	Indirect carbon footprint of electricity (2019) (kgCO2/degree)	carbon emissions (kgCO2e/year)	carbon emissions (metric tons CO2e/year)
7,603,609	0.0923	701813.1107	701.8131107
Upstream emissions of purchased diesel oil (liter/year)	Diesel (unburned, 2019) (kgCO2e/liter)	carbon emissions (kgCO2e/year)	carbon emissions (metric tons CO2e/year)
44585.72	0.733	32681.33276	32.68133276
Upstream emissions of purchased gasoline (liter/year)	Motor gasoline (Unburned, 2019) (kgCO2e/liter)	carbon emissions (kgCO2e/year)	carbon emissions (metric tons CO2e/year)
11,510.20	0.66	7596.732	7.596732
			742.0911755

Waste factors and formulas (Category 4)

- Waste

Waste incineration treatment service (Miaoli County Waste Incineration Plant): 340 kgCO2e/metric ton

Removal and transportation of general waste with diesel-powered garbage trucks: 1.31 $kgCO_2e$/tkm

Organic waste ferment-free conversion fertilizer treatment service: 48.30 $kgCO_2e$/metric ton (mt)

Greenhouse gas emissions (CO2e) = waste disposal (incineration) (metric ton/year) * waste incineration treatment service (Miaoli County Waste Incineration Plant) (kgCO2e/metric ton)

Greenhouse gas emissions (CO2e) = waste transportation (tonnes/year) * incineration plant destination (km) * waste is removed and transported by diesel-powered garbage trucks for general waste ($kgCO_2e$/tkm (tkm))

Greenhouse gas emissions (CO2e) = Fertilization of organic waste (metric ton/year) * Fertilizer treatment service of organic waste without fermentation ($kgCO_2e$/metric ton (mt))

Waste activity data calculation (Category 4)

- General waste (incineration) Incineration amount
- General waste (transportation) Transportation volume, distance to incineration plant

General waste (incineration)				
Waste disposal (incineration) (metric tons/year)	Waste incineration treatment service (Miaoli County Waste incineration Plant) (kgCO2e/metric ton)		Carbon emissions (kgCO2e/year)	Carbon emissions (metric tons kgCO2e/year)
141.446		340	48091.64	48.09164
General waste (transportation)				
waste transportation (tons/year)	Clean and transport general waste with diesel-powered garbage trucks (kgCO2e/tkm)		Carbon emissions (kgCO2e/year)	Carbon emissions (metric tons kgCO2e/year)
141.446		1.31		
35.2 kilometers from the destination to the deergrass incineration plant (tkm)				
4978.8992			6522.357952	6.522357952

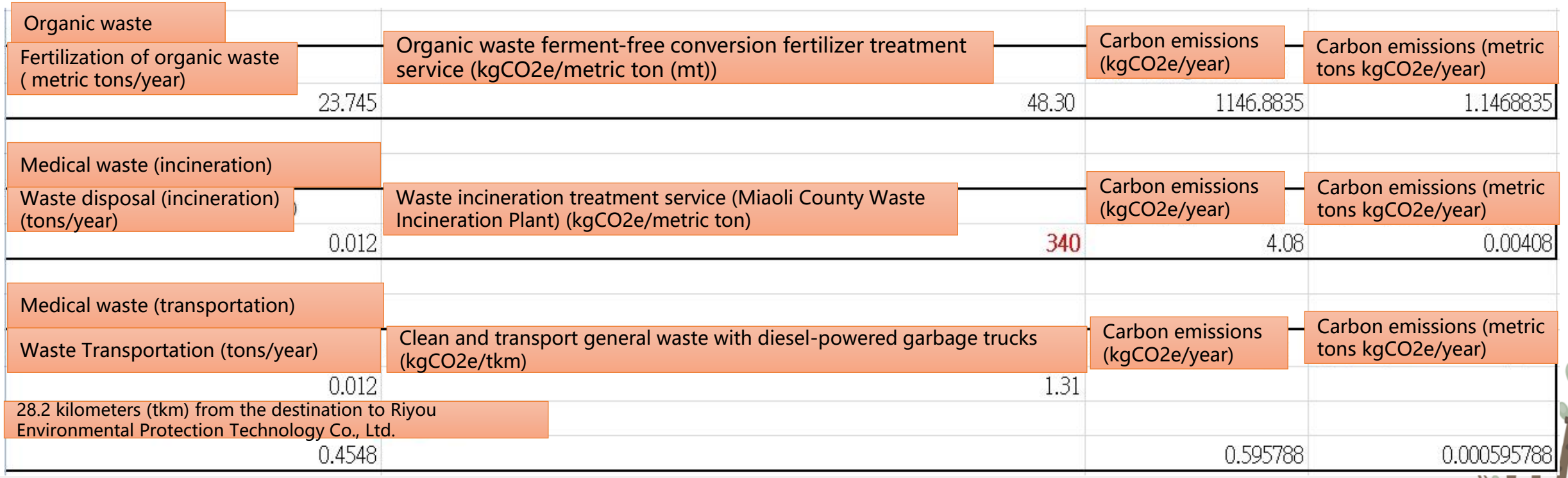
Waste activity data calculation (Category 4)

- Transportation of recyclables (transportation) Recycling volume, distance between four manufacturers

Recycling Transportation (Transportation)				
Transportation of recyclables (ton/year)		Clean and transport general waste with diesel-powered garbage trucks (kgCO2e/tkm)	Carbon emissions (kgCO2e/year)	Carbon emissions (metric tons kgCO2e/year)
59.12		1.31		
Destination to Dashun (km)				
8.8			681.53536	0.68153536
Transportation of recyclables (ton/year)				
5.3795				
Destination to Lianyi Secondhand Merchant(km)				
5.5			38.7592975	0.038759298
Transportation of recyclables (ton/year)				
1.36				
Destination to cleaning team of Dalin Town Hall(km)				
10.4			18.52864	0.01852864
Transportation of recyclables (ton/year)				
1.95215				
Destination to Londing (km)				
1.9			4.85890135	0.004858901

Waste activity data calculation (Category 4)

- Organic waste (compost) Amount of compost
- Medical waste (incineration) Incineration amount
- Medical waste (transportation) Transportation volume, distance to incineration plant



Waste activity data calculation (Category 4)

- Laboratory waste (incineration)
- Laboratory waste (transportation)
- Add up to get the Category 4 greenhouse gas emissions of 56.55kgCO2e for the year.

Laboratory waste (incineration			
Waste disposal (incineration) (tons/year)	Waste incineration treatment service (Miaoli County Waste Incineration Plant) (kgCO2e/metric ton)	Carbon emissions (kgCO2e/year)	Carbon emissions (metric tons kgCO2e/year)
0.09	340	30.6	0.0306
Laboratory waste (transportation)			
Waste transportation (tons/year)	Clean and transport general waste with diesel-powered garbage trucks (kgCO2e/tkm)	Carbon emissions (kgCO2e/year)	Carbon emissions (metric tons kgCO2e/year)
0.09	1.31		
84.5 kilometers (tkm) from the destination to National Cheng Kung University Environmental Resources Research management Center			
7.605		9.96255	0.00996255
			56.54980199

Greenhouse Gas Emissions (Category 4)

- The greenhouse gas emission of Category 4 for the year is 798.64 metric tons CO2e/year.

Emission proportion of each category	Category 4
Greenhouse gas emissions (metric tons CO2e/year)	798.64
Proportion of total emissions (%)	-

Taking the Gukeng Organic Cooperative as an Example

Data Creation (Category 1)

- Project:

Diesel equipment: refrigerated truck (diesel)

Refrigerant equipment: refrigerated truck (vehicle refrigerant), refrigerated truck (freezer), freezer, air conditioner, refrigerator

- Collection method:

Oil bills and invoices, equipment brand labels, and declarations from refrigerant manufacturers.

- Precautions:

Refrigerant equipment requires equipment nameplate labels to record the type of refrigerant and the original capacity of the refrigerant.

Data Creation (Category 1)

- Mobile combustion:

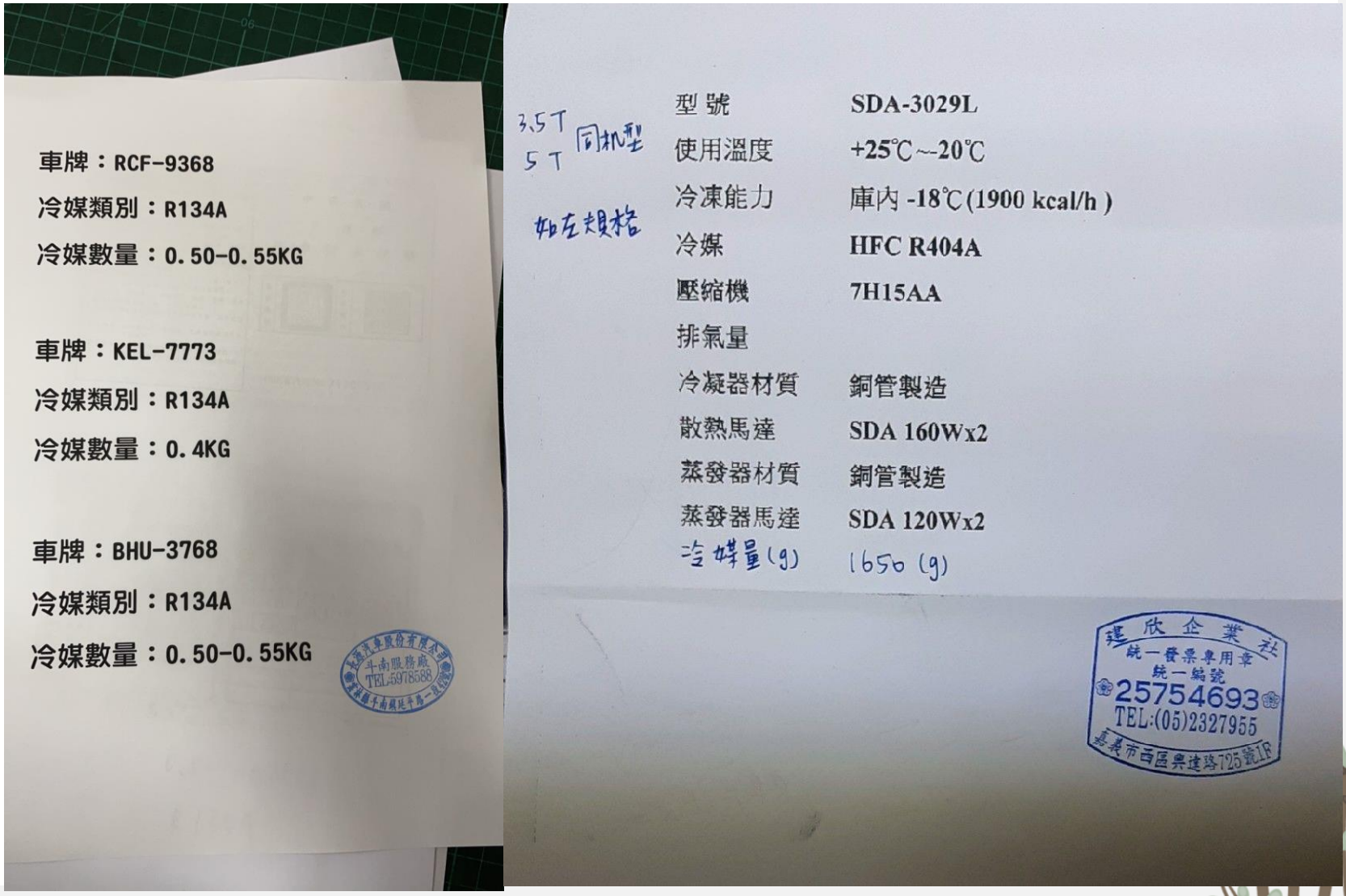
  Refrigerated truck (diesel).

- Dissipation:

  Refrigerated vehicles (refrigerant for vehicles), refrigerated vehicles (freezers), freezers, air conditioners, refrigerators.

Data Creation (Category 1)

- Refrigerant manufacturer statement



Data Creation (Category 2)

- Project:

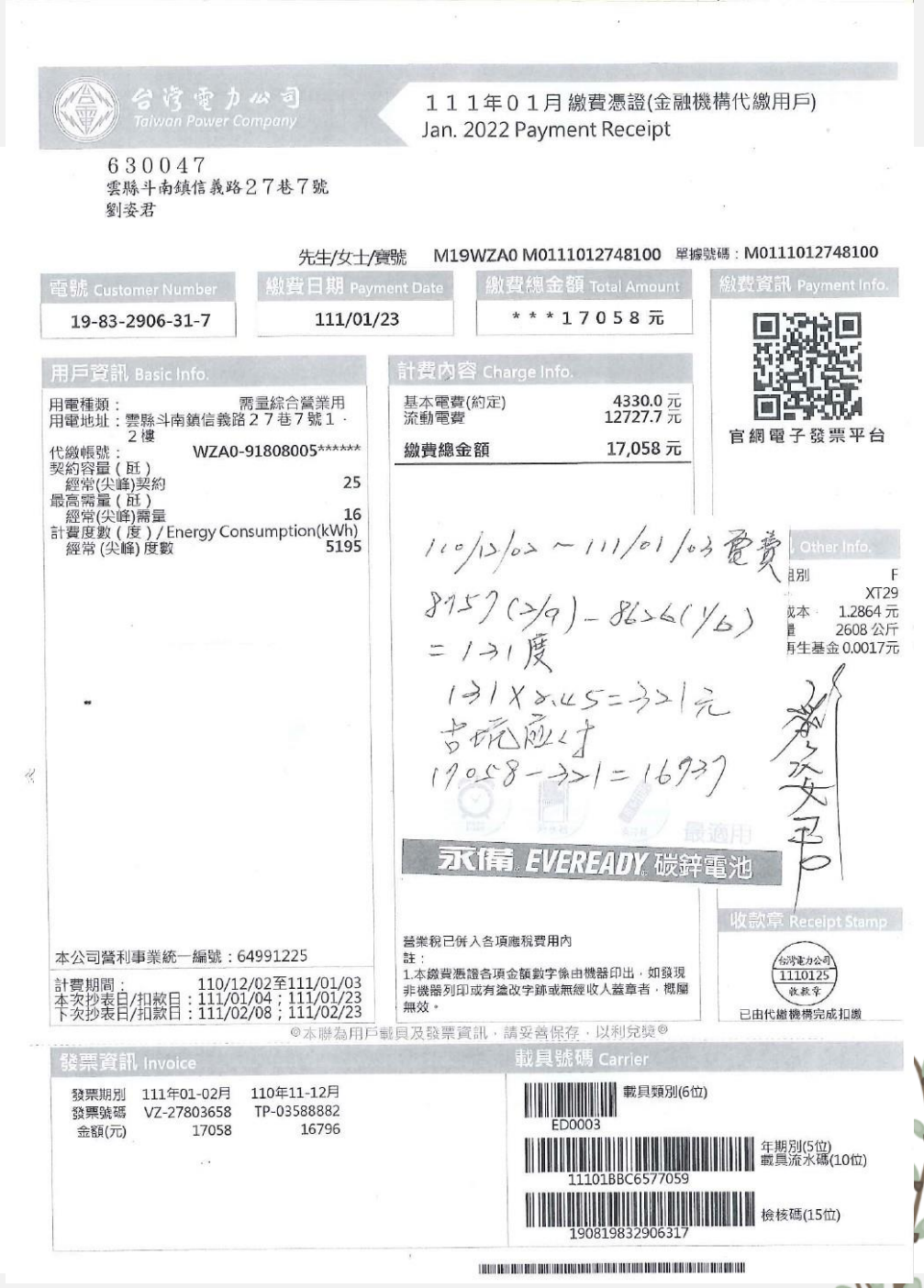
  purchased electricity
- Collection method:

  Taipower Telephone Bill
- Precautions:

  With the actual date 2021/1/1-2021/12/31.

Data Creation (Category 2)

- Billing hours are 110/12/02 to 111/01/03.
- The electricity consumption quota is 5195-131 (the landlord's electricity consumption quota) = 5064 degrees.
- Calculate the electricity consumption from 110/12/02 to 110/12/31 as 5064/33*30=4603 degrees 。


台灣電力公司 Taiwan Power Company

111年01月繳費憑證(金融機構代繳用戶)
Jan. 2022 Payment Receipt

630047
雲縣斗南鎮信義路27巷7號
劉姿君

先生/女士/寶號 M19WZA0 M0111012748100 單據號碼：M0111012748100

電號 Customer Number	繳費日期 Payment Date	繳費總金額 Total Amount
19-83-2906-31-7	111/01/23	＊＊＊17058元

繳費資訊 Payment Info.
官網電子發票平台

用戶資訊 Basic Info.
用電種類：需量綜合營業用
用電地址：雲縣斗南鎮信義路27巷7號1、2樓
代繳帳號：WZA0-91808005******
契約容量(瓩)
經常(尖峰)契約 25
最高需量(瓩)
經常(尖峰)需量 16
計費度數(度)/Energy Consumption(kWh)
經常(尖峰)度數 5195

計費內容 Charge Info.

基本電費(約定)	4330.0元
流動電費	12727.7元
繳費總金額	17,058元

110/12/02～111/01/03電費
8757(3/9)－8626(1/6)
=131度
131×2.45=321元
古硫應付
17058－321=16737

永備 EVEREADY 碳鋅電池

Other Info.
XT29
成本 1.2864元
2608公斤
再生基金0.0017元

營業稅已併入各項應稅費用內
註：
1.本繳費憑證各項金額數字係由機器印出，如發現非機器列印或有塗改字跡或無經收人蓋章者，概屬無效。

收款章 Receipt Stamp
台灣電力公司 1110125 收款章
已由代繳機構完成扣繳

本公司營利事業統一編號：64991225

計費期間：	110/12/02至111/01/03
本次抄表日/扣款日：	111/01/04；111/01/23
下次抄表日/扣款日：	111/02/08；111/02/23

◎本聯為用戶載具及發票資訊，請妥善保存，以利兌獎◎

發票資訊 Invoice

發票期別	111年01-02月	110年11-12月
發票號碼	VZ-27803658	TP-03588882
金額(元)	17058	16796

載具號碼 Carrier
ED0003 載具類別(6位)
11101BBC6577059 年期別(5位) 載具流水碼(10位)
190819832906317 檢核碼(15位)

Create emission source identification table

廠區/製程別	活動/設施	排放源	範疇別				可能產生溫室氣體種類								排放源類別				說明
			1	2	3	4	CO_2	CH_4	N_2O	HFCs / 物種		PFCs / 物種		SF_6	固定式燃燒	移動式燃燒	逸散	製程	
合作社	用電設施	外購電力(台電)		V			V	V	V										
合作社	冷藏車	柴油	V				V	V	V							V			
合作社	冷藏車	冷媒 R134	V									V	R134				V		
合作社	冷藏庫	冷媒 R22	V									V	R22				V		
合作社	冷藏庫	冷媒 R427a	V									V	R427a				V		
合作社	冷藏庫	冷媒 R507a	V									V	R507a				V		
合作社	一樓冷氣	R410a	V									V	R410a				V		
合作社	二樓冷氣	R22	V									V	R22				V		
合作社	一樓冰箱	R134a	V									V	R134a				V		
合作社	員工通勤	汽機車			V														
合作社	商務出差	高鐵、火車、汽機車			V														

Establishment of emission source activity data management table

廠區/製程別	活動/設施	排放源	負責單位	來源說明	活動數據1				
					年用量	單位	數據來源	資料存放單位	數據品質
合作社	用電設施	外購電力	行政部	台電網站	65,283	度	電號查詢	行政部	電號查詢
合作社	冷藏車	柴油	儲運部	油單發票	17531.72	公升	油單發票	行政部	油單發票
合作社	冷藏車	冷媒 R134	行政部	設備清單	500	公克	冷媒總表	行政部	設備名牌
合作社	冷藏車	冷媒 R134	行政部	設備清單	500	公克	冷媒總表	行政部	設備名牌
合作社	冷藏車	冷媒 R134	行政部	設備清單	400	公克	冷媒總表	行政部	設備名牌
合作社	冷凍庫	冷媒 R22	行政部	設備清單	3	公斤	冷媒總表	行政部	設備名牌
合作社	冷凍庫	冷媒 R22	行政部	設備清單	4	公斤	冷媒總表	行政部	設備名牌
合作社	冷凍庫	冷媒 R427a	行政部	設備清單	8	公斤	冷媒總表	行政部	設備名牌
合作社	冷凍庫	冷媒 R507a	行政部	設備清單	3	公斤	冷媒總表	行政部	設備名牌
合作社	冷凍庫	冷媒 R507a	行政部	設備清單	6	公斤	冷媒總表	行政部	設備名牌
合作社	一樓冷氣	R410a	行政部	設備清單	3	公斤	冷媒總表	行政部	設備名牌
合作社	二樓冷氣	R22	行政部	設備清單	3.2	公斤	冷媒總表	行政部	設備名牌
合作社	一樓冰箱	R134a	行政部	設備清單	0.51	公斤	冷媒總表	行政部	設備名牌
合作社	員工通勤	汽車	行政部	Googlemap測量	114	公里	員工通勤總表	行政部	Googlemap測量
合作社	員工通勤	機車	行政部	Googlemap測量	48	公里	員工通勤總表	行政部	Googlemap測量
合作社	商務出差	高鐵	行政部	高鐵網站里程數	2,467.65	公里	商務出差總表	行政部	高鐵網站里程數
合作社	商務出差	火車	行政部	台鐵網站試算	135.70	公里	商務出差總表	行政部	台鐵網站試算
合作社	商務出差	汽車	行政部	Googlemap測量	145.60	公里	商務出差總表	行政部	Googlemap測量
合作社	商務出差	機車	行政部	Googlemap測量	39.79	公里	商務出差總表	行政部	Googlemap測量

Fill in the inventory data (Category 1)

- Mobile Combustion Unit: Gongbing

4-1-2 Mobile combustion emission sources:	The means of transportation owned or controlled by your factory (such as official vehicles, transport fleets, stackers, etc.

Energy category	Usage amount		Greenhouse gas emissions			
	Quantity	Unit	CO_2 (metric tons/year)	CH_4 (metric tons/year)	N_2O (metric tons/year)	Total GHG (metric tons CO_2/year)
Gasoline for cars		kiloliter/ year	0.00	0.00	0.00	0.00
Diesel for cars	17.53	kiloliter/ year	45.69	0.00	0.00	46.41
Total emissions from mobile combustion sources:			45.69	0.00	0.00	46.41

Fill in the inventory data (Category 1)

- Calculation of refrigerant emission, in this case, there is a rental car that needs to be calculated for the use time

Equipment	Refrigerant model/weight	Use time/month			capacity (kg)	Emissions factor (%)	Dissipation (kg)	Dissipation (kiloliter)	Dissipation during use (kiloliter)	Types of refrigerant	Sum
					容量Kg	排放因子(%)	逸散量(Kg)	逸散量(公秉)	使用期間逸散量(公秉)	冷媒種類	總和
KEF-0668(車用)		12	reconfirm	再確認	再確認	20					
BHU-3768(車用)	R134/500~550g	12		R134	0.5	20	0.1	0.0001	0.0001	R134	0.00021
RCF-9368(更換BS	R134/500~550g	12	11 tons/ December replacement (calculate one month)	R134	0.5	20	0.1	0.0001	0.0001	R22	0.00160305
8102-R5(車用)		5		再確認	再確認	20				R507a	0.002025
KEN-7560(車用)		?		再確認	再確認	20				R427a	0.0018
KEL-7773(車用)	R134/400g	1	17頓/12月更換(計算一個月)	R134	0.4	20	0.08	0.00008	0.00001	R410a	0.000176
KEF-0668(車廂冷藏設備)		12		再確認	再確認	32.5				R134a	0.00000033
BHU-3768(車廂冷	R404/1650g	12		R404	1.65	32.5	0.53625	0.00053625	0.00053625	R404	0.0010725
RCF-9368(車廂冷	R404/1650g	12		R404	1.65	32.5	0.53625	0.00053625	0.00053625		
8102-R5(車廂冷藏設備)		5		再確認	再確認	32.5					
KEN-7560(車廂冷藏設備)		?		再確認	再確認	32.5					
KEL-7773(車廂冷藏設備)		1		再確認	再確認	32.5					
A庫	R22/4kg	12		R22	4	22.5	0.9	0.0009	0.0009		
B庫	R507a/3kg	12		R507a	3	22.5	0.675	0.000675	0.000675		
C庫	R507a/6kg	12		R507a	6	22.5	1.35	0.00135	0.00135		
D庫	R427a/8kg	12		R427a	8	22.5	1.8	0.0018	0.0018		
E庫	R22/3kg	12		R22	3	22.5	0.675	0.000675	0.000675		
一樓冷氣	R410a/3.2kg	12		R410a	3.2	5.5	0.176	0.000176	0.000176		
二樓冷氣	R22/0.51kg	12		R22	0.51	5.5	0.02805	0.00002805	0.00002805		
一樓冰箱	R134a/110g	12		R134a	0.11	0.3	0.00033	0.00000033	0.00000033		

Fill in the inventory data (Category 1)

1,1,2,2-四氟乙烷HFC-134，$C_2H_2F_4$	0.0002	1,260	0.2646
1,1,1,2-四氟乙烷HFC-134a/R-134a，$C_2H_2F_4$	0.0000	1,530	0.0005
1,1,2-三氟乙烷HFC-143，CHF2CH2F		—	0.0000
1,1,1-三氟乙烷HFC-143a/R-143a，$C_2H_3F_3$		5,810	0.0000
1,2-二氟乙烷HFC-152，CH_2FCH_2F		—	0.0000
1,1-二氟乙烷HFC-152a/R-152a，$C_2H_4F_2$		124	0.0000
一氟乙烷HFC-161，CH_3CH_2F		—	0.0000
1,1,1,2,3,3,3-七氟丙烷HFC-227ea，CF_3CHFCF_3		3,220	0.0000
1,1,1,2,2,3-六氟丙烷HFC-236cb，$CH_2FCF_2CF_3$		—	0.0000
1,1,1,2,3,3-六氟丙烷HFC-236ea，CHF_2CHFCF_3		—	0.0000
1,1,1,3,3,3-六氟丙烷HFC-236fa，$C_3H_2F_6$		9,810	0.0000
1,1,2,2,3-五氟丙烷HFC-245ca，$CH_2FCF_2CHF_2$		—	0.0000
1,1,1,3,3-五氟丙烷HFC-245fa，CHF2CH2CF3		1,030	0.0000
1,1,1,3,3-五氟丁烷HFC-365mfc，$CF_3CH_2CF_2CH_3$		794	0.0000
1,1,1,2,2,3,4,5,5,5-十氟戊烷HFC-43-10mee，$CF_3CHFCHFCF_2CF_3$		1,640	0.0000
HCFC-22，CHF_2Cl		1,500	0.0000
R401a，R22/152a/124（53/13/34）		1,263	0.0000
R401b，R22/152a/124（61/11/28）		1,221	0.0000
R404a，R125/143a/134a（44/52/4）		4,728	0.0000
R407a，R32/125/134a（20/40/40）		2,262	0.0000
R407b，R32/125/134a（10/70/20）		2,804	0.0000
R407c，R32/125/134a（23/25/52）		2,508	0.0000
R408a，R125/143a/22（7/46/47）		3,257	0.0000
R410a，R32/125（50/50）	0.0005	2,256	1.0829
R507a，R125/143a（50.0/50.0）	0.0029	13,258	38.1830
六氟化硫，SF_6		25,200	0.0000
		CO_2 :	0.0000
		HFCs :	39.5310
		SF_6 :	0.0000
			39.5310

Total fugitive emissions of greenhouse gases such as solvents, aerosols, and refrigerant

total greenhouse gases

Fill in the inventory data (Category 2)

- Electricity consumption unit: 1,000 kWh

4-2. Energy ~ Electricity and Steam

The power coefficient is not a fixed value, please update the coefficient according to the check year

Electricity Usage		Consumption/sales (thousand) kWh/year	Emission coefficient (metric tons/kWh) CO_2	CH_4	N_2O	Power purchase source	Greenhouse gas emissions CO2 (metric tons/year)	CH_4 (metric tons/year)	N_2O (metric tons/year)	Total GHG (metric tons CO_2e/year)
Purchased electricity	Taipower	65.283	0.509	0	0	台電	33.23	0.00	0.00	33.23
	Cogeneration plant						0.00	0.00	0.00	0.00
Sales of self-generated electricity (unit1)						—	0.00	0.00	0.00	0.00
Sales of self-generated electricity (unit 2)							0.00	0.00	0.00	0.00
	Total emissions from purchased electricity use (scope 2)						33.23	0.00	0.00	33.23
	Total emissions from electricity sold outside:						0.00	0.00	0.00	0.00

Greenhouse Gas Emissions (Category 1&2)

- The emission inventory can obtain the Category 1&2 greenhouse gas emissions of the year。

Emission proportion of each category	Category 1	Category 2
Greenhouse gas emissions (metric tons CO2e/year)	85.94	33.23
Proportion of total emissions (%)	72.12	27.88

Data Creation (Category 3)

- Project:

Emissions from business travel: time of business trip, destination, number of people traveling, mode of transportation

Emissions from employee commuting: employee name, commuting method, residential address, number of working days

- How activity data is measured:

Google map shortest time distance.

- Precautions:

It is recommended to take a screenshot after the measurement. There will be errors in the distance measured by Google map at different time points.

Business travel, employee commuting coefficients and formulas (Category 3)

- **Business travel**

Private passenger car (gasoline) (2014): 0.115 $kgCO_2e$/person-km (pkm)

Robotic bicycle (gasoline) (2014): 0.0951 $kgCO_2e$/person-kilometer (pkm)

Taiwan Railway Transportation Service (Electrical Multiple Units) (2015): 0.054 $kgCO_2e$/person-kilometer (pkm)

High-speed rail transport services: official website carbon footprint map ($kgCO_2e$)

Taipei MRT carbon footprint (2016): 0.035 $kgCO_2e$/person-km (pkm)

Greenhouse gas emissions (CO2e) = travel distance (km) * number of travelers (p) * carbon footprint emission factor

- Employee commuting

Private passenger car (gasoline) (2014): 0.115 $kgCO_2e$/person-km (pkm)

Robotic bicycle (gasoline) (2014): 0.0951 $kgCO_2e$/person-kilometer (pkm)

Greenhouse gas emissions (CO2e) = commuting distance (km) * number of employees (p) * working days (days) * carbon footprint emission factor

Business travel, employee commuting coefficients and formulas (Category 3)

- High-speed rail transport services: official website carbon footprint map ($kgCO_2e$)

Carbon Footprint of Passenger Ships Between Stations

station	Nangang	Taipei	Banqiao	Taoyuan	Hsinchu	Maioli	Taichung	Changhua	Yunlin	Chiayi	Tainan	Zuoying
Nangang	—	0.30	0.53	1.46	2.42	3.47	5.42	6.32	7.11	8.18	10.17	11.18
Taipei	0.30	—	0.23	1.17	2.13	3.17	5.13	6.03	6.82	7.88	9.88	10.88
Banqiao	0.53	0.23	—	0.94	1.89	2.94	4.89	5.80	6.59	7.65	9.65	10.65
Taoyuan	1.46	1.17	0.94	—	0.96	2.01	3.96	4.86	5.65	6.71	8.71	9.72
Hsinchu	2.42	2.13	1.89	0.96	—	1.05	3.00	3.90	4.69	5.75	7.75	8.76
Maioli	3.47	3.17	2.94	2.01	1.05	—	1.95	2.86	3.64	4.71	6.70	7.71
Taichung	5.42	5.13	4.89	3.96	3.00	1.95	—	0.90	1.69	2.75	4.75	5.76
Changhua	6.32	6.03	5.80	4.86	3.90	2.86	0.90	—	0.79	1.85	3.85	4.85
Yunlin	7.11	6.82	6.59	5.65	4.69	3.64	1.69	0.79	—	1.06	3.06	4.06
Chiayi	8.18	7.88	7.65	6.71	5.75	4.71	2.75	1.85	1.06	—	2.00	3.00
Tainan	10.17	9.88	9.65	8.71	7.75	6.70	4.75	3.85	3.06	2.00	—	1.00
Zuoying	11.18	10.88	10.65	9.72	8.76	7.71	5.76	4.85	4.06	3.00	1.00	—

Unit: Carbon Footprint ($kgCO_2e$)

Business travel activity data (Category 3)

On Business trip	Yitong’ s North	Rebate	Human Effect	Mode of transportation		Paths
2021/1/14	No. 335, Ruigguang Road, Neihu District, Taipei city	231公里	1	HSR+MRT	locomotive	合作社=>機車=>高鐵雲林=>高鐵南港=>>捷運南港=>捷運港墘站=>目的地
2021/1/16	台南市麻豆區新生北路56號	58.6公里	1	Train + model car	locomotive	住宅=>機車=>火車站 大林-隆田=>機車=>麻豆農會超市
2021/3/16	雲林縣斗六市雲林路二段515號	5.9公里	1	locomotive		合作社=>機車=>目的地
2021/3/17	臺北市中正區南海路37號	224公里	1	HSR+MRT	truck	合作社=>貨車=>高鐵雲林=>高鐵台北=>捷運台北=>捷運中正紀念堂站=>目的地
2021/3/17	臺北市中正區南海路37號	224公里	1	HSR+MRT	Minibus	合作社=>小客車=>高鐵雲林=>高鐵台北=>捷運台北=>捷運中正紀念堂站=>目的地
2021/3/17	臺北市中正區南海路37號	224公里	1	HSR+MRT	locomotive	合作社=>機車=>高鐵雲林=>高鐵台北=>捷運台北=>捷運中正紀念堂站=>目的地
2021/3/23	台南市東區北門路二段16號	89.6公里	1	train	locomotive	合作社=>機車=>台鐵斗南=>台鐵台南=>目的地
2021/4/14	高雄市前金區中正四路230號	134公里	1	HSR+ bicycle	locomotive	合作社=>機車=>高鐵雲林=>高鐵左營=>自行車=>目的地
2021/4/29	台北市信義區忠孝東路四段560號	233公里	1	HSR+MRT	truck	合作社=>貨車=>高鐵雲林=>高鐵台北=>捷運台北=>捷運市政府站=>目的地
2021/4/29	台北市信義區忠孝東路四段560號	233公里	1	HSR+MRT	Minibus	合作社=>小客車=>高鐵雲林=>高鐵台北=>捷運台北=>捷運市政府站=>目的地
2021/7/6	台北市中山區民族東路336號	230公里	1	HSR+MRT	truck	合作社=>貨車=>高鐵雲林=>高鐵台北=>捷運台北=>捷運行天宮站=>目的地
2021/7/6	台北市中山區民族東路336號	230公里	1	HSR+MRT	Minibus	合作社=>小客車=>高鐵雲林=>高鐵台北=>捷運台北=>捷運行天宮站=>目的地
2021/7/12	台北市中山區民族東路336號	230公里	1	HSR+taxi	Minibus	合作社=>小客車=>高鐵雲林=>高鐵台北=>捷運台北=>捷運行天宮站=>計程車=>目的地
2021/8/10	台北市信義區忠孝東路四段560號	233公里	1	HSR+MRT	truck	合作社=>貨車=>高鐵雲林=>高鐵台北=>捷運台北=>捷運市政府站=>目的地
2021/12/16	台北市中山區民族東路336號	230公里	1	HSR+taxi	Minibus	合作社=>小客車=>高鐵雲林=>高鐵台北=>捷運台北=>捷運行天宮站=>計程車=>目的地

Business travel activity data calculation (Category 3)

Distance (km)

Self-use minibus (gasoline) (2014)

Carbon emissions (kgCO2e/year)

Carbon emissions (public CO2e/year)

Round-trip Carbon emissions (public CO2e/year)

距離(km)	自用小客車(汽油)(2014)	碳排放(kgC02e/年)	碳排放(公噸C02e/年)	來回碳排放(公噸C02e/年)
143	0.115			
人數(p)				
1				
延人公里(pkm)				
143		16.445	0.016445	0.03289

Number of people (p)

person-kilometer (pkm)

Little Business (gasoline) (2014)

距離(km)	營業小客車(汽油)(2014)	碳排放(kgC02e/年)	碳排放(公噸C02e/年)	
2.6	0.133			
人數(p)				
1				
延人公里(pkm)				
2.6		0.3458	0.0003458	0.0006916

Taiwan Railway Transportation Service (Electrical Multiple Units) (2015)

距離(km)	臺灣鐵路運輸服務(電聯車)(2015)			
135.7	0.054			
人數(p)				
1				
延人公里(pkm)				
135.7		7.3278	0.0073278	0.0146556

Business travel activity data calculation (Category 3)

- Emissions need to be calculated for round trips, business travel is 0.281583167 metric tons CO2e/year

Distance (km)

Road inspection pedal sales (gasoline)(2014)

Number of people (p)

person-kilometer (pkm)

距離(km)	機器腳踏車(汽油)(2014)			
49.085	0.0951			
人數(p)				
1				
延人公里(pkm)				
49.085		4.6679835	0.0046679835	0.009335967

Taiwan’ s high-speed rail carbon footprint (2014)

距離(km)	台灣高鐵碳足跡(2014)			
79.37				
人數(p)				
1				
延人公里(pkm)				
79.37		79.37	0.07937	0.15874

The footprints of apes in Taipei (2016)

距離(km)	台北捷運碳足跡(2016)			
61	0.5350			
人數(p)				
1				
延人公里(pkm)				
61		32.635	0.032635	0.06527
			0.1407915835	**0.281583167**

Employee commuting activity data (Category 3)

Employee's name	Commuting	Xing company distance (km)	110 year in service	Place of residence
盧　期	car	8	12 month	Dazhi Street, Douliu City, Yunlin County　No
張　雄	car	8.1	12 month	Mayuan, Mayuan Village, Gukeng Township, Yunlin County
劉　福	car	9.4	12 month	Tianxin Village, Gukeng Township, Yunlin City
高　銓	car	62.4	12 month	Shuilin Village. Liujia Township, Tainan County 12 Neighborhood street no.
翁　翔	car	7.6	6 month	Horitou, Huwei Town, Lin County
蔡　寧	car	17.8	3.5 month	Chongyang Street, Xiluo Town, Yunlin
詹　如	walking	0.8	12 month	Minsheng Road Building, Dounan Town
曾　玲	locomotive	7.8	12 month	Xiaxili, Huwei Town, Yunlin County
劉　婷	locomotive	1	12 month	Xinsheng Third Road, Dounan Town
王　蓉	locomotive	8.6	12 month	Pinglinli, Dalin Town, Chiayi County　Shuiyuan Road
林　岑	locomotive	3.6	7 month	Wen' an, Xinguangli, Dounan Town, Yunlin County
余　城	locomotive	17	7 month	Daxinli, Xiluo Town, Yunlin county
林　蕙	locomotive	6.1	3 month	Xingnanli, Huwei Town, Yunlin County

Calculation of employee commuting activity data (Category 3)

- Emissions need to be calculated for round trips, employee commuting is 7.4454523 metric tons CO2e/year

Positive test(km)	Number of people (p)	Employee		Zipeng Bus (gasoline) (2014		Carbon emissions (kgCo2e/year)	Carbon emissions (public item CO2e/year)	
距離(km)	人數(p)	員工	延人公里(pkm)	自用小客車(汽油)(2014	上班天數	碳排放(kgCO2e/年)	碳排放(公噸CO2e/年	來回碳排放(公噸CO2e/年)
8	1	盧　期	8	0.115	204	187.68	0.18768	
6.6	1	張　雄	8.1	0.115	280	260.82	0.26082	
11	1	劉　福	9.4	0.115	285	308.085	0.308085	
62.5	1	高　銓	62.4	0.115	268	1923.168	1.923168	
7.6	1	翁　翔	7.6	0.115	130	113.62	0.11362	
17.9	1	蔡　寧	17.8	0.115	76	155.572	0.155572	
							2.948945	5.89789
距離(km)	人數(p)	員工	延人公里(pkm)	機器腳踏車(汽油)(2014	上班天數	碳排放(kgCO2e/年)	碳排放(公噸CO2e/年)	
7.9	1	曾　玲	7.8	0.0951	263	195.08814	0.19508814	
1	1	劉　婷	1	0.0951	249	23.6799	0.0236799	
8.6	1	王　蓉	8.6	0.0951	243	198.73998	0.19873998	
4.3	1	林　岑	3.6	0.0951	150	51.354	0.051354	
19.7	1	余　城	17	0.0951	166	268.3722	0.2683722	
6.3	1	林　蕙	6.1	0.0951	63	36.54693	0.03654693	
							0.77378115	1.5475623
								7.4454523

Greenhouse Gas Emissions (Category 3)

- The greenhouse gas emissions of Category 3 of the year can be obtained.

Emission proportion of each category	Category 3
Greenhouse gas emissions (metric tons CO2e/year)	7.73
Proportion of total emissions (%)	-

4. Key points of the Greenhouse gas report

Greenhouse Gas Report Information

Necessary information

- Explanation of company and inspection boundaries
- Quantification method
- Emission related data information
- selected information

– Environmental performance information
– Requirements for Greenhouse Gas Program
– Greenhouse gas emission reduction and removal plan

Contents of the Greenhouse Gas Report

Necessary items		Optional items
Organization introduction	Reasons for Quantification of Major Greenhouse Gas Source Exclusions	policy, strategy or program
Responsible person or unit	Base Year Inventory List	Reduction Initiatives (metric tons CO2e)
Covered period	Base year or other past GHG numbers Any change in data or category	Greenhouse gas emission reduction plan (metric tons CO2e)
organizational boundaries	Quantification method	Greenhouse Gas Plan Requirements
Reporting Boundary, Guidelines for Including Significant Releases	Reference or Documentation of Emission Factors	Greenhouse gas emissions generated by the facility (metric tons CO2e)
Direct GHG emissions (metric tons CO2e)	Global warming potential (GWP) value	Quantified total indirect GHG emissions (metric tons CO2e)
Category GHG emissions (metric tons CO2e)	Uncertainty	Emission intensity (metric tons CO2e/per unit of production)
Emissions from biosources (metric tons CO2e)	Claims, Verification Types, and Assurance Levels	Grade
		Greenhouse Gas Information Management and Monitoring Procedures
		Difference in GHG emissions between current inventory and previous inventory (metric tons CO2e)

Framework for Greenhouse Gas Reporting (Reference Example)

Chapter 1 Company Profile
1.1 Preface
1.2 Company Profile
1.3 Policy Statement
Chapter II Organizational Boundary
2.1 Company Organization
2.2 Company organizational boundaries
2.3 Period covered by the report and responsibilities
Chapter 3 Report Boundary
3.1 Definition
3.2 Category 1 emissions
3.3 Category 2 emissions
3.4 Emissions of other major indirect greenhouse gases (category 3~6)
3.5 Total Greenhouse Gas Emissions
3.6 Items Excluded from Inventory of Greenhouse Gas Emissions
Chapter 4 Quantification of Greenhouse Gases
4.1 Quantification method
4.2 Emission factor management
4.3 Description of Quantification Method Changes
4.4 Explanation of Change of Emission Coefficient